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Doctoral Dissertation

A Constraint-based Grammar Approach to Japanese Sentence Processing:

Designing a Systematic Parser for Fundamental Grammatical Constructions and Its Extensions with Semantic and Pragmatic Constraints

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A Constraint-based Grammar Approach to Japanese Sentence Processing:

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Abstract

This thesis investigates how to develop and use a grammar-based practical parser. More specifically, we will explore the significance and implementation of constraint-based grammar approach to Japanese sentence processing. The main purpose of the thesis is to demonstrate that constraint-based grammar formalisms enable us to develop an executable, efficient and extendable grammar system.

Chapter 1 gives an introduction. The background, goals and outline of the thesis are presented.

Part I (Chapters 2, 3 and 4) implements a parser with constraint-based grammar formalisms. Chapter 2 provides a concise introduction of the typed feature structures and Head-driven Phrase Structure Grammar (HPSG) together with the constraint-based grammar notations and techniques necessary for the discussions that follow in this thesis. Chapter 3 offers a brief sketch of previous studies on the development of grammar and a concise introduction of the fundamentals of our grammar development system, GraDEUS. Chapter 4 demonstrates some of the main ideas of executable NAIST Japanese Phrase Structure Grammar (JPSG) which is developed under the HPSG framework using GraDEUS. This chapter discusses some grammatical phenomena in Japanese that are crucial in clarifying some features involved in the sentences.

Part II (Chapters 5, 6 and 7) explores various linguistic complexities which cause the failure of Japanese sentence parsing. To overcome this parsing problem, Part II makes tunes a grammar-based parser for efficient handling of fundamental grammatical constructions. Chapter 5 shows that the adjacent feature principle and the pseudo-lexical-rule schema treat the biclausal structure of causatives, often causing the problem on long-sentence parsing failure, as a monoclausal structure and then parse such constructions efficiently. Chapter 6 shows that some subordinate clause modifications, which have been scarcely studied in the linguistic literature, can be accounted for consistently by describing the lexical information

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of conjunctive particles. Chapter 7 deals with control and raising verb constructions, with respect to the possibility of word order variation and the restriction of the complement predicate, which are not fully explained in the previous studies.

In Part III, the JPSG system developed in the previous parts is further refined. Chapters 8, 9 and 10 attempt an extension of the proposed grammar system with semantic and pragmatic constraints. Chapter 8 proposes a new approach to Japanese passives, which has been a focus of attention in many linguistic studies in English and many other languages. Chapter 9 discusses the benefactives at which only few attempts have so far been made, compared with the passives. The idea of thematic underspecification adopted in these chapters reconciles the apparent syntactic commonality and semantic differences between passives and benefactives. Chapter 10 is concerned with how topic/focus articulation should be optimally integrated into Japanese grammar. The information structure introduced here is an integral part of the grammar and interacts in principled ways with both syntax and morphophonology.

Concluding remarks together with comments on the future directions of the JPSG grammar system will come in Chapter 11.

Keywords:

grammar-based practical parser
Japanese sentence processing
constraint-based grammar formalisms
executable, efficient and extendable grammar system
Head-driven Phrase Structure Grammar (HPSG)
Japanese Phrase Structure Grammar (JPSG)

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List of Abbreviations

For Gloss:

ACC	accusative case marker
ASP	aspectual morpheme
BEN	benefactive morpheme
CAUS	causative morpheme
CF	contrastive focus marker
COMP	complementizer
COP	copulative morpheme
DAT	dative case marker
GEN	genitive case marker
HON	honorific marker
INFL	inflectional morpheme
LOC	locative marker
MOD	modal morpheme
NOM	nominative case marker
NEG	negative morpheme
NRF	non restrictive focus marker
TPC	topic marker
PASS	passive morpheme
PAST	past tense morpheme
PRES	present tense morpheme
PROG	progressive morpheme
Q	question marker
VOC	vocative marker

For Attribute-Value Matrix:

ACT	ACTOR
ADJCNT	ADJACENT
ARG-ST	ARGUMENT-STRUCTURE
CAT	CATEGORY
COMP-DTRS	COMPLEMENT-DAUGHTERS
COMPS	COMPLEMENTS
CONT	CONTENT
CONX	CONTEXT
DTR	DAUGHTER
FOC	FOCUS
HEAD-DTR	HEAD-DTR
INFO-ST	INFORMATION-STRUCTURE
INST	INSTANCE
LOC	LOCAL
MARK-DTR	MARKER-DTR
MOD	MODIFICATION
PHON	PHONOLOGY
RESTR	RESTRICTION
SUBJ	SUBJECT
SUBJ-DTR	SUBJECT-DAUGHTER
SPEC	SPECIFIED
SPR	SPECIFIER
SYNSEM	SYNTAX-SEMANTICS
UND	UNDERGOER
VAL	VALENCE

Chapter 1

Introduction

1.1 Background and Motivation

The corpus-based statistical analysis of natural languages in the field of information processing has achieved a considerable success during the past a few decades. Recent advances in natural language processing (NLP) owe greatly to statistical approaches. In the 1990s, as the availability of large-scale machine-readable linguistic resources and computational power increased, the majority of NLP researchers were occupied with processing a large amount of linguistic data using computationally expensive statistical methods that could not have been employed before. Now statistical approaches can be seen in every aspect of NLP and researchers have considered their success itself as a reason to turn away from grammar-based analysis.

Statistical approaches have recently been applied in studies on various linguistic phenomena, such as dependency analysis between phrases, anaphora resolution and so on. These approaches have succeeded in obtaining linguistic knowledge of particular linguistic phenomena, but few studies have not investigated interaction of the knowledge across the phenomena yet.

One of the difficulties of such investigation is that there is no framework in which the linguistic knowledge obtained from each study can be uniformly described. As a result, they are treated as independent studies though their aim, significance and moreover most of the resources and tasks are overlapping.

The grammar-based approaches that we try to develop throughout this thesis attempt to reconcile such knowledge observed in not only a particular language but natural language broadly. One of the extreme proponents of our approach is constructing an explicit and executable grammar based on constraint-based formalisms. From the viewpoint of constraint-based grammar, each of particular item of linguistic knowledge can be seen as a constraint on a set of specific features. We will specify a set of features that are commonly used for various knowledge elements and study how particular linguistic phenomena can be explained through description by such a feature set.

1.2 Goals and Objectives

We will explore the significance and implementation of the constraint-based grammar approach to Japanese sentence processing. The goal of capturing linguistic knowledge–providing a model of the system of language in a form suitable for computer-based, algorithmic processing–is the central concern of this thesis.

1.2.1 Grammar Description

The grammar descriptions we examine in this thesis are Japanese only. However this grammar is parallels others in the sense that they are guided by a common set of linguistic constraints and a commonly agreed set of grammatical analyses and aspects. This approach was also taken in order to maximize compatibility between the different grammars in the same and different languages with respect to the phenomena being treated, and to ensure a maximal degree of generality.

Thus, ultimately, we expect to achieve adequate grammatical descriptions by studying only some aspects of Japanese grammar.

1.2.2 Grammar Engineering

This thesis investigates how to develop and use a grammar-based practical parser for Japanese. The main purpose of the thesis is to demonstrate that constraint-based grammar formalisms enable us to develop an executable, efficient and extendable grammar system. The figure 1.1 illustrates the organization of modules of the grammar developement system.

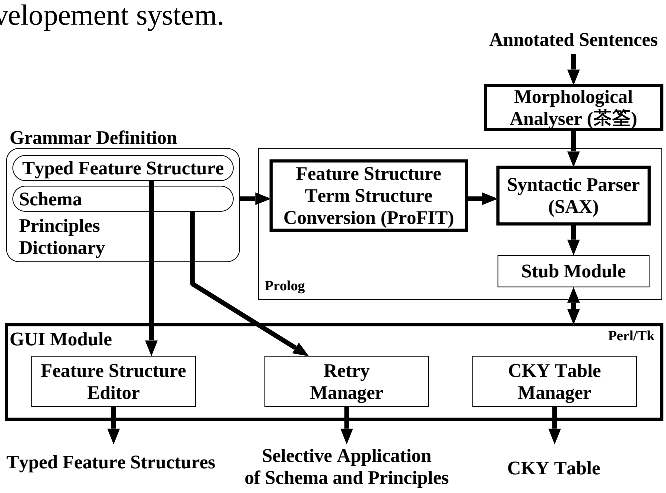


Figure 1.1: Organization of Modules of the Grammar Developement System.

To capture the essentials of Japanese sentence processing, we will restrict our attention to the design of optimal feature structures and construct an efficient grammar from the view of theoretical and computational linguistics. The refinement and extension of tools themselves lies outside the scope of this thesis.

1.3 The Overview of the Thesis

This thesis is divided into three parts in addition to the introductory and concluding remarks.

Part I, “Issues in Implementing a Parser with Constraint-based Grammar Formalisms”, provides a background for the formalization of linguistic information, the introduction of grammar development systems and constraint-based grammar for Japanese: unification and typed feature structures, Head-driven Phrase Structure Grammar, the grammar development system GraDEUS, NAIST Japanese Phrase Structure Grammar and some linguistic analyses for grammar-based sentence processing.

Part II, “Tuning a Grammar-based Parser for Fundamental Grammatical Constructions”, argues efficient parsing techniques for linguistic complexities, hierachical semantic representation and linearization approach to word order variation: bi-clausal analysis of causative constructions, Japanese sentence hierarchy, lexical description of complex predicates and conjunctive particles, and tectogrammatical and phenogrammatical levels for representing word order flexibility.

Part III, “Extensions of the Proposed Grammar System with Semantic and Pragmatic Constraints”, covers thematic underspecification and a way of representing contextual information: three types of Japanese passives, semantic commonality between passives and adversity causatives, parallelism between passives and benefactives, and Japanese topic and focus subjects with particles *wa* and *ga*.

Part I

Issues in Implementing a Parser
with
Constraint-based Grammar Formalisms

Introduction

This section outlines the fundamentals of Japanese Phrase Structure Grammar (JPSG) with constraint-based grammar formalisms. In the following chapters, we will design and implement an explicit and executable grammar.

We will see that an operation in a programming language is sometimes very much like an operation in a grammar for a natural language. It turns out, as a result, that the basic concept in JPSG is *unification*, both in Head-driven Phrase Structure Grammar (HPSG) which we assume and in its implementation in Prolog, the programming language used to build the engine of our grammar development system.

Part I, especially Chapter 4, covers only a few aspects of Japanese grammar, but the linguistic phenomena and the data mentioned provide clues for elucidating the efficiency of unification. Although we will not refer to any of implementation details in regard to the natural language processing tools themselves, theoretical and computational linguists might find a grammar-based parser of some relevance.

This section is organized in the following way:

Chapter 2 provides a concise introduction of the typed feature structures and HPSG together with constraint-based grammar notations and techniques prerequisite to the discussions that follow in this thesis.

Chapter 3 offers a brief sketch of previous studies on the development of grammar and a concise introduction of the fundamentals of our grammar development system, GraDEUS.

Chapter 4 demonstrates some of the main ideas of executable grammar, NAIST JPSG, which is developed under the framework of HPSG with using GraDEUS. This chapter also discusses some grammatical phenomena in Japanese that are crucial to clarify some features of sentences.

Chapter 2

Conceptual and Theoretical Backgrounds

2.1 Introduction

We will start off detailed explanation of Typed Feature Structures (TFSs) by discussing *type systems*, which form the backbone of grammars. A type system consists of a *type hierarchy*, which indicates specialization and consistency of types, plus a set of *constraints* on types which determine which TFSs are *well-formed*.

We will also adopt Head-driven Phrase Structure Grammar (HPSG) (Pollard & Sag 1987, 1994) as a tool for the formal representation of the analysis. We introduce a background to the feature structures of HPSG. Additionally we introduce the operations, principles, schemata, rules and notational conventions of the framework for linguistic knowledge representation assumed throughout the rest of the dissertation.

2.2 Typed Feature Structures

The core of recent *constraint-based* grammars is the *type system*, which consists of a *hierarchy of types*, each of which has a *constraint* which is expressed as a *typed feature structure*. A typed feature structure is modeled by a directed graph with a root and with labels on all of nodes and arcs. Each node is labeled with a symbol representing a *type*, and each arc is labeled with a symbol representing a *feature*. Constraints are used to capture generalization that the type hierarchy allows for the *inheritance* of constraints.

2.2.1 Type Hierarchy

Following Carpenter (1992),[1] we assume that we are dealing with a finite set of types, Type as an *inheritance hierarchy*:

(1) **Definition 1 (Type Inheritance Hierarchy)**
An inheritance hierarchy is a finite bounded complete partial order $\langle \mathsf{Type}, \sqsubseteq \rangle$.

The existence of consistent joins and the most general type simply amounts to assuming that our inheritance hierarchy is a bounded (or consistent) complete partial order (BCPO). In general a partial order is a BCPO just in case for every set of elements with an upper bound there is a least upper bound or join. A BCPO always has a least element, which we write $\perp$.

We also say that a τ is more specific than σ (or σ is more general than τ) if τ inherits all information from another type σ. We denote $\sigma \sqsubseteq \tau$ for type σ, $\tau \in \mathsf{Type}$ if σ is more general than τ (or inversely τ is more specific than σ). We also say "σ subsumes τ" if $\sigma \sqsubseteq \tau$ for types σ, τ (or inversely "τ is subsumed by σ), or "σ is a *supertype* of τ (or inversely, τ is a *subtype* of σ).

(2) is a summary of the properties of type hierarchies in general. Following Carpenter (1992), we use signs of *inequality* $<, >$, *bottom* $\perp$, and so on. However we draw our inheritance hierarchies with the most general elements toward the top, following standard convention in artificial intelligence and contrary to the practice in Carpenter (1992).

(2) **General Properties of Type Hierarchies**

Unique Bottom The hierarchy has a unique type named *bottom type*.

Unique Least Upper Bounds Any two types in the hierarchy must either be incompatible, in which case they will not share any descendants, or they are compatible, in which case they must have a unique highest common descendant (referred to as the unique *least upper bound*, denoted as $\tau \sqcup \sigma$).

Our grammar discussed in the later chapters is based on such a type hierarchy since HPSG, especially its lexical organization, depends heavily on a hierarchical organization of linguistic objects[2]. Figure 2.1 is an example of a type hierarchy. Two types connected by a line shows that the upper one is more general than the lower one.

A type hierarchy always has a least element (i.e., the most general type), which we write $\perp$ and refer to as the *bottom* type. In Figure 2.1, the lowest type in the hierarchy is the bottom.

[1] There are several slightly different variants of TFS formalisms. Here we are only describing the version which is generally based on Carpenter (1992), but there are some differences in the treatment of type constraints and well-formedness.

[2] See Section 2.3.1

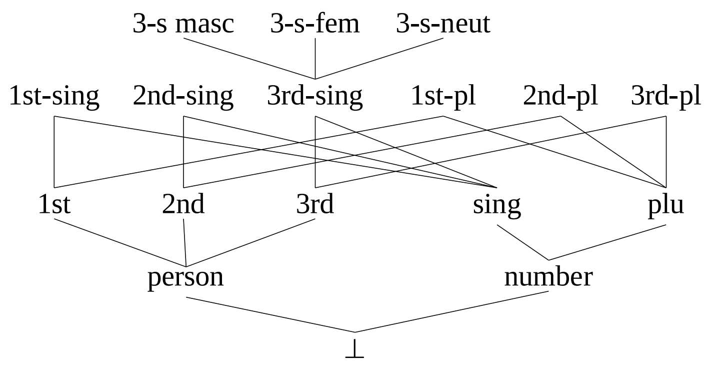


Figure 2.1: Type Hierarchy

We are thus ready to state our assumptions about the type hierarchy. These are summarized in (3).

(3) **Definition 2 (Type Hierarchy)**

a. A type hierarchy is a finite bounded complete partial order $\langle \mathsf{Type}, \sqsubseteq \rangle$.

b. The unique least upper bound of a set of types $S \subseteq \mathsf{Type}$ *is written* $\sqcup S$

c. The most general element $\bot$ *is defined so that* $\bot \sqsubseteq t$ *for any* t *in* Type.

2.2.2 Feature Structures

We now move on to describing typed feature structures in general. We make a distinction between the TFSs discussed in this section and the subset TFSs which are *well-formed* with respect to a set of type constraints and which are described in Section 2.2.4.

TFSs can be thought of as directed acyclic graphs, which have exactly one type on each node, and which have labeled arcs connecting nodes. The labels on the arcs are referred to as *features*. Figure 2.2 shows an example of such a graphical notation for feature structures.

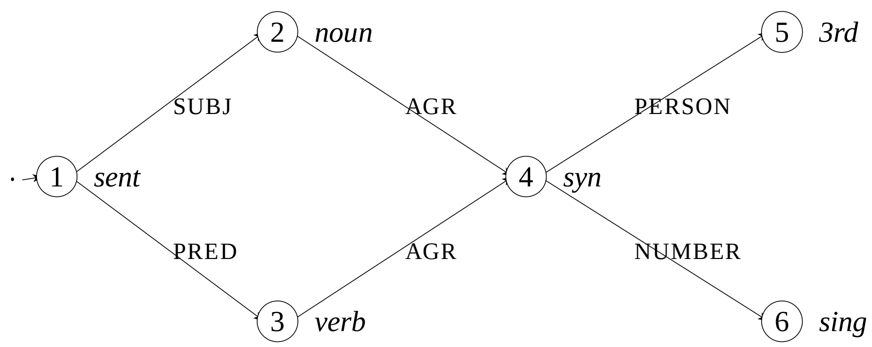


Figure 2.2: Feature Structure: Graph Notation

This graph notation is a standard and straightforward way to represent feature structures since these are defined as a directed acyclic graph. We can now state the properties of TFSs:

(4) **Properties of Typed Feature Structures**

Connectedness and Unique Root A TFS must have a unique root node: apart from the root, all nodes must have one or more parent nodes.

Unique Features Any node may have zero or more arcs leading from it, but the label on each arc (that is the feature) must be unique.

Types Each node must have a single type which must be represented in the type hierarchy.

Finiteness A TFS must have a finite number of nodes.

Now we can define TFSs on a finite set of features Feat and an type inheritance hierarchy $\langle \mathtt{Type}, \sqsubseteq \rangle$. The following is taken from Carpenter (1992).

(5) **Definition 3 (Typed Feature Structure)**
A feature structure over Type *and* Feat *is a tuple* $F = \langle Q, \bar{q}, \theta, \delta \rangle$ *where:*

- Q: *a finite set of nodes*
- $\bar{q} \in Q$: *the root note*
- θ: $Q \rightarrow$Type *: a total node typing function*
- δ: Feat $\times Q \rightarrow Q$: *a partial feature value function*

Let $\mathcal{F}$ *denote a collection of feature structures.*

In general, it is convenient to indicate a path to define a substructure of feature structure. A path is sequence of features. Let Path = Feat* be the set of paths. We also let ϵ be the *empty path* of length 0. We can then extend δ to paths so that $\delta(\pi, q)$ is the node that can be reached by following the features in π from q. Formally, we define δ as follows:

(6)
- $\delta(\epsilon, q) = q$
- $\delta(f\pi, q) = \delta(\pi, \delta(f, q))$

It is also convenient to indicate a set of paths. Let Path$_F$ be a set of all paths that can be followed by δ from the root node of $F \in \mathcal{F}$.

Structure Sharing

It is possible for the values of two paths in a given feature structure to lead to the same object. In this case we have *structure sharing* or *reentrancy*. This is illustrated in the example given in Figure 2.2, where the values of the feature AGR at node 2 and at node 3 are identical.

As a result, whatever the value of the feature AGR at node 2 may turn out to be, we automatically know that it is *token-identical* to the value of the feature AGR at node 3.

Attribute Value Matrices

Since a (complicated) graph notation is cumbersome (and difficult to draw), it is usual to illustrate TFSs with an alternative notation, known as an *attribute-value matrices* (AVM). The AVM corresponding to Figure 2.2 is given in Figure2.3:

$$\begin{bmatrix} \textit{sent} & \\ \text{SUBJ} & \begin{bmatrix} \textit{noun} & & \\ \text{AGR} & \boxed{4} & \begin{bmatrix} \textit{syn} & \\ \text{PERSON} & \textit{3rd} \\ \text{NUMBER} & \textit{singular} \end{bmatrix} \end{bmatrix} \\ \text{PRED} & \begin{bmatrix} \textit{verb} & \\ \text{AGR} & \boxed{4} \end{bmatrix} \end{bmatrix}$$

Figure 2.3: Feature Structure: AVM Notation

In this notation, each square bracketed entry (i.e., frame) represents a node. We adopt the convention of annotating the type of the described object in italics in the upper left corner of the frame. Slots represent features and their values are written next to them. This is also the format to specify which features are introduced as appropriate for a particular type and all of its subtypes. Also note that structure-sharing is represented by means of *coreferenced tags* such " $\boxed{4}$ ".

2.2.3 Unification

Unification is the combination of two TFSs to give the most general TFS which retains all the information which they individually contain. If there is no such TFS, unification is said to fail.

Subsumption

The specific TFS will always have all the *paths* and *path equivalences* of the more general structure, and may have additional paths and path equivalences. The *subsumption* relationship is also controlled by the types on the paths. The more general TFS must have types for its paths that are either equal to or more general than those for the corresponding paths in the more specific structure. The most general TFS of all is always root. Subsumption can now be described as follows:

(7) **Properties of Subsumption**
A TFS1 subsumes another TFS2 if and only if the following conditions hold:

Path Values For every path P in TFS1 with a value of type t, there is a corresponding path P in TFS2 with a value which is either t or a subtype of t.

Path Equivalences Every pair of paths P and Q which are structure-shared in TFS1 are also structure-shared in TFS2.

We will see the formal definition for *Path Value* and *Path Equivalences* in Section 2.2.4.

Some examples of subsumption relations are illustrated in Figure 2.4:

a. $$\begin{bmatrix} \textit{agr} & \\ \text{PERS} & \textit{3rd} \end{bmatrix} \sqsubseteq \begin{bmatrix} \textit{agr} & \\ \text{PERS} & \textit{3rd} \\ \text{NUM} & \textit{sing} \end{bmatrix}$$

b. $$\begin{bmatrix} \textit{sign} & \\ \text{AGR} & \begin{bmatrix} \textit{agr} & \\ \text{PERS} & \textit{3rd} \end{bmatrix} \end{bmatrix} \sqsubseteq \begin{bmatrix} \textit{phrase} & \\ \text{AGR} & \begin{bmatrix} \textit{agr} & \\ \text{PERS} & \textit{3rd} \\ \text{NUM} & \textit{sing} \end{bmatrix} \end{bmatrix}$$

iff *sign* $\sqsubseteq$ *phrase*

c. $$\begin{bmatrix} \textit{sign} & \\ \text{SUBJ} & \begin{bmatrix} \textit{noun} & \\ \text{AGR} & \begin{bmatrix} \textit{syn} & \\ \text{PERS} & \textit{3rd} \end{bmatrix} \end{bmatrix} \\ \text{PRED} & \begin{bmatrix} \textit{verb} & \\ \text{AGR} & \begin{bmatrix} \textit{syn} & \\ \text{PERS} & \textit{3rd} \end{bmatrix} \end{bmatrix} \end{bmatrix} \sqsubseteq \begin{bmatrix} \textit{sign} & \\ \text{SUBJ} & \begin{bmatrix} \textit{noun} & \\ \text{AGR} & \boxed{1} \begin{bmatrix} \textit{syn} & \\ \text{PERS} & \textit{3rd} \end{bmatrix} \end{bmatrix} \\ \text{PRED} & \begin{bmatrix} \textit{verb} & \\ \text{AGR} & \boxed{1} \end{bmatrix} \end{bmatrix}$$

d. $$\begin{bmatrix} \textit{noun} & \\ \text{AGR} & \boxed{1} \begin{bmatrix} \textit{noun} & \\ \text{AGR} & \boxed{1} \end{bmatrix} \end{bmatrix} \sqsubseteq \boxed{1} \begin{bmatrix} \textit{noun} & \\ \text{AGR} & \boxed{1} \end{bmatrix}$$

Figure 2.4: Some Examples of Subsumption

All of the examples in Figure 2.4 are proper in the sense that the inverse subsumptions do not hold. The subsumption relation over feature structures is transitive and reflexive, but not anti-symmetric, because it is possible to have two distinct feature structures that mutually subsume each other.

The subsumption relation is defined over two feature structures. This is formally defined as follows:

(8) **Definition 4 (Subsumption)**
$F = \langle Q, \bar{q}, \theta, \delta \rangle$ subsumes $F' = \langle Q', \bar{q}', \theta', \delta' \rangle$, $F \sqsubseteq F'$, if and only if there is a total function $h : Q \rightarrow Q'$, called a morphism such that:

- $h(\bar{q}) = \bar{q}'$
- $\theta(q) \sqsubseteq \theta'(h(q))$ *for every* $q \in Q$
- $h(\delta(f, q)) = \delta'(f, h(q))$ *for every* $q \in Q$ *and feature* f *such that* $\delta(f, q)$ *is defined.*

Unification

Unification can now be defined in terms of subsumption (8).

(9) **Properties of Unification**
The Unification of TFS1 and TFS2 is the most general TFS which is subsumed by both TFS1 and TFS2, if it exists.

Figure 2.5 show illustrates examples of unification:

a. $$\begin{bmatrix} \textit{agr} & \\ \text{PERS} & \textit{3rd} \end{bmatrix} \sqcup \begin{bmatrix} \textit{agr} & \\ \text{NUM} & \textit{sing} \end{bmatrix} = \begin{bmatrix} \textit{agr} & \\ \text{PERS} & \textit{3rd} \\ \text{NUM} & \textit{sing} \end{bmatrix}$$

b. $$\begin{bmatrix} \textit{agr} & \\ \text{PERS} & \textit{1st} \end{bmatrix} \sqcup \begin{bmatrix} \textit{agr} & \\ \text{PERS} & \textit{3rd} \end{bmatrix} = \top$$

c. $$\begin{bmatrix} \textit{nom} & \\ \text{PERS} & \textit{3rd} \\ \text{GEN} & \textit{neut} \end{bmatrix} \sqcup \begin{bmatrix} \textit{expletive} & \\ \text{NUM} & \textit{sing} \\ \text{GEN} & \textit{neut} \end{bmatrix} = \begin{bmatrix} \textit{nom-expletive} & \\ \text{PERS} & \textit{3rd} \\ \text{NUM} & \textit{sing} \\ \text{GEN} & \textit{neut} \end{bmatrix}$$

iff nom ⊔ expletive = nom-expletive

d. $$\begin{bmatrix} \textit{sent} & \\ \text{SUBJ} & \begin{bmatrix} \textit{noun} & \\ \text{AGR} & \begin{bmatrix} \textit{syn} & \\ \text{PERS} & \textit{3rd} \end{bmatrix} \end{bmatrix} \\ \text{PRED} & \begin{bmatrix} \textit{verb} & \\ \text{AGR} & \begin{bmatrix} \textit{syn} & \\ \text{PERS} & \textit{3rd} \end{bmatrix} \end{bmatrix} \end{bmatrix} \sqcup \begin{bmatrix} \textit{sent} & \\ \text{SUBJ} & \begin{bmatrix} \textit{noun} & \\ \text{AGR} & \boxed{1} \end{bmatrix} \\ \text{PRED} & \begin{bmatrix} \textit{verb} & \\ \text{AGR} & \boxed{1} \end{bmatrix} \end{bmatrix}$$

$$= \begin{bmatrix} \textit{sent} & \\ \text{SUBJ} & \begin{bmatrix} \textit{noun} & \\ \text{AGR} & \boxed{1} \begin{bmatrix} \textit{syn} & \\ \text{PERS} & \textit{3rd} \end{bmatrix} \end{bmatrix} \\ \text{PRED} & \begin{bmatrix} \textit{verb} & \\ \text{AGR} & \boxed{1} \end{bmatrix} \end{bmatrix}$$

Figure 2.5: Some Examples of Unification

It follows from (9) that if one of the structures specifies that a node at the end of some path P has a type a, and in the other structure path P leads to a node of type b, the structures will only unify if a and b are compatible types. If they are compatible, the node in the result will have the type which is the least upper bound of a and b. More precisely, $F \sqcup F'$ is the least upper bound of F and F' in $\langle F, \sqsubseteq \rangle$ if F and F' have an upper bound (i.e., $F \sqcup F' = G$ if and only if $F \sqsubseteq G, F' \sqsubseteq G$ and there is no G' such that $F \sqsubseteq G', F' \sqsubseteq G'$ and $G' \sqsubset G$).

The following definition is taken from Carpenter (1992).

(10) **Definition 5 (Unification)**
Suppose $F, F' \in \mathcal{F}$ *are feature structures such that* $F = \langle Q, \bar{q}, \theta, \delta \rangle$ *and* $F' = \langle Q', \bar{q}', \theta', \delta' \rangle$ *are such that* $Q \cap Q' = \emptyset$*. We define an equivalence relation* $\bowtie$ *on* $Q \cup Q'$ *as the least equivalence relation such that:*

- $\bar{q} \bowtie \bar{q}'$
- $\delta(f, q) \bowtie \delta(f, q')$ *if both are defined and* $q \bowtie q'$

The unification of F *and* F' *is then defined to be* :

$$F \sqcup F' = \langle (Q \cup Q')/_{\bowtie}, [\bar{q}]_{\bowtie}, \theta^{\bowtie}, \delta^{\bowtie} \rangle$$

where:

$$\theta^{\bowtie}([q]_{\bowtie}) = \bigsqcup \{(\theta \cup \theta')(q') | q' \bowtie q\}$$

and

$$\delta^{\bowtie}(f, [q]_{\bowtie}]) = \begin{cases} [(\delta \cup \delta')(f, q)]_{\bowtie} & if (\delta \cup \delta')(f, q)\ is\ uniquely\ defined \\ undefined & otherwise \end{cases}$$

if all of the joins in the definition of $\theta^{\bowtie}$ *exist,* $F \sqcup F'$ *is undefined otherwise.*

(11) **Definition 6 (Alphabetic Variants)**
If F *and* F' *are feature structures such that* $F \sqsubseteq F'$ *and* $F' \sqsubseteq F$*, then we write* $F \sim F'$ *and say that they are alphabetic variants.*

If $F \sqcup F'$ is defined, then $F \sqcup F' \in \mathcal{F}$ is a feature structure[3].

2.2.4 Well-Typedness

Usually TFSs corresponding directly to descriptions of (e.g., lexical entries) will not be *well-typed*. The process of inheriting or inferring information is precisely the process of making the structure well-typed.

The purposes of type constraints as far as the grammar engineer is concerned are listed below:

(12)
- To allow generalization to be expressed, so that lexical entries and other descriptions can be kept succinct.
- To detect errors that come from misspelling, misplaced constraints, or other violations of the type system.
- To avoid errors entering into a grammar.
- To improve efficiency of parsing, and so on.

Modern systems support a *totally well-typed feature structure* method.

[3]This is a lemma of (10).

Appropriateness

We now turn our attention to the presentation of our system for specifying *appropriateness* conditions on types. Appropriateness conditions are meant to specify the features that are appropriate for each type and to provide restrictions on their values in a way that respects the inheritance hierarchy.

In Carpenter (1992), appropriateness is defined as follows:

(13) **Definition 7 (Appropriateness Specification)**
An appropriateness specification over the inheritance hierarchy $\langle \mathsf{Type}, \sqsubseteq \rangle$ *and feature* Feat *is a partial function* $Approp : \mathsf{Feat} \times \mathsf{Type} \rightarrow \mathsf{Type}$ *meets the following conditions:*

- *(Feature Introduction)*
  for every feature $f \in \mathsf{Feat}$*, there is a most general type* $Intro(f) \in \mathsf{Type}$ *such that* $Approp(f, Intro(f))$ *is defined.*
- *(Upward Closure / Right Monotonicity)*
  if $Approp(f, \sigma)$ *is defined and* $\sigma \sqsubseteq \tau$*, then* $Approp(f, \tau)$ *is also defined and* $Approp(f, \sigma) \sqsubseteq Approp(f, \tau)$

Well-Typedness

We now present our formal definition of well-typedness.

(14) **Definition 8 (Well-Typedness)**
A feature structure $F = \langle Q, \bar{q}, \theta, \delta \rangle$ *is said to be well-typed if whenever* $\delta(f, q)$ *is defined,* $Approp(f, \theta(q))$ *is defined, and such that* $Approp(f, \theta(q)) \sqsubseteq \theta(\delta(f, q))$.
Let $\mathcal{TF}$ *be the collection of well-typed feature structures.*

(15) **Definition 9 (Total Well-Typedness)**
A feature structure $F = \langle Q, \bar{q}, \theta, \delta \rangle$ *is totally well-typed if and only if it is well-typed and if* $q \in Q$ *and* $f \in \mathsf{Feat}$ *are such that* $Approp(f, \theta(q))$ *is defined, then* $\delta(f, q)$ *is defined.*
Let $\mathcal{TTF}$ *be the collection of totally well-typed feature structures.*

This *totally well-typedness* means that each type has a fixed number of features, that features defined for each type have their own appropriate types, and that the node must have arcs whose features are appropriate for its type.

The following is a definition of a *substructure requirement* relation $SubReq \subseteq \mathsf{Type} \times \mathsf{Type}$ over features as the most general relation:

(16)
- $SubReq(\sigma, \tau)$ if $Approp(f, \sigma) = \tau$ for some $f \in \mathsf{Feat}$
- $SubReq(\sigma, \gamma)$ if $Approp(f, \sigma) = \tau$ and $SubReq(\tau, \gamma)$ for some $f \in \mathsf{Feat}$ and some $\gamma \in \mathsf{Type}$

If there is a type σ such that $SubReq(\sigma, \sigma)$, then we say that $Approp$ contains an *appropriateness loop*. We are always able to find the most general totally well-typed extension of a well-typed feature structure, if appropriateness is specified without such loops.

Type Inference

Well-typedness can be enforced by a partial function called *type inference*.

(17) **Definition 10 (Type Inference)**
There is a partial function TypeInf: $\mathcal{F} \rightarrow \mathcal{TF}$ such that for $F \in \mathcal{F}$, $F \sqsubseteq F'$ for $F' \in \mathcal{TF}$ if and only if TypInf(F) $\sqsubseteq F'$.

(17) means that $TypInf$ returns the most general well-typed extension of a feature structure.

Totally well-typedness can be enforced by the *total type inference* function $TotTypInf$. See below:

(18) **Definition 11 (Total Type Inference)** $(Fill : \mathcal{TF} \rightarrow \mathcal{TTF})$
If Approp contains no loops, then there is a total function $Fill : \mathcal{TF} \rightarrow \mathcal{TTF}$ such that $F \in \mathcal{TF}$, $F' \in \mathcal{TTF}$, and $F \sqsubseteq F'$ if and only if $Fill(F) \sqsubseteq F'$.

i. *$Fill$ is defined by iterating the following step until the result is totally well-typed:*

ii. *Select a node q with a type σ such that $Approp(f, \sigma)$ is defined but $\delta(f, q)$ is undefined, and then add an arc $\delta(f, q) = q'$ is a new node that does not occur elsewhere in the structure, and $\theta(q') = Approp(f, \sigma)$.*

(19) **Definition 12 (Total Type Inference)** *$(TotTypInf : \mathcal{F} \rightarrow \mathcal{TTF})$*
If $Approp$ contains no loops and $F \in \mathcal{F}$, then there is a partial function TotTypInf : $\mathcal{F} \rightarrow \mathcal{TTF}$ such that $TotTypInf(F) = Fill(TypInf(F))$.

Path Values and Path Equivalences

In Section 2.2.3, we have given informal definitions for *path values* and *path equivalences*, these can now be described formally as $PathValue$: Path $\times$ Type and $PathEquiv$: Path $\times$ Path $\rightarrow \mathcal{TTF}$ based on the function $TotTypeInf$:

(20) **Definition 13 (Path Value)**

$$PathValue(\pi(= f_1 f_2 \ldots f_n), \sigma(\in \text{Type})) = TotTypInf(F)$$

where:

- *F is a feature structure $\langle Q, q_0, \theta, \delta \rangle$.*
- *$Q = \{q_0, q_1, q_2, \ldots, q_n\}$ where $q_i \neq q_j$ for every integer $i(0 \leq i \leq n)$ and every integer $j(0 \leq j \leq n)$ such that $i \neq j$.*

- $\delta(f_i, q_{i-1}) = q_i$ *for every integer* $i(1 \leq i \leq n)$.
- $\theta(q_0) = \sigma$.

(21) **Definition 14 (Path Equivalence)**

$$PathEquiv(\pi(= f_1 f_2 \ldots f_m), \pi'(= f'_1 f'_2 \ldots f'_n)) = TotTypInf(F)$$

where:

- *F is a feature structure* $\langle Q, q_0, \theta, \delta \rangle$.
- $Q = \{q_0, q_1, q_2, \ldots, q_m, q'_0, q'_1, q'_2, \ldots, q'_n\}$ *such that:*
  - $q_m = q'_n$
  - $q_i \neq q_j$ *for every integer* $i(0 \leq i \leq m)$ *and every integer* $j(0 \leq j \leq m)$ *such that* $i \neq j$
  - $q'_i \neq q'_j$ *for every integer* $i(0 \leq i \leq m)$ *and every integer* $j(0 \leq j \leq m)$ *such that* $i \neq j$
  - $q_i \neq q'_j$ *for every integer* $i(0 \leq i < m)$ *and every integer* $j(0 \leq j < n)$ *such that* $i \neq j$
  - *For every integer* $i(0 \leq i < min(m, n))$,
    $\begin{cases} q_i = q'_i & \text{if} f_1 f_2 \ldots f_i = f'_1 f'_2 \ldots f'_i \\ q_i \neq q'_i & \text{otherwise} \end{cases}$
- $\delta(f_i, q_{i-1}) = q_i$ *for every integer* $i(0 \leq i \leq m)$
- $\delta(f'_i, q'_{i-1}) = q'_i$ *for every integer* $i(0 \leq i \leq n)$

$PathEquiv(\pi \in \mathsf{Path}, \pi' \in \mathsf{Path})$ is a partial function that returns the most general feature structure such that the paths π and π' can be followed from the root node and they lead to the same node from the root, that is, structure-shared.

2.3 Head-driven Phrase Structure Grammar

Two assumptions underlie the theories defining a *constraint-based grammar*, especially Head-driven Phrase Structure Grammar (HPSG) (Pollard & Sag 1987, 1994), which we assume throughout this dissertation.

The first is that language is the system of *types* of *linguistic objects* at a variety of levels of abstraction, not just collections of sentences. Thus, the goal of such theories is to be able to define grammars that analyze and generate the set of sentences that represent one of the natural languages, assigning empirically satisfactory structural descriptions and semantic interpretations, in a way that is responsible to what is known about human sentence processing.

The second is that a grammar is best represented as a process-neutral system of *declarative constraints*. Thus, a grammar is seen as consisting of an *inheritance hierarchy* of types, with constraints of various kinds on the types of linguistic object in the hierarchy.

2.3.1 Linguistic Objects

Inheritance Hierarchy

A (simple) type hierarchy can be represented as a taxonomic tree representing the types of all of the linguistic objects that the grammar deals with. For each local tree in the hierarchy, the type names which label the daughter nodes partition the type which labels the mother. These are necessarily disjoint subtypes which exhaust the type of the mother.

For example, subtypes of the sort *feature-structure* can be *part-of-speech* of various kinds, as illustrated in Figure 2.6.[4]

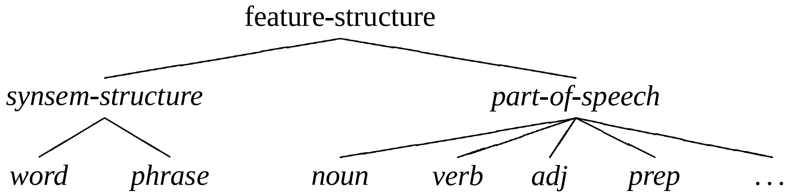


Figure 2.6: A Partial Inheritance Hierarchy for *part-of-speech*

A multiple-inheritance hierarchy is an interlocking set of simple hierarchies, each representing a linguistic dimension of analysis that intersects with other dimensions. As we will see in later chapters, HPSG's multi-dimensional constraint-based architecture lends itself very well to expressing the mutual constraints on natural language phonology, syntax, semantics and pragmatics.

The Architecture of Sign

All linguistic entries (including both expression types, and the abstract objects that are invoked to describe them) can be formally modeled as *typed feature structures* discussed in Section 2.2.2.

In HPSG, a linguistic object is referred as a *sign* which includes a word, a sub-sentential phrase, and a sentence. All *signs* are represented by an *attribute value matrix*. Features (also referred to as *attributes*) appear in capitals, and the type of an object appears in italics. Figure 2.7 is the AVM description of a verb phrase.

The type *phrase* is a subtype of *synsem-structure* that we will need to distinguish, for example, verb phrases from *lexical signs* representing verbs, which could contain the same information given in Figure 2.7. *Phrasal signs* have the attribute DTRS which represents the immediate constituent structure of the phrase. We will see the constituency in Section 2.3.2.

PHON(OLOGY) serves to represent phonological and morphological properties of a word or phrase while SYN(TAX-)SEM(ANTICS) encodes various aspects of

[4]To be precise, *part-of-speech* is a subtype of type *head*. Most general type in our theory will called *feature-structure*. All of the types we introduce will be subtypes of it.

$$\begin{bmatrix} \textit{phrase} & \\ \text{PHON} & \langle \ldots \rangle \\ \text{SYNSEM} & \begin{bmatrix} \textit{synsem} & \\ \text{SYN} & \begin{bmatrix} \textit{syn} & \\ \text{HEAD} & \begin{bmatrix} \textit{head} & \\ \text{VFORM} & \textit{fin} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \textit{val} & \\ \text{SPR} & \langle\rangle \\ \text{SUBJ} & \langle \text{NP} \rangle \\ \text{COMPS} & \langle\rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \textit{act-rel} \end{bmatrix} \\ \text{DTRS} & \textit{dtr-str} \end{bmatrix}$$

Figure 2.7: Sign for Transitive Verb

syntactic and semantic information.[5] The value of a SYNSEM is a type called a SYNSEM object. A type assigned to the node also determines which attribute labels can appear in its feature structure. Thus a feature structure of type SYNSEM can have the attribute labels SYN(TAX) and SEM(ANTICS). SYN is concerned with syntactic information about the 'underlying' structure. Therefore it includes attributes for not only syntactic category, HEAD but also a specification of the grammatical arguments that are required, VAL(ENCE). HEAD indicates the part of speech of the word or phrase, and its values are *noun, verb, adjective, preposition* and so on. Some parts of speech have attributes of their own. For instance, *verb* has the features VFORM, and *noun* has CASE.

In Chapter 9 of Pollard and Sag (1994), the valence list VAL (SUBCAT in Pollard and Sag (1987)) is splitted by adding attributes SUBJ(ECT), COMP(LEMENT)S and SP(ECIFIE)R, [6] which have lists of *synsem* objects as their values. The objects are enclosed in angle brackets, with the first element on the left. VAL takes care of the syntactic realization of arguments. [7]

For every type, there are certain features which are appropriate, and, for each of these features, its value must be of a specified type. Figure 2.7 leaves out many required features, and underspecifies the type of the SEM value. Any individual member of this class will be explicit in these matters, but it is crucial for a grammar to refer to classes of linguistic objects.

[5] SYNSEM also includes pragmatic information labeled CON(TE)X(T). We will discuss the feature in Section 10.5.

[6] Note the signifi cance of this revision in Borsley (1987, 1989), Pollard and Sag (1994)

[7] SUBCAT is a substantially renamed ARG-ST whose list still serves as locus of binding theory and unbounded dependency construction.

Lexical Signs and Some Abbreviations

A grammar is thus a system of constraints, both unique and inherited, on types of linguistic objects. Now, we will see features of some of *lexical signs* (e.g., words) that will also be referred to in the later discussion in Section 2.3.2 for *phrasal signs* (e.g., phrases):

a. $$\begin{bmatrix} \textit{word} & \\ \text{PHON} & \langle \textit{eats} \rangle \\ \text{SYNSEM} & \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{VFORM} & \textit{fin} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \left\langle \text{NP}[\textit{nom}]_{\boxed{1}[\textit{3rd},\textit{sing}]} \right\rangle \\ \text{COMPS} & \langle \text{NP}[\textit{acc}]_{\boxed{2}} \rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \textit{eat-rel} & \\ \text{EATER} & \boxed{1} \\ \text{EATEN} & \boxed{2} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

b. $$\begin{bmatrix} \textit{word} & \\ \text{PHON} & \langle \textit{she} \rangle \\ \text{SYNSEM} & \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{noun} & \\ \text{CASE} & \textit{nom} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\rangle \\ \text{COMPS} & \langle\rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & \boxed{1} \begin{bmatrix} \text{PERSON} & \textit{3rd} \\ \text{NUMBER} & \textit{sing} \\ \text{GENDER} & \textit{fem} \end{bmatrix} \\ \text{RESTR} & \begin{bmatrix} \text{RELN} & \textit{female-rel} \\ \text{INST} & \boxed{1} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

c. $$\begin{bmatrix} \textit{word} & \\ \text{PHON} & \langle \textit{cakes} \rangle \\ \text{SYNSEM} & \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \textit{noun} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & \boxed{1} \begin{bmatrix} \text{PERSON} & \textit{3rd} \\ \text{NUMBER} & \textit{plural} \end{bmatrix} \\ \text{RESTR} & \begin{bmatrix} \text{RELN} & \textit{cake-rel} \\ \text{INST} & \boxed{1} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Figure 2.8: Some Lexical *Signs*

A few additional remarks on SYNSEM features are necessary for Figure 2.8.

From Figure 2.8a, we see that SEM of '*eats*' is a semantic relation, *eat-rel*, which will also be the SEM of the entire sentence headed by '*eats*'. However, the SEM in Figure 2.8a is (necessarily) incomplete, lacking specifications of the participants in the eating event. This information is, of course, supplied by the arguments of '*eats*'. Because the verb is in the third person singular present, it does impose some syntactic constraints on its subject, too, but this is purely syntactic information. [8]

SEM of non-predicative nouns in Figure 2.8b and Figure 2.8c contain two attributes, INDEX and RESTR(ICTION). INDEX in Figure 2.8c, for instance, provides a way to connect the use of the word '*cakes*' to a collection of cakes that the speaker is referring to. Pronouns which refer to the same cakes in subsequent discourse will have the same INDEX; thus they will be third person plural. To ensure that the INDEX is anchored to some cakes, RESTR feature contains a sort called *cake-rel*, with one argument, INST(ANCE). The value of INST is the same object as the value of INDEX. The type *cake-rel* is roughly the predicate 'being a cake,' and the value of INST refers to some object(s) of which that predicate is true.

Before moving on to the complex representation of *signs*, it will be useful to explain some abbreviations which will be employed through this dissertation. See Figure 2.9.

a. NP$_{\boxed{1}}$

$$\left[\text{SYNSEM}\left[\begin{array}{ll}\text{SYN} & \left[\begin{array}{ll}\text{HEAD} & \textit{noun}\\ \text{VAL} & \left[\begin{array}{ll}\text{SUBJ} & \langle\rangle\\ \text{COMPS} & \langle\rangle\end{array}\right]\end{array}\right]\\ \text{SEM} & \left|\ \text{INDEX}\ \boxed{1}\right.\end{array}\right]\right]$$

b. $\boxed{1}$NP

$$\boxed{1}\left[\text{SYNSEM}\left[\text{SYN}\left[\begin{array}{ll}\text{HEAD} & \textit{noun}\\ \text{VAL} & \left[\begin{array}{ll}\text{SUBJ} & \langle\rangle\\ \text{COMPS} & \langle\rangle\end{array}\right]\end{array}\right]\right]\right]$$

c. S:$\boxed{1}$

$$\left[\text{SYNSEM}\left[\begin{array}{ll}\text{SYN} & \left[\begin{array}{ll}\text{HEAD} & \textit{verb}\\ \text{VAL} & \left[\begin{array}{ll}\text{SUBJ} & \langle\rangle\\ \text{COMPS} & \langle\rangle\end{array}\right]\end{array}\right]\\ \text{SEM} & \boxed{1}\end{array}\right]\right]$$

d. VP:$\boxed{1}$

$$\left[\text{SYNSEM}\left[\begin{array}{ll}\text{SYN} & \left[\begin{array}{ll}\text{HEAD} & \textit{verb}\\ \text{VAL} & \left[\begin{array}{ll}\text{SUBJ} & \langle\text{NP}\rangle\\ \text{COMPS} & \langle\rangle\end{array}\right]\end{array}\right]\\ \text{SEM} & \boxed{1}\end{array}\right]\right]$$

Figure 2.9: Some Abbreviations for the Feature Structure: Tag Notation

NP indicates the SYNSEM value of a saturated nominal *sign*: the indices, if mentioned, are written as right subscripts as Figure 2.9a. Information internal to indices can be abbreviated: NP$_{\boxed{1}\,[3rd,sing,fem]}$ abbreviates an NP whose INDEX is $\boxed{1}$ and the further specification of its features is [PERSON *3rd*], [NUMBER *singular*], and [GENDER *feminine*] When the *tag* is used on the left of the category as Figure 2.9b, it represents the whole SYNSEM structure as an instance of SYNSEM sharing. In Figure 2.9c and Figure 2.9d, S denotes the SYNSEM value of a saturated verbal

[8] The mechanism of argument specifi cation will be introduced in Section 4.2.4.

sign, while VP denotes the SYNSEM value of a verbal *sign* that is saturated except for a single element which corresponds to the subject. The SEM value is expressed after a colon in the cases of S and VP.

The feature value can also appear without a path label such as VP[*fin*], NP[*nom*]: VP[*fin*], for example, means that the given VP has the feature value *fin* whose path could be represented as |SYN|HEAD|VFORM.

To save space in matrices and to focus attention on the relevant features, types, and values, information in *signs* is often abbreviated by omitting features and type designations that can be readily inferred. See Figure 2.10.

a.
$$\begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{VFORM} & \textit{fin} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{SUBJ} & \langle \text{NP} \rangle \\ \text{COMPS} & \langle\rangle \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \textit{act-rel} \end{bmatrix}$$

b.
$$\begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SUBJ} & \langle \text{NP} \rangle \\ \text{COMPS} & \langle\rangle \\ \text{SEM} & \textit{act-rel} \end{bmatrix}$$

Figure 2.10: Some Abbreviations for the Feature Structure

For example, we will describe feature structure in Figure 2.7 in terms of SYNSEM features only, as in Figure 2.10a or more simply Figure 2.10b.

We will describe classes of linguistic objects using feature structures in which many of the features appropriate only for a subset of that class will be omitted, and the types of some value may not be maximally specific.

2.3.2 Grammar Schemata

Phrasal Sign and Unification

So far we have seen the feature structure of *lexical signs* (e.g., words). We are ready to move on to more complicated representations of the *phrasal signs* (e.g., phrases).

In common with other constraint-based theories of grammar, such as Categorial Grammar (Steedman 1996, 2000), Generalized Phrase Structure Grammar (Gazdar 1981, Gazdar, Klein, Pullum, & Sag 1985), and Lexical-Functional Grammar (Kaplan & Bresnan 1982, Dalrymple 1999, 2001), HPSG is *non-derivational*, in contrast with Government-Binding Theory (i.e., Principle and Parameters Theory Chomsky (1981, 1982, 1986a, 1986b)), Minimalist Program (Chomsky (1995)) or any version of the Chomskyan Transformational Grammar. There is no notion of *transformation,* or *movement*. The attributes of linguistic structure in HPSG are related not by movement but rather by *structure-sharing*,[9] token identity between substructures of a given structure. Tree-configurational notions such as *government*, *c-command* and so on are also not necessary. Their role is partially taken over by the relation of relative obliqueness determined in a VALENCE list that obtains between syntactic dependents of the same head.[10]

HPSG relies heavily on *unification*, discussed in Section 2.2.3. It is informally the operation of combining two or more descriptions of representation into a single coherent description. With feature structures as descriptions, unification involves compatibility of the types and values in the descriptions. The unification of two feature structures FS1 and FS2, written FS1 $\sqcup$ FS2, is the feature structure which contains all the information in both FS1 and FS2 and nothing more. If two feature structures contain incompatible information, they do not unify. This is best illustrated by concrete examples using the features introduced above:

a.
$$\begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{head} & \\ \text{VFORM} & \textit{fin} \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \textit{act-rel} & \\ \text{ACTOR} & \boxed{1} \end{bmatrix} \end{bmatrix} \sqcup \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{head} & \\ \text{CASE} & \textit{nom} \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & \boxed{2} \end{bmatrix} \end{bmatrix}$$
$$\rightarrow \top$$

b.
$$\begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{head} & \\ \text{VFORM} & \textit{fin} \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \textit{act-rel} & \\ \text{ACTOR} & \boxed{1} \end{bmatrix} \end{bmatrix} \sqcup \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{head} & \\ \text{VFORM} & \textit{fin} \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \textit{und-rel} & \\ \text{UNDERGOER} & \boxed{2} \end{bmatrix} \end{bmatrix}$$
$$\rightarrow \begin{bmatrix} \text{SYN} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{head} & \\ \text{VFORM} & \textit{fin} \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \textit{act-und-rel} & \\ \text{ACTOR} & \boxed{1} \\ \text{UNDERGOER} & \boxed{2} \end{bmatrix} \end{bmatrix}$$

Figure 2.11: Typed Feature Unification

In Figure 2.11a, unification fails since the types *noun* and *verb* are disjoint as the inheritance hierarchy in Figure 2.1 shows. Unification of the types *act(or)-rel* and *und(ergoer)-rel* in Figure 2.11b has, on the other hand, not failed. Because of a subsumption-preserving homomorphism that Davis (2001) establishes between stem types and types of semantic relation, it follows that any stem must obey the constraints established for superordinate stem types. Since *act(or)-und(ergoer)-rel* is a subtype of both *act-rel* and *und-rel*, unifying them derives the correct verb se-

[9]See Section 2.2.2

[10]ARG-ST is assumed as a lexical property and declared as feature associated with the *sort* word. See fn. 7.

mantics where the constraints associated with those types are multiply inherited.[11]

Let us now turn to some universal principles to see how they interact with the set of schemata. We take a simple example (22) to examine how it is actually analyzed in the HPSG framework.

(22) She eats cakes.

Head-Complement Schema

In the HPSG feature system, phrases have the attribute D(AUGH)T(E)R in addition to PHON and SYNSEM, which represent the immediate constituents of the phrase.[12]

We will look at the headed constituent structures, which are of the sort *headed-structure*.

The schema that relates VP to the verb and the direct object that constitutes it is called the Head-Complement Schema:

(23) **Definition 15 (Head-Complement Schema (Schema 2))**

$$\begin{bmatrix} \textit{phrase} & \\ \textrm{DTRS} & \begin{bmatrix} \textit{head-complement-structure} & \\ \textrm{HEAD-DTR} & \textit{word} \\ \textrm{COMP-DTRS} & \textit{list}(\textrm{PHRASE}) \end{bmatrix} \end{bmatrix}$$

A phrase with DTRS *value of sort head-complement-structure in which the* HEAD-DTR *value is a lexical sign.*

A *head-complement-structure* is a type of *sign* which has the feature HEAD-DTR and COMP-DTRS within its value. The value of COMP-DTRS is a list of phrases, the complements of the head of the phrase. Thus, (23) is HPSG's analog of a phrase structure rule that expands a VP as a verb followed by some complements.

Let us take the VP '*eats cakes*' as an example for (23). See Figure 2.12.

One more requirement not specified in (23) is that the complements specified in the head verb's COMPS list have to match those in the COMP-DTRS list. Once the complements have combined with the head, the COMPS list of the resulting phrase, the VP '*eats cakes*,' should be empty. This calls for another constraint, (a portion of) the Valence Principle described in (24):

(24) **Definition 16 (The Valence Principle (for COMPS Lists))**
In a headed phrase, the COMPS *list of the head daughter is the concatenation of the phrase's* COMPS *list with the list of* SYNSEM *values of the* COMPS-DTRS *list.*

[11] See Davis (2001) for more detailed discussion.

[12] NAIST JPSG does not adopt the feature DTR for processing efficiency purpose. D(AUGH)T(E)R really include all features whose specifications are unnecessary for certain point of pursing. NAIST JPSG gets and checks the record of pursing by CKY-table.

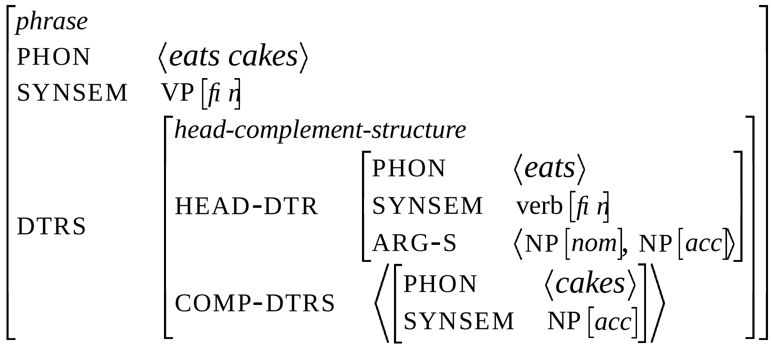


Figure 2.12: ‘*eats cakes*’: Example of Head-Complement Schema

(24) is the relevant part of the valence principle (see (32) for complete definition). It ensures that the complements of a head cancels a member in the list of the corresponding headed phrase. The VP ‘*eats cakes*’ has a structure conventionally represented in a tree diagram as in Figure 2.13:

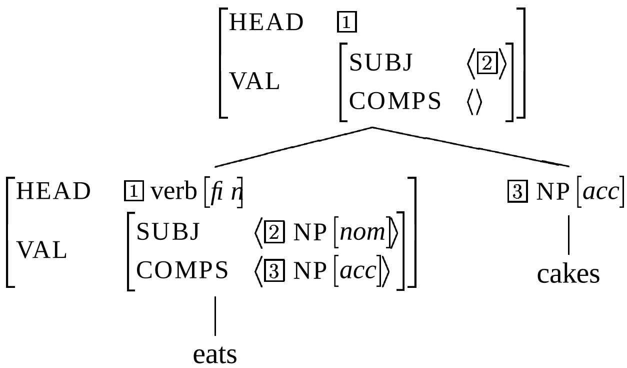


Figure 2.13: ‘*eats cakes*’: Tree Diagram

In Figure 2.13, the COMPS list of the head ‘*eats*’ contains just one element, which is to match the SYNSEM value of ‘*cakes.*’ The constraint in (24) tells us that this list must consist of the COMPS list of the whole phrase, and the list of SYNSEM values of the COMP-DTRS list. This means that the COMP-DTRS list of ‘*eats cakes*’ must have exactly one element. This element is the sign for ‘*cakes*’, and its SYNSEM value is therefore the same SYNSEM object that appears on the COMPS list of ‘*eat.*’

The AVM diagrams in Figure 2.14 exemplify the typed feature structure representation for the VP ‘*eats cakes.*’

Head-Subject Schema

A sentence is a phrase with DTRS value of sort *head-subject-structure* which has attributes HEAD-DTR, SUBJ(ECT)-D(AUGH)T(E)R, as well as COMP-DTRS. The

$$
\left[\begin{array}{ll}
\text{PHON} & \langle \textit{eats cakes} \rangle \\
\text{SYNSEM} & \left[\begin{array}{ll}
\text{SYN} & \left[\begin{array}{ll}
\text{HEAD} & \boxed{1} \\
\text{VAL} & \left[\begin{array}{ll}
\text{SUBJ} & \langle \boxed{2} \rangle \\
\text{COMPS} & \langle \rangle
\end{array}\right]
\end{array}\right] \\
\text{SEM} & \boxed{6}
\end{array}\right] \\
\text{DTRS} & \left[\begin{array}{ll}
\text{HEAD-DTR} & \left[\begin{array}{ll}
\text{PHON} & \langle \textit{eats} \rangle \\
\text{SYNSEM} & \left[\begin{array}{ll}
\text{SYN} & \left[\begin{array}{ll}
\text{HEAD} & \boxed{1} \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{verb}} \\
\text{VFORM} & \textit{fin}
\end{array}\right] \\
\text{VAL} & \left[\begin{array}{ll}
\text{SUBJ} & \langle \boxed{2}\ \text{NP}[\textit{nom}]_{\boxed{4}[3rd,sing]} \rangle \\
\text{COMPS} & \langle \boxed{3}\ \text{NP}[\textit{acc}]_{\boxed{5}} \rangle
\end{array}\right]
\end{array}\right] \\
\text{SEM} & \boxed{6} \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{eat-rel}} \\
\text{ACT} & \boxed{4} \\
\text{UND} & \boxed{5}
\end{array}\right]
\end{array}\right]
\end{array}\right] \\
\text{COMP-DTRS} & \left\langle \left[\begin{array}{ll}
\text{PHON} & \langle \textit{cakes} \rangle \\
\text{SYNSEM} & \left[\begin{array}{ll}
\text{SYN} & \left[\begin{array}{ll}
\text{HEAD} & \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{noun}} \\
\text{CASE} & \textit{acc}
\end{array}\right]
\end{array}\right] \\
\text{SEM} & \left[\begin{array}{ll}
\text{INDEX} & \boxed{7} \left[\begin{array}{ll}
\text{PERSON} & \textit{3rd} \\
\text{NUMBER} & \textit{plural}
\end{array}\right] \\
\text{RESTR} & \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{cake-rel}} \\
\text{INST} & \boxed{7}
\end{array}\right]
\end{array}\right]
\end{array}\right]
\end{array}\right] \right\rangle
\end{array}\right]
\end{array}\right]
$$

Figure 2.14: ‘*eats cakes*’: Feature Structure

schema that relates S to the verb and the subject that constitutes it is called the Head-Subject Schema:

(25) **Definition 17 (Head-Subject Schema (Schema 1))**

$$
\left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{phrase}} \\
\text{DTRS} & \left[\begin{array}{ll}
\multicolumn{2}{l}{\textit{head-subject-structure}} \\
\text{HEAD-DTR} & \textit{phrase} \\
\text{SUBJ-DTR} & \textit{list}(\text{PHRASE})
\end{array}\right]
\end{array}\right]
$$

A phrase with DTRS *value of sort head-subject-structure in which the* HEAD-DTR *value is a phrasal sign.*

The head daughter here is a *phrase*, rather than a *word* as in the Head-Complement Schema in (23). This difference ensures that complements will combine with the verb first to form a VP, which can then combine with a subject to form a sentence.

Let us apply (25) to our example ‘she eats cakes’ It relates S to the VP ‘eats cakes’ and the subject ‘she’ that constitute it, shown in Figure 2.15.

The SUBJ list of ‘eats cakes’ is identical to that of ‘eats,’ because there is no SUBJ-DTR in a *head-complement-structure*. Therefore, the VP ‘eats cakes’ is still looking for a subject. Head-Subject Schema in (25) and (another part of) the Valence Principle in (26) determine how a sentence, which we can define as a *phrase* in which the SUBJ and COMPS lists are both empty, is made from a subject and a VP.

(26) **Definition 18 (The Valence Principle (for SUBJ Lists))**
In a headed phrase, the SUBJ *list of the head daughter is the concatenation of the phrase's* SUBJ *list with the list of* SYNSEM *values of the* SUBJ-DTR *value.*

$$\begin{bmatrix} \textit{phrase} & \\ \text{PHON} & \langle \textit{she eats cakes} \rangle \\ \text{SYNSEM} & \text{S}\,[\textit{fin}] \\ \text{DTRS} & \begin{bmatrix} \textit{head-subject-structure} & \\ \text{HEAD-DTR} & \begin{bmatrix} \text{PHON} & \langle \textit{eats cakes} \rangle \\ \text{SYNSEM} & \text{VP}\,[\textit{fin}] \end{bmatrix} \\ \text{SUBJ-DTR} & \left\langle \begin{bmatrix} \text{PHON} & \langle \textit{she} \rangle \\ \text{SYNSEM} & \text{NP}\,[\textit{nom}] \end{bmatrix} \right\rangle \\ \text{COMP-DTRS} & \langle \rangle \end{bmatrix} \end{bmatrix}$$

Figure 2.15: '*she eats cakes*': Example of Head-Subject Schema

Let us see how sentence 'she eats cakes' is fully represented in an AVM diagram. See Figure 2.16.

The VP's SUBJ list contains a single SYNSEM object, which the verb 'eats' specifies as third person singular. The sentence's SUBJ list is empty. The SYNSEM value of the SUBJ-DTR value is therefore token identical to the element of the VP's SUBJ list, so it must also be third person singular.

Head-Marker Schema

The other possible daughter attributes in a headed structure are ADJUNCT-DAUGHTER, FILLER-DAUGHTER, SPECIFIER-DAUGHTER and MARK(ER)-D(AUGH)T(E)R, which are categorized as the subsorts *head-adjunct-structure*, *head-filler-structure*, *head-specifier-structure* and *head-marker-structure*, respectively. Here we take a simple phrase (27) as an example of *marker-structure*, which is a subsort of *headed-structure*.

(27) that she eats cakes.

In Chomsky (1986a) and much subsequent GB work it is assumed that complementizers are heads. However Pollard and Sag (1994) assumes that they are a subspecies of *marker*. Markers are distinguished from non-markers by a new category-valued attribute MARKING. Figure 2.17 is a lexical *sign* for *that*:

Figure 2.17 bears head feature SPEC(IFIED) whose value is of sort *synsem*. This value is structure-shared with the SYNSEM value of the head *sign* that the marker combined with to construct a phrase. Such a combination is effected by the following schema in (28):

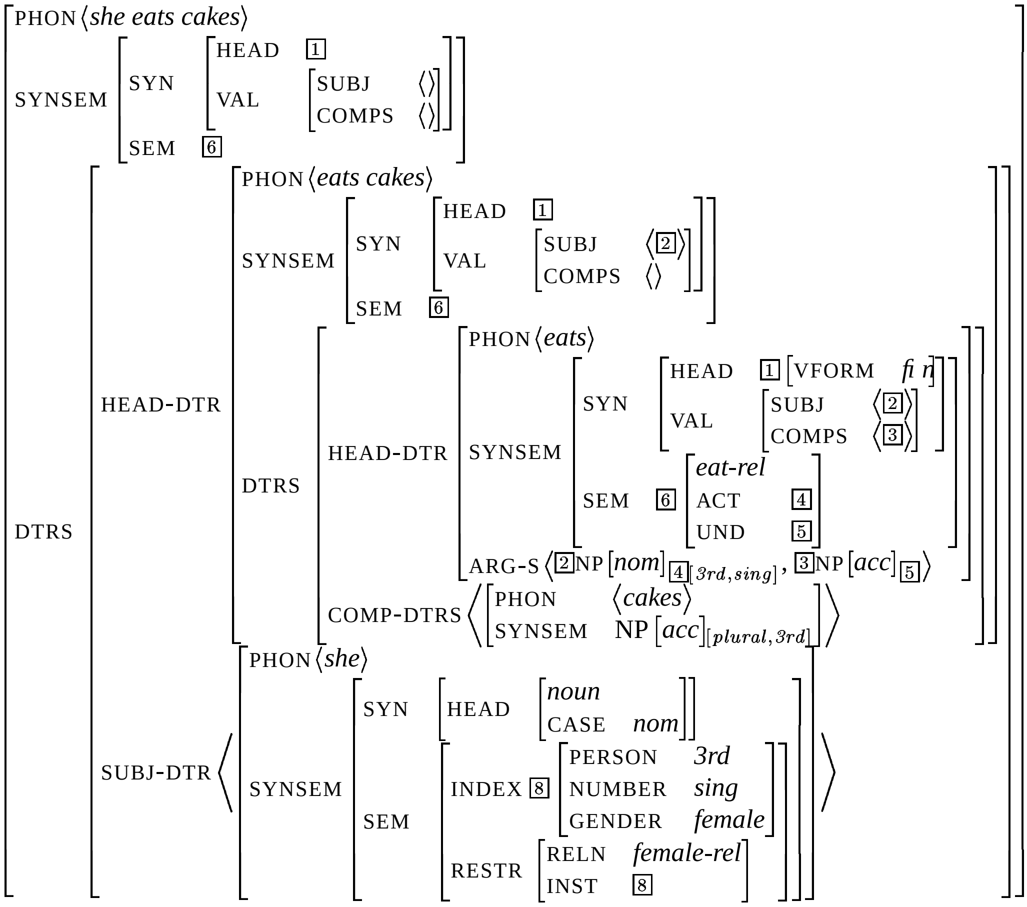


Figure 2.16: ‘*she eats cakes*’: Feature Structure

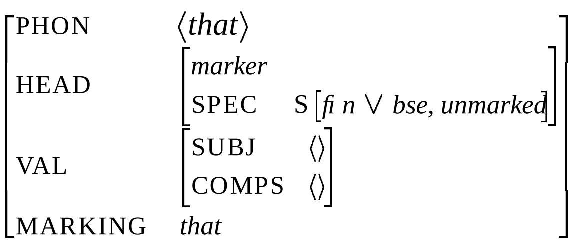


Figure 2.17: ‘*that*’: Feature Structure

(28) **Definition 19 (Head-Marker Schema (Schema 4))**

$$\begin{bmatrix} \textit{phrase} & \\ \text{SYNSEM} & \mid \ldots \mid \text{MARKING } \boxed{2} \\ \text{DTRS} & \begin{bmatrix} \textit{head-marker-structure} & \\ \text{HEAD-DTR} & \begin{bmatrix} \textit{phrase} \\ \text{SYNSEM } \boxed{1} \end{bmatrix} \\ \text{MARK-DTR} & \left\langle \begin{bmatrix} \text{HEAD} \mid \text{SPEC} & \boxed{1} \\ \text{MARKING} & \boxed{2} \end{bmatrix} \right\rangle \\ \text{COMP-DTRS} & \langle \rangle \end{bmatrix} \end{bmatrix}$$

A phrase with DTRS *value of sort head-marker-structure whose* MARK-DTR *is a marker whose* SPEC *value is structure-shared with the* SYNSEM *value of the* HEAD-DTR, *and whose* MARKING *value is structure-shared with that of the mother.*

The sort *head-marker-structure* bears an additional attribute MARK(ER)-D(AUGH)T(E)R and has no complement daughters. This schema relates S 'that she eats cakes' to the S 'she eats cakes' and the marker 'that' which constitute it. Thus, the analysis of a 'that-clause' in (27) will be as in Figure 2.18.

$$\begin{bmatrix} \text{PHON} & \langle \textit{that she eats cakes} \rangle \\ \text{SYNSEM} & \text{S}\left[\textit{fin, that}\right] \\ \text{DTRS} & \begin{bmatrix} \textit{head-marker-structure} & \\ \text{HEAD-DTR} & \begin{bmatrix} \text{PHON} & \langle \textit{she eats cakes} \rangle \\ \text{SYNSEM} & \text{S}\left[\textit{fin}\right] \end{bmatrix} \\ \text{MARK-DTR} & \left\langle \begin{bmatrix} \text{PHON} & \langle \textit{that} \rangle \\ \text{MARKING} & \textit{that} \end{bmatrix} \right\rangle \\ \text{COMP-DTRS} & \langle \rangle \end{bmatrix} \end{bmatrix}$$

Figure 2.18: '*that she eats cakes*': Example of Head-Marker Schema

2.3.3 Universal Principles

In Sections 2.3.2, three schemata, Head-Subject Schema (Schema 1), Head-Complement Schema (Schema 2), and Head-Marker Schema (Schema 4) have been introduced. As these schemata, in particular Schemata 1 and 2, actually work in place of more traditional phrase structure rules, the phrase structure of the sentence in (22) and that-clause in (27), repeated as (29a) and (29b) are licensed.

(29) a. She eats cakes.
  b. that she eats cakes

Figure 2.19 is the structure for (29b) conventionally represented in a tree diagram.

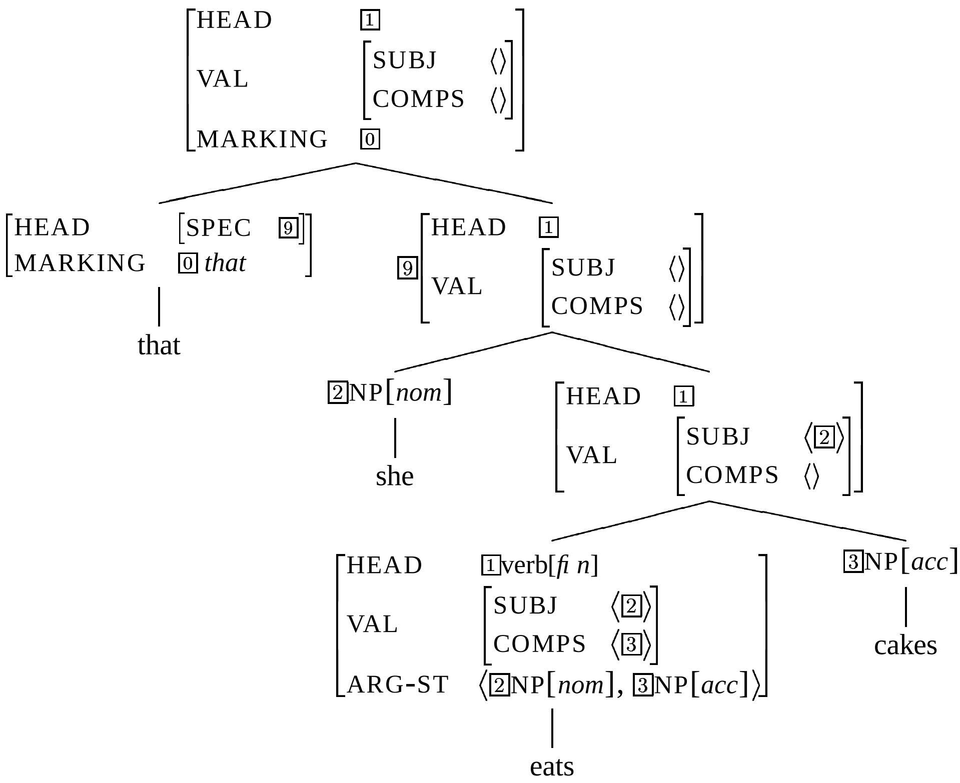


Figure 2.19: ‘*that she eats cakes*’: Tree Diagram

The Immediate Dominance Principle

In order to construct well-formed phrases, HPSG uses six schemata, but they are stated as a part of a universal principle, called the Immediate Dominance Principle shown in (30) below:

(30) **Definition 20 (The Immediate Dominance Principle)**
Every headed phrase must satisfy exactly one of the ID schemata.

Within (30), schemata are set as the universally available options for constructing a well-formed phrase structure.

The Head Feature Principle

In Figure 2.19, the head verb is of the category verb[*fin*], a specification which is a part of its HEAD feature. The legitimate propagation of this feature between the head and its projection is guaranteed by the Head Feature Principle, stated in (31):

(31) **Definition 21 (The Head Feature Principle)**

$$\begin{bmatrix}\text{DTRS} & [\textit{headed-structure}]\end{bmatrix} \Rightarrow \begin{bmatrix}\text{SYNSEM} \mid \ldots \mid \text{HEAD} & \boxed{1} \\ \text{DTR} \mid \text{HEAD-DTR} \mid \ldots \mid \text{HEAD} & \boxed{1}\end{bmatrix}$$

The HEAD *value of a headed phrase is identified with that of its head daughter.*

Structure-sharing, indicated by tags, involves the token identity of values. As a result, it is guaranteed that the HEAD value of the entire phrase is token-identical to that of the lexical head. Note that the whole clause (S) and its head (V) are of the same category. Namely, S is defined as a projection of V as in GPSG, rather than a projection of some functional category corresponding to CP, IP, etc. in GB Theory. So S is defined as a V with a saturated VAL list(s). We will still refer to this category as S, for simplicity's sake.

The Valence Principle

Figure 2.19 also shows that the head verb 'eat' subcategorizes for two NPs. The first one, tagged with $\boxed{1}$, corresponds to the subject, while the second one, tagged with $\boxed{2}$, corresponds to the direct object. Notice also that the mother node immediately dominating the head verb has a COMPS feature whose value is empty, and the top node further has empty SUBJ feature. The headed phrase in Figure 2.19 is well-formed only if it satisfies the following principle:

(32) **Definition 22 (Valence Principle)**

$$\begin{bmatrix}\text{DTRS} & [\textit{headed-structure}]\end{bmatrix} \Rightarrow \begin{bmatrix}\text{SYNSEM} \mid \text{SYN} \mid \text{VAL} & \begin{bmatrix}\text{SPR} & \alpha - \boxed{0} \\ \text{SUBJ} & \beta - \boxed{0} \\ \text{COMPS} & \gamma - \boxed{0}\end{bmatrix} \\ \text{DTR} & \begin{bmatrix}\text{HEAD-DTR} \mid \ldots \mid \text{VAL} & \begin{bmatrix}\text{SPR} & \alpha \\ \text{SUBJ} & \beta \\ \text{COMPS} & \gamma\end{bmatrix} \\ \text{NON-HEAD-DTR} & \left\langle [\text{SYNSEM} \;\; \boxed{1}] \ldots, [\text{SYNSEM} \;\; \boxed{n}] \right\rangle\end{bmatrix}\end{bmatrix}$$

where $\boxed{0} = \langle \boxed{1}, \ldots, \boxed{n} \rangle$

A headed phrase's value for each valence feature F *(*F $\in$ {SPR, SUBJ, COMPS}*) is the head daughter's* F *value minus (the synsems of) the realized non-head-daughters.*

With this principle, the subcategorization requirements of the lexical head checks off as they become satisfied by the non-head-daughters of its phrasal projections.

At the same time, the valence elements themselves are token-identical to the SYNSEM values of the corresponding syntactic arguments. Thus, a grammatically complete phrasal projection has an empty VALENCE list, or a saturated VAL value.[13]

[13] Note that HPSG does not require that every lexical *signs* end up in a saturated phrasal projection.

The Valence Principle really plays a role within HPSG much like that of the category cancellation associated with function application in Categorial Grammar. Although such principles are often described informally in terms of a bottom-up phrase generation procedure, it is actually a static constraint on a headed phrase.

Other Principles

In Figure 2.19, the MARKING value and the SYNSEM value are passed up to the mother node by the SPEC Principle and the Marking Principle, stated as follows, respectively.

(33) **Definition 23 (The SPEC Principle)**
In a headed phrase whose nonhead daughter (either the MARKER-DTR *or* COMP-DTRS|FIRST*) has a* SPEC *value, it must be token-identical with the phrase's* DTR|HEAD-DTR|SYNSEM.

(34) **Definition 24 (The Marking Principle)**
In a headed phrase, the MARKING *value is token-identical with that of the* MARKER-DTR *if any, and with that of the* HEAD-DTR *otherwise.*

The reference to the HEAD-DTR in (33) is due to the assumption that markers select their head. The basic idea of these principles is that, in a *head-marker-structure*, the SYNSEM of the mother is token identical to that of the HEAD. If S is the head of that-clause, various patterns of subcategorization are treated simply by constructing larger (phrasal) *signs*, like sentences, which take a complement clause.

Thus, sentences, clauses, phrases, words and more primitive lexical items are all treated as the same linguistic object, *sign*, which is type-hierarchically sorted in the lexicon, and treated in a unified manner called unification.

2.3.4 Lexical Rules

HPSG utilizes various lexical rules, which are basically functions mapping one class of words to another. Some of them are similar to the metarules in GPSG (Gazdar et al. 1985). The postulation of lexical rules has been defended in lexicalist approaches, e.g., the early version of LFG in Kaplan and Bresnan (1982), for its advantage of simplifying the organization of the lexicon.

Lexical rules in HPSG are allowed to refer to some specific features, most typically the VAL and ARG-ST features. One of the lexical rules crucially relevant to the present study is the Passive Lexical Rule, shown in below:

(35) Passive Lexical Rule (for English):

$$\begin{bmatrix} \text{HEAD} & \text{verb} \\ \text{SUBJ} & \langle \boxed{1}\text{NP}_{\boxed{2}} \rangle \\ \text{COMPS} & \langle \boxed{3}\ldots \rangle \\ \text{ARG-ST} & \langle \boxed{1}\ldots \rangle \\ \text{SEM} & \boxed{4} \end{bmatrix} \Rightarrow \begin{bmatrix} \text{HEAD} & \text{verb}\,[\text{PASS}] \\ \text{SUBJ} & \langle \boxed{3}\ldots \rangle \\ \text{COMPS} & \langle \ldots (\boxed{5}\text{PP}\,[\text{by}]_{\boxed{2}}) \rangle \\ \text{ARG-ST} & \langle \ldots\ \boxed{5} \rangle \\ \text{SEM} & \boxed{4} \end{bmatrix}$$

(35) simply recapitulates the traditional view, RG (Perlmutter 1978, Perlmutter & Postal 1983), GPSG (Gazdar et al. 1985), LFG (Kaplan & Bresnan 1982)), where passivization is an operation on grammatical relations. This rule promotes a non-subject argument to the subject status, at the same time demoting the subject argument to the most oblique status. The core operation also affects the ARG-ST list. The input form's least oblique argument is dropped and its index is reassigned to an optional PP[by]-phrase added at the end of the ARG-ST list. The semantic content is simply carried over from the input without change.

Though there have been alternative syntactic approaches, the treatment of passivization as a lexical operation has found support in many theories. The alternation of grammatical relations seems observationally correct. Besides this, other support for the lexical treatment of passives comes from observations about phrase structure. In (35), the output form, the passive participle (in English), is treated simply as another type of lexical verb to be mapped onto syntax following exactly the same phrase structure schemata as active verbs. And in fact, there seems to be no language where passives occur in totally different phrase structures.

Moreover, the HPSG theory provides implicit support. Within HPSG, the organization of feature structures regulated by the mechanism of unification allows only unifying compatible pieces of information or adding legitimate information, maintaining monotonicity (on the syntactic level). Hence, feature values cannot be changed in order to achieve compatibility or for any other purpose.

Given the characterization of passivization as a change in grammatical relations, non-existence of passive-oriented phrase structure in any language, and the constraint on monotonicity for unification, it is obvious that passivization cannot be a syntactic process. Syntactic processes in HPSG do not allow such a radical change of information. From these considerations Pollard and Sag (1994) concludes that passives should be obtained through a lexical rule which changes the grammatical relation among arguments.

2.4 Summary

In this chapter, we have sketched the basic mechanisms for formalizing linguistic information within the TFSs and HPSG theories. We have not completely reviewed the essentials of the HPSG theory, nor have we discussed the HPSG treatment of various fundamental phenomena. For the overall architecture and applications of the theory, see Pollard and Sag (1987, 1994).

In the next chapter, we will see some studies of grammar engineering and our grammar development system based on the framework of HPSG.

Chapter 3

Grammar Engineering and the Development Systems

3.1 Introduction

This chapter discusses issues that arise with respect to the engineering aspects of grammar development.

In the first half, we will review grammar development systems based on HPSG. Some constraint-based linguistic theory, constraint logic programming language and grammar development environment based on such a theory and a programming language are developed during the past quarter century. HPSG is one of the constraint-based theory of grammatical competence. As we discussed in the previous chapter, all of its lexical entries, (phrasal) representations, rules and even universal principles are partial constraints on constructs used to model types of linguistic object, moreover they are usually described by some (extended) version of Prolog or Lisp.

In the second half, we will provide a concise introduction of the fundamentals of our grammar development system called GraDEUS. The GraDEUS is a grammar and lexicon development environment for typed feature structure grammars. The architecture and user interface of the GraDEUS will be exhibited by way of an example of simple parsing.

3.2 Some Implementations of Japanese Grammar

Given a broad acceptance of unfication-based approaches, in particular of the HPSG and LFG frameworks, to computational grammar, it may seem from the outside that the formal foundation of typed feature structures have been long established. In this section, we will survey such previous and ongoing studies of of constraint-based grammar development whose target language is (mainly) Japanese.

3.2.1 ICOT JPSG

The first and the most important constraint-based Japanese grammar, which discussed some of the major grammatical constructions of Japanese in a version of Phrase Structure Grammar called, in later years, Japanese Phrase Structure Grammar (JPSG) started as a revision of Dr. Takao Gunji's masters thesis *A Phrase Structural Analysis of the Japanese Language* (Gunji 1981). Gunji then became involved in a project to construct a comprehensive grammar for Japanese based on his book *Japanese Phrase Structure Grammar* (Gunji 1987), a revision of his thesis, and its parser at the Institute for New Generation Computer Technology (ICOT) in Tokyo. This was intended to construct the so-called Fifth-Generation Computer near the beginning of the 1990s.

cu-Prolog

ICOT JPSG illustrates how to implement such a constraint-based approach to NLP. In Tsuda, Hasida, and Sirai (1989b), ICOT JPSG Working Group introduced a symbolic constraint logic programming language, cu-Prolog (Tsuda & Hasida 1990, Tsuda, Hasida, & Sirai 1992, Tsuda 1993) and showed how it may be applied to parsing based on JPSG (Tsuda, Hasida, & Sirai 1989a, Hasida & Tsuda 1991)

Under their framework, dependency propagation is a constraint solver which transforms the constraint program represented in terms of logic programs. Constraint unification is a unification method incorporating such dependency propagation efficiently (Hasida & Sirai 1986, Tsuda, Hasida, & Sirai 1989c, Tsuda 1991). cu-Prolog itself is an extended Prolog which employs constraint unification instead of the standard unification.

In their system, constraint unification is the unifier employed in cu-Prolog, and is roughly regarded as the standard unification plus dependency propagation. cu-Prolog deals with various constraints on the structures of grammatical categories without any special programming besides the encoding of the relevant constraint.

A program of cu-Prolog is a set of constraint-added Horn clauses (CAHC). CAHC is a Horn clause followed by constraints:

(1) **Definition 25 (Constraint-Added Horn Clause)**

$$\overbrace{H}^{\textit{Head}} \quad :\!- \quad \overbrace{B_1, B_2, \ldots, B_n}^{\textit{Body}} \quad ; \quad \overbrace{C_1, C_2, \ldots, C_m}^{\textit{Constraint}}$$

The Prolog part (the head plus the body) of a CAHC is processed procedurally just as in standard Prolog, whereas the constraint part is dynamically transformed with a sort of unfold/fold transformation during the execution of the former part. In cu-Prolog, unification-based grammar such as JPSG can be implemented naturally by treating the constraints formulated in those theories almost as they are.

Figure 3.1 shows an example session of the JPSG parser when it processes an ambiguous sentence.

```
_:-p([ken, ga, ai,suru]).

v[Form_675, AJN{Adj_677}, SC{SubCat_679}]:SEM_681---[suff_p]
 |
 +--v[vs2, SC{p[wo]}]:[love,ken,Obj0_415]---[subcat_p]
 |  |
 |  +--p[ga]:ken---[adjacent_p]
 |  |  |
 |  |  +--n[n]:ken---[ken]
 |  |  |
 |  |  +--p[ga, AJA{n[n]}]:ken---[ga]
 |  |
 |  +--v[vs2, SC{p[ga], p[wo]}]:[love,ken,Obj0_415]---[ai]
 |
 +--v[Form_675, AJN{v[vs2, SC{p[wo]}]}, AJN{Adj_677},
               SC{SubCat_679}]:SEM_681---[suru]

cat   cat(v, Form_675, [], Adj_677, SubCat_679, SEM_681)
cond  c7(Form_675, SubCat_679, Obj0_415, Adj_677, SEM_681)
True.
CPU Time = 0.050 sec

_:-c7(F,SC,_,A,SEM).
 F = syusi SC=[cat(p, wo, [], [], [], Obj00_30)] A= []
           SEM = [love,ken,Obj00_30];
 F = rentai SC = [] A = [cat(n, n, [], [], [],
                              inst(Obj00_38, Type3_36))]
 SEM = inst(Obj00_38, [and, Type3_36, [love,ken,Obj00_38]])
no.
CPU Time = 0.017 sec
```

Figure 3.1: Session of the JPSG parser

In Figure 3.1, the first line is a user's input. "Ken ga ai suru" has two readings: "Ken loves (someone)" and "(someone) whom loves Ken." The parser draws a parse tree and returns constraint on the structure of the top node. In this example, the ambiguity of the sentence is captured as the two solutions of the piece of constraint `c7(F,SC,_,A,SEM).` The first solution corresponds to "Ken loves (someone)" and the second solution to "(someone) whom loves Ken."

Linguistics as a Constraint

By treating grammatical principles and ambiguity concerning polysemy or homonymy straightforwardly in terms of constraints, syntactic, semantic and other types of ambiguity are processed in an integrated manner by Constraint Unification. Thus, cu-Prolog/ICOT JPSG can treat some lexical and grammatical knowledge as constraints on the structure of grammatical categories, enabling a very straightforward implementation of a parser using constraint-based grammars.

cu-Prolog uses Prolog's term and provides neither type system nor underspecification based on TFSs.[1]

Therefore ICOT JPSG has no mechanism which makes it possible to write a concise, but wide coverage grammar.

However ICOT JPSG's real contribution to Japanese Computational Linguistics is that their theoretical proposals and practical implementation show that an elementary and important concept in phrase structure grammar, even in Japanese, is *unification*, both in the grammatical theory and in its implementation in constraint logic programming through writing an experimental but an explicit and executable grammar. Therefore, our study and this dissertation cannot escape from having to study this concept.

3.2.2 SLUNG

Programming Language LiLFeS

LiLFeS (Torisawa, Makino, Yoshida, Ninomiya, Nishida, Imai, Mitsuishi, Kanayama, Tateisi, Miyao, & Tsujii 1999) is a programming language and system for linguistic formalisms based on typed feature structures. It is a logic programming language similar to Prolog. Its control mechanism also include disjunction, negation and cut, following standard Prolog function. Built-in predicates such as copy feature structures assertion, lazy evaluation, multi-dimensional arrays and find all predicates are provided. Thus, LiLFeS is designed to allow for the easy description of TFSs as a built-in data structure, and is suitable for writing programs with TFSs, such as unification grammars and parsers(Makino, Torisawa, & Tsujii 1997, Makino, Yoshida, Torisawa, & Tsujii 1998).

Templates and Underspecification

Small Lexicon Underspecified Nipponese Grammar (SLUNG) (Mitsuishi, Torisawa, & Tsujii 1998a, 1998b) is such a LiLFeS application which is a wide-coverage Japanese grammar based on HPSG. SLUNG consists of only 6 rule schemata, 68 lexical entries, and 63 lexical entry templates.[2] The grammar can generate parse trees for 87% of the 10,000 sentences in the Japanese EDR corpus, [3] because lexical entry templates are underspecified. The templates describes general behavior of words belonging to each part of speech and they contain less information than specific lexical entry to be given to an individual word. Unlike other grammar formalisms, a lack of specific description does not mean a parsing failure under the SLUNG and LiLFeS framework.

[1] Like the ProFIT, the system can include TFSs externally.

[2] In (Torisawa et al. 1999) the grammar consists of 8 rule schemata, 286 lexical entries, and 110 lexical entry templates.

[3] EDR (Japan Electronic Dictionary Research Institute, Ltd.).

Heuristics for Natural Language Processing

Another characteristic of SLUNG is its treatment of heuristics. It uses several heuristics, whose origins are found in traditional descriptive linguistics, to assist in analyzing Japanese syntactic structures. Unlike the analysis of linguistic phenomena found in linguistic literatures, the heuristics for NLP used in commercial MT systems and practical parsers are not always valid. But Mitsuishi et al. (1998a, 1998b) showed that some of heuristics in linguistics can be treated in HPSG. The heuristics can be easily described in typed feature structures and can be applied by simply unifying the feature structure with other principles.

They claim a dependency accuracy of 78% when the parser uses the heuristic that every *bunsetsu* is attached to the nearest possible dependentee. But we think this heuristic only generates simplified (left-)branching structures for parsing purposes and this does not correctly treat the underlying complex structure which the simple sentence (covertly) inclused.

Moreover, another heuristic "–postpositional phrase marked by postposition 'wa' in Japanese tends to be an argument of the verb in the end of the sentence as far as another noun phrases in the sentence is not marked by another 'wa'–" can be easily described in HPSG,[4] and this means that SLUNG seems to use typed feature system as its computational theory rather than HPSG as a grammatical theory.

However, linguistically valid grammar and heuristics cannot be distinguished easily in grammar descriptions and this leads to SLUNG's approach that their merging by simple unification may provide alternative view for modularizing grammar descriptions. It is noteworthy that the system has a graphical user interface which is useful for writing a complex grammar by trial and error. As for grammar, LiLFeS has an implementation of large-scale English grammar (XHPSG) which has been converted from XTAG grammar (Tateishi, Torisawa, Makino, Nishida, Fuchigami, & Tsujii 1997, Tateishi, Torisawa, Miyao, & Tsujii 1998). Moreover, LiLFeS itself is a runtime system, implemented as an abstract machine, which allows efficient execution of compiled code. It can efficiently process the unification of feature structures, which tend to require heavy processing (Makino et al. 1997, 1998).

Thus LiLFeS can be used as a core system for developing not only executable but practical natural language processing systems.

3.2.3 JaCY and Hinoki

Pure HPSG implementation with Semantics

Siegel and Bender (2002) describe the development of a broad-coverage grammar for Japanese that is used in an automatic email response application. The grammar, called JaCY, is based on work done in the Verbmobil Project (Siegel 1998, 1999, 2000b, 2000a) on machine translation of spoken dialogues in the domain of travel

[4] See 10.5.1.

planning. It has since been greatly extended to accommodate written Japanese and new domains.

JaCY's grammar is based on HPSG but with semantic representations in Minimal Recursion Semantics (MRS) (Copestake, Flickinger, Pollard, & Sag 1999). MRS is a flat semantic formalism that works well with typed feature structures and is flexible in that it provides structures that are underspecified for scopal information. These structures give compact representations of ambiguities that are often irrelevant to the task at hand.

While based on the same HPSG framework, JaCY's approach differs from that of LiLFeS (Kanayama, Torisawa, Mitsuishi, & Tsujii 2000) which achieves impressive coverage with an underspecified grammar consisting of a small number of lexical entries, lexical types associated with parts of speech, and 6 underspecified grammar rules. The grammar implementation is based on a system of types, as is LiLFeS. However, there are 9,000 lexical types that define the syntactic, semantic and pragmatic properties of words, and 188 types that define the properties of phrases and lexical rules. The grammar also includes 50 lexical rules for inflectional and derivational morphology and 47 phrase structure rules. The lexicon contains 5,100 stem entries.

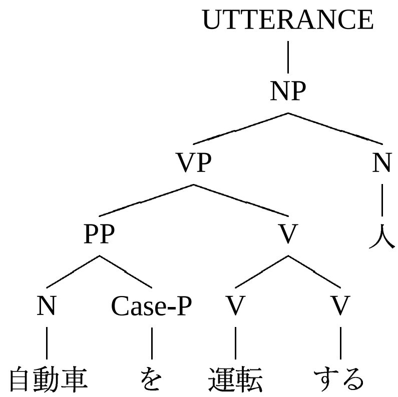
Treebank for Text Understanding

Bond, Fujita, Hashimoto, Kasahara, Nariyama, Nichols, Ohtani, Tanaka, and Amano (2004c) constructed a Japanese lexical resource: the Hinoki treebank. The Hinoki is built from dictionary definition sentences, and uses JaCY grammar to encode the syntactic and semantic information. Bond, Fujita, Hashimoto, Nariyama, Nichols, Ohtani, and Tanaka (2004d) extend JaCY by adding the defining vocabulary, and add some new rules and lexical types. Definition sentences are rewritten to use the 28,000 familiar words and some function words. The definition vocabulary is actually 16,900 different words. An example entry for first two senses of the word ドライバー *doraibā* 'driver' is given in Figure 3.2.

INDEX	ドライバー *doraibā*	
POS	noun Lexical-type noun-lex	
FAMILIARITY	6.5 [1-7]	
SENSE1	DEFINITION	ねじ/を/差し入れ/たり/、抜き取っ/たり/する/道具。
	HYPERNYM	道具 *1*
	SEM.CLASS	⟨942:TOOL⟩(⊂893:EQUIPMENT)
SENSE2	DEFINITION	自動車/を/運転/する/人/。
	HYPERNYM	人 *1* *hito*
	SEM.CLASS	⟨292:DRIVER⟩(⊂4:PERSON)

Figure 3.2: *doraibā* 'driver': Hinoki Lexical Entry

The Hinoki treebank is inspired by the Redwoods treebank of English in which utterances are parsed and the annotator selects the best parse from the full analysis derived by the grammar (Oepen, Toutanoya, Shieber, Manning, Flickinger, & Brant 2002). A simplified example of the labeled tree, MRS and dependency views for the definition of ドライバー $_2$ 'driver' is given in Figure 3.3.



MRS

$\langle h_0, x_1$ { h_0 *:proposition$_r$el(h_1)*
h_1 *:hito(x_1)*
h_2 *:u$_d$ef(x_1, h_1, h_6)*
h_3 *:jidosha(x_2)*
h_4 *:u$_d$ef(x_2, h_3, h_7)*
h_5 *:unten(e_1, x_1, x_2)* } $\rangle$

Dependency

{ x_1 :
e_1 : *unten(*ARG$_1$ x_1*: hito*
ARG$_2$ x_2*: jidosha)*
r_1 *:proposition(*MARG e_1*: unten)*}

Figure 3.3: *doraibā* 'driver': Hinoki Parse Tree, MRS and Dependency

DELPHIN Tools

JaCY, MRS and Hinoki have practical and useful open-source tools for writing, testing, and efficiently processing grammars written in these formalisms. The tools used in the Hinoki project include the Linguistic Knowledge Base (LKB) system (Copestake 2002) for grammar development, [incr tsdb()] (Oepen & Carroll 2000) for testing the grammar and tracking changes, and PET (Callmeier 2000), very efficient HPSG processing. Using these DELPHIN tools, the Hinoki now can be used to extract thesaurus information from definition sentences in a language-neutral way using MRS, and also build a stochastic parse ranking model (Bond, Fujita, Hashimoto, Kasahara, Nariyama, Nichols, Ohtani, Tanaka, & Amano 2004a, 2004b).

As the grammar is developed for use in real-world applications, it treats a wide range of (basic) constructions. To extend the JaCY for such purpose, a great number of lexical entries, a number of grammar rules, and the constraints on both are needed. Grammar development by explicitly and manually describing various constraints without underspecification is very difficult and more effort is directed at raising the level of coverage.

However, HPSG is also well suited to the task of multilingual development of broad-coverage grammars. There is a rich theoretical literature from which it can draw analysis and inspiration. The grammar Matrix (Bender, Flickinger, & Oepen 2002, Flickinger & Bender 2003) is an open-source starter-kit for the development of broad-coverage HPSG tuned for particular languages. The AVM of a *sign* in the JaCY (Siegel & Bender 2004, Bender & Siegel 2004) is now quite similar to a *sign* in English grammar and benefits from the LinGO English Resource Grammar (ERG) (Flickinger 2000). A higher level of detail allows JaCY to output precise semantic representations as well as to use syntactic, semantic and lexical information to reduce ambiguity and rank parses.

3.2.4 XLE

Another important grammar development is Parallel Grammar Project (ParGram), which is to produce collaboratively written large LFG computational grammars for various language. Grammar writers in the project used the Xerox Linguistic Environment. We do not refer to ParGram and XLE in this thesis. See Masuichi and Ohkuma (2003) for the overview of the Japanese study and their contribution to the ParGram project.

3.3 NAIST Grammar Development System

3.3.1 GraDEUS

Grammar development system GraDEUS (Miyata & Matsumoto 1999, Miyata, Takaoka, & Matsumoto 1999, Ohtani, Miyata, & Matsumoto 2001, Miyata & Ohtani 2001) is an implemented system which provides a procedure for computing the interpretation of clausal fragments. The system comprises two main components: a grammar and a resolution procedure. The grammar, encoded in ProFIT (Erbach 1994, 1995b, 1995a), assigns HPSG feature structures to Japanese and English sentences.[5] Once a sentence has been parsed, the second component of the system resolves the ellipsis sites on the basis of contextual information contained in preceding sentences, located in a structured record stored in memory.

The current grammar, which is the main topic of this thesis and will be described in the following sections, is a substantially modified version of the grammar described in NAIST JPSG (Ohtani, Miyata, & Matsumoto 2000b) and some recent research employed by (Ohtani 1999b, 1999a, Ohtani, Miyata, & Matsumoto 2000a, 2000d, 2000c, Ohtani et al. 2001, Ohtani & Matsumoto 2002, 2004, Ohtani & Miyata 2005)

Organization of Modules

The Grammar development system, GraDEUS (Miyata & Matsumoto 1999) is organized as illustrated in Figure 3.4.

[5]We will offer a concise introduction of ProFIT in Section 3.4 and an application to Japanese in Chapter 4.

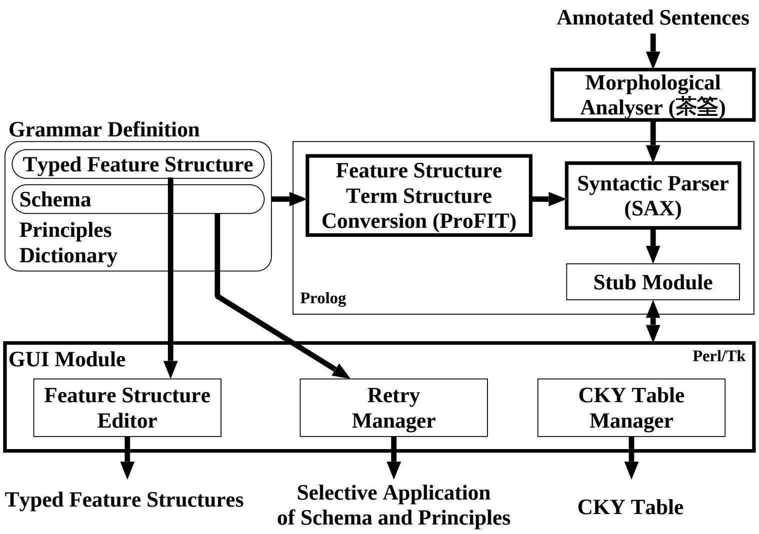


Figure 3.4: Organization of Modules

GraDEUS consists of four modules: morphological analysis system ChaSen (Matsumoto, Kitauchi, Yamashita, & Hirano 1997), syntactic parser SAX (Matsumoto, Den, & Utsuro 1993), unification engine ProFIT (Erbach 1994, 1995b, 1995a), and GUI module.

The GUI module is subdivided into three parts. Various programming languages are used; C for ChaSen, SICStus Prolog 3 for ProFIT and SAX, and Perl/Tk for the GUI module. The modules are independent of each other and they can be replaced with other implementations as long as the interface protocol and the format of the grammar are preserved. Additionally the feature structure editor can be used as a stand alone system.

The system has been ported onto various UNIX platforms: Sun workstations, SGI O2, and PC versions of Linux and FreeBSD. The parsing speed is not high, but users can change the parser module with their own or a preferred parser as long as the interface protocol and the format of the grammar are preserved.

Features of the System

Our system has following features:

(2)
- Modular Structure
- Graphical User Interface (GUI).
- Annotation-aware Parsing

The fist feature concerns implementation and design of our system, the modular structure enhances the system's portability.

The second feature hides the parser implementation as this will be of little interest to most users. Although the stable version does not support grammar editing through the GUI,[6] it allows users to browse parses of a given sentence on the level of linguistic abstraction. Because of this interface, users can easily do the follwing operations and as a relust they concentrate on grammar development linguistically.

(3)
- checking
  - parsing ambiguities
  - parse tree structures
  - selective application of schema and principles
- manipulating on feature structures for lexeme and word

The lexical entries described based on HPSG include some grammar constraints. Thus this interface substantially provides the function for editing grammar, especially constraint-based grammar.[7]

The last feature means that our syntactic parser accepts bracketed and/or tagged sentences as input. These annotations reduce the ambiguities of a long sentences without modifying the currently developed grammar.

Efficiency in Grammar Development

The third feature can be regarded as a preprocessor interface which allows chunking and dependency analysis. However there is more essential benefit in that it allows us to to annotate input sentences.

NAIST JPSG's theoretical analysis-based bottom up approach is like that of ICOT JPSG, discussed in Section 3.2.1, but our project aims to construct a grammar which has wider coverage. Generally speaking, grammar development requires enormous effort, especially in the early stages. In such situations, tackling problems one by one makes the grammar vague and extensions to the grammar become difficult. This greatly disturbs grammar development, even if we use ad hoc solutions.

Annotating a sentence actively for the grammar handling it without correct analysis provides one solution for overcoming the difficulty of general procedure of the grammar development. This also means that any extension of the grammar is deferred until the difficulties can be clarified by analyzing the annotated sentences. Such sentences are also useful in obtaining information about the constructed grammar since they describe a kind of specification of the grammar.

When we modify the constructed grammar in order to achieve more efficiency in parsing or to adapt it to specific domain, we can consult annotated sentences instead of a large and complex grammar.

[6]The experimental version (Miyata & Ohtani 2001) has a function for describing lexical entries and editing grammar but the latter is partially supported.

[7]The GUI system assists beginners to using our system to learn about feature structure-based unifi cation grammar formalisms.

Miyata and Ohtani (2004) used Global Document Annotation (GDA) tags[8] in a study of the syntactic and semantic properties of long-sentences in Japanese newspapers. These annotation can be seen as preprocessing since recent researche on statistical sentence segmentation and phrasal dependency analysis become more and more feasible.

3.3.2 A Session with the System

To show the general procedure for grammar development with the feature structure editor in GraDEUS, let us take a simple example:

(4) Ken-ga Naomi-wo ai-su.
Ken-NOM Naomi-ACC love-do
'Ken loves Naomi. (健が直美を愛す.)'

After loading and booting the system, the sentence to be parsed is prompted. We can type either a raw or annotated sentence.

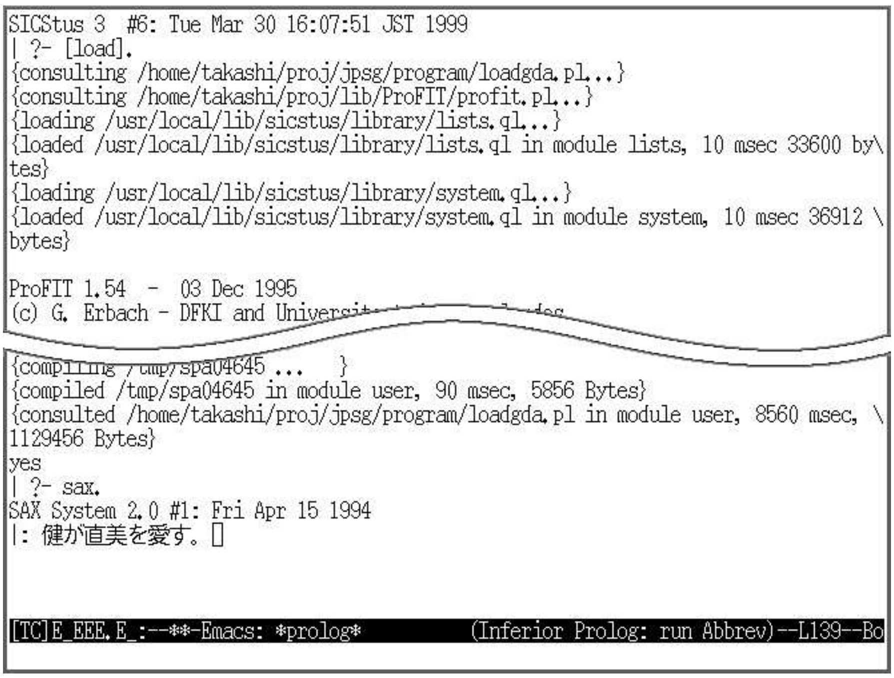


Figure 3.5: Booting the System

[8] GDA project(Hasida 1997) offers another viewpoint to annotation. This project proposes standard tag sets and aims to promote development and spread of useful applications which exploit those tags.

CKY Table

The system parses a given sentence then displays a window containing the CKY table for the sentence. The table in Figure 3.6 is firstly presented in a folded form, which looks like the phrase.

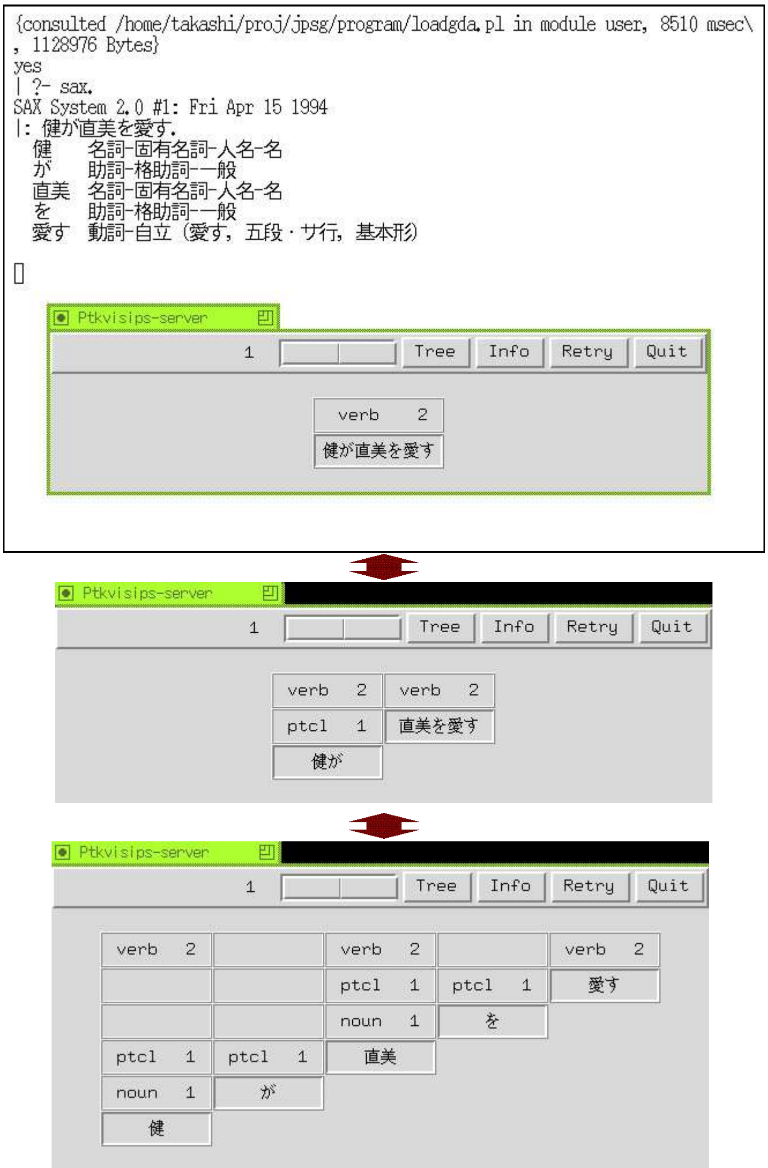


Figure 3.6: Folding and Unfolding the CKY Table

Each part of the table can be folded and unfolded. This function hides unnecessarily detailed information allows the user to concentrate on the problematic part of the sentence.

Parse Tree

When an entry is clicked by the left mouse button, then that entry is selected. When the 'Tree' button is clicked, the partial parse tree whose root node is the selected entry is displayed as shown in Figure 3.7

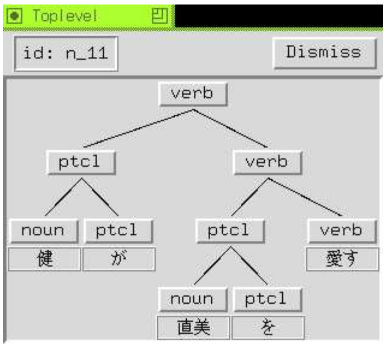


Figure 3.7: Parse Tree

Typed Feature Structure Editor

If the 'Info' button is clicked then the typed feature structure carried by the selected entry is displayed.

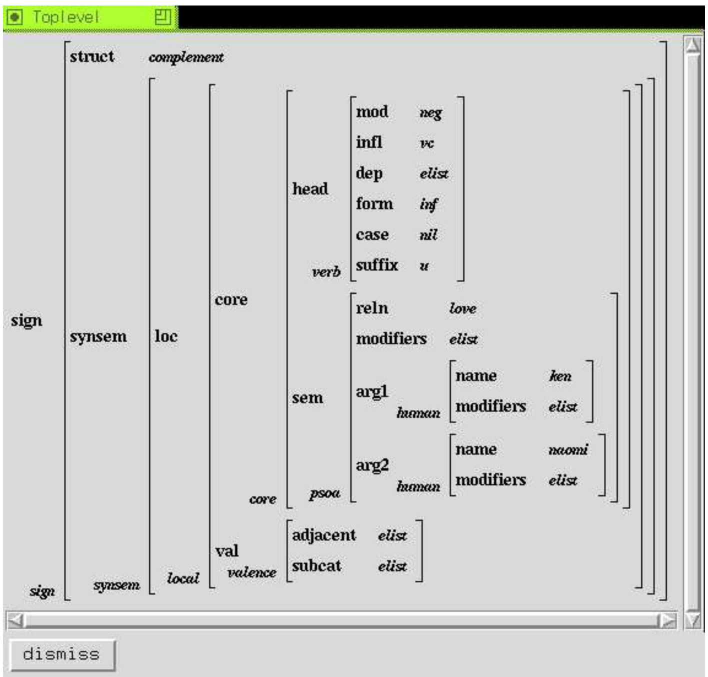


Figure 3.8: Typed Feature Structure Editor

The user can variously manipulate the typed feature structure with GUI. However, errors are reduced compared to writing it by hand since the system only allows valid manipulations.

In the window in Figure 3.8, the user tries to unify a pair of features' values.

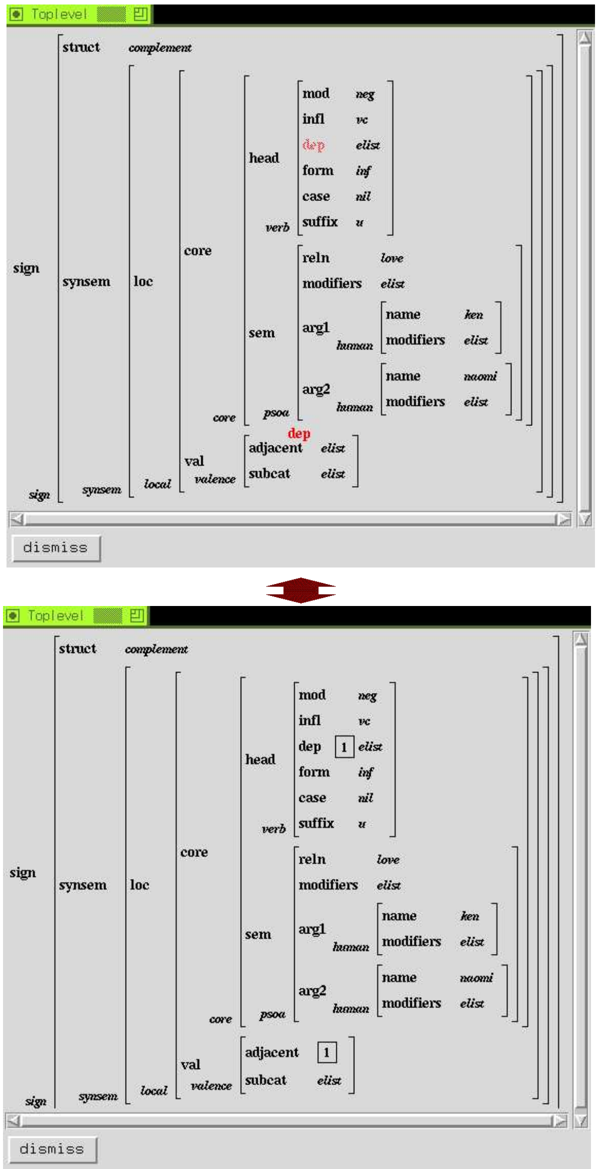


Figure 3.9: Unification

When the user drags one feature name onto the another one, they are unified if possible. A unification failure simply results in an error beep.

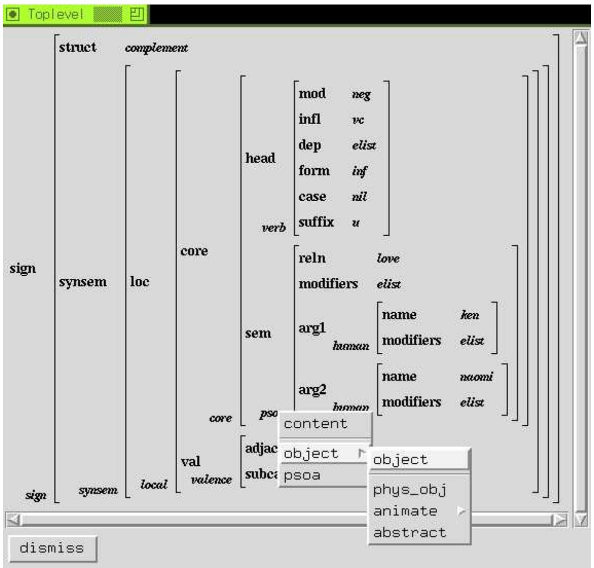


Figure 3.10: Changing Type

Figure 3.10 shows the function for changing the type or value of the feature. The menu of alternative types is opened, when the user pushes the type name.

The typed feature structure editor also has a useful function which makes and saves files in various formats of the output of the system. These LaTeX DVI and PostScript files can be included into other documents by using avm.sty and epsf.sty style file.

Each feature value is formatted so as to be suitable for ProFIT, the unification engine used by the system. The user can paste this fragment into their own dictionary or program. This assists greatly in incremental grammar development.

Selective Application of Schemata and Principles

Another GUI-based debugging function is the selective application of the schemata and principles. In Figure 3.11, '健が' (*Ken-ga*, Subject) and '直美を' (*Naomi-wo*, Object) are selected as an example. After selecting adjacent entries by clicking them with the left button of the mouse holding down the shift key, the user can click 'Retry' button. Then the system finds out applicable schemata only according to the number of entries the user has selected from the grammar file, and shows the schemata as a pop-up menu, below left of Figure 3.11.

The pop-up menu in the window contains two schemata: one is for complementation, the other is for adjunction.[9] This is because both of them include two daughters for their definition.

[9]Sample grammar in Miyata and Matsumoto (1999) has only these two schemata. Ohtani et al. (2000b) adds more two schemata.

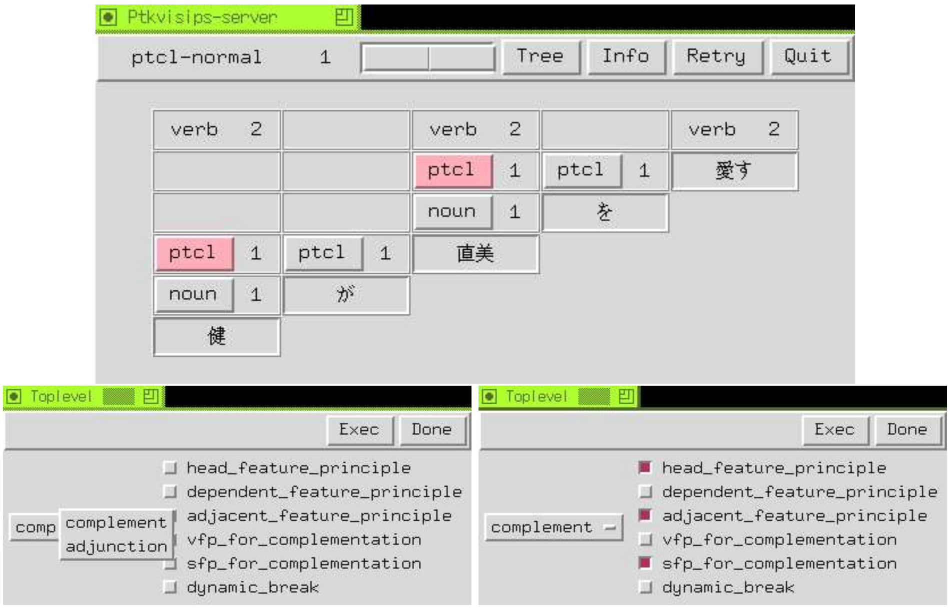


Figure 3.11: Selective Application of Schemata and Principles

Note that the schemata themselves cannot exclude the possibility that '健が' and '直美を' make a phrase, which is of course a wrong parse. The grammaticality is mainly regulated by the principles listed at the right of the pop-up menu.

At the bottom right of Figure 3.11, complementation schema is selected. The principles adopted with that schema appear at the right. After selecting the principles, you can make the system apply them by clicking 'Exec' button.

If the application succeeds then the typed feature structure of the mother node is displayed accompanied with the typed feature structures of the selected daughters. In Figure 3.12, the user can verify that the principles excluding the inappropriate phrase structures are the Dependent Feature Principle and the Valence Feature Principle. This function allows for intuitive verification both in the case that an inappropriate phrase was created or the case that desired phrase was not created.

Annotation-Aware Parsing

The parser in our system can parse tagged and/or bracketed sentences. The tagged sentence in (5), which is taken from the article in the Mainichi newspaper:

(5) [[[[通商分野, noun], [の, adn], 摩擦, noun], が, ptcl]
[[日米関係全体, noun], を, ptcl]
[[[損なって, verb], [は, ptcl], adv], [なら, verb], [ない, verb], verb], su].
'Friction caused by trading should not harm the whole of the relationship between Japan and U.S. A.'

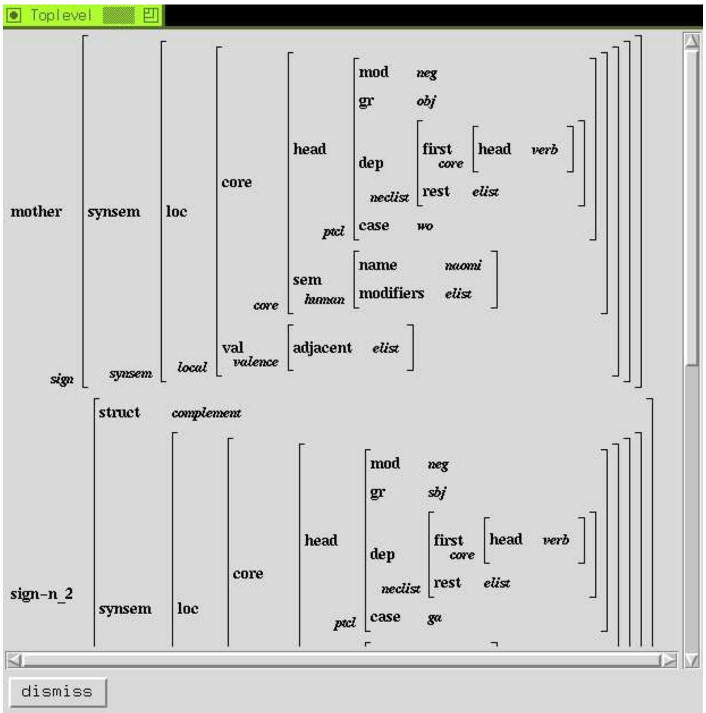


Figure 3.12: Retrying the Application of Complement Schema

Sentences like (5) are generally hard for naive grammar to parse correctly. Note that the problems listed in (6) are not only the problems in (5) but the traditional problems that the whole study of natural language processing hold.

(6)
- The sentence contains compound and unknown words.
- Multiple auxiliary verbs cause the growth of unnecessary structural ambiguities.

It is said that semantic and pragmatic information is required to overcome the problems listed in (6), this additional information also introduces difficulties to language processing.

However, the GraDEUS's parser does not fail as shown in Figure 3.13.

The parsing also efficiently excludes unnecessary ambiguities by using the syntactic constituency information given by bracketing. Annotation (indirectly) prevents the user from modifying the grammar so as to manage idiosyncratic phenomena. This is a serious issue constraint-based lexicalized grammar like HPSG.

Other merits of parsing annotated sentences are that (i) these sentences can be regarded as a rough specification of the grammar and (ii) annotation can be an interface or protocol between the parser and the preprocessor such as segmentation and dependency analysis.

Thus, the functions of GraDEUS allow users to concentrate on proper linguistic issues.

Figure 3.13: Parsing the Sentence cited from the Newspaper

3.4 Implementation of TFSs and ProFIT

Typed feature formalisms, discussed in Section 2.2, are often used for the development of large-coverage grammars because they are very well suited to a structured description of complex linguistic objects. Typed feature terms have several advantages over Prolog terms as a representation language (Erbach 1995b):

(7)
- Typed feature terms provide a compact notation. Features that are not instantiated can be omitted; there is no need for anonymous variables.
- Feature names are mnemonic, argument positions are not.
- Adding a new feature to a sort requires one change in a description, whereas adding an argument to a Prolog functor requires changes (mostly the insertion of anonymous variables) to every occurrence of that functor.
- Specification of the subsort relationship is more convenient than constructing Prolog terms which mirror these subsumption relationships.

Implementations of typed feature formalisms such as LiLFeS and LKB have been used successfully for the development and testing of large grammars and lexicons.

ProFIT (Erbach 1994, 1995b, 1995a) is an efficient language for the implementation of grammars developed with typed feature structures in Prolog programs. The ProFIT language itself is an extension of Standard Prolog with Features, Inheritance and Templates. GraDEUS includes it as its unification engine. It also allows the grammar developer to declare an inheritance hierarchy, features and templates. Typed feature structure terms can be used in ProFIT programs together with Prolog terms to provide a clearer description language for linguistic structure.

In Chapter 4, we will present an overview of the implementation of the HPSG-based Japanese grammar used and developed within GraDEUS –NAIST Japanese Phrase Structure Grammar. The grammar is based on the theoretical framework presented in Ohtani et al. (2000b) and it is encoded in ProFIT.

3.5 Summary

In this chapter, we have reviewed some grammar development systems. LiLFeS and JaCY/Hinoki are constructed for use in real world applications where robustness and performance issues play an important role. However NAIST JPSG, which is introduced in the following chapters, mainly conducts a detailed examination of the comprehensive grammar for Japanese, as the ICOT JPSG Working group did. But the grammar is based on typed feature system and we use our own grammar development system GraDEUS for describing and evaluating the grammar constraints in a similar manner to that of SLANG/LiLFeS and JaCY/Hinoki.

Chapter 4

An Implementation of a Constraint-Based Grammar for Japanese

4.1 Introduction

This chapter will explore some of the main ideas of a phrase structure grammar for Japanese based on HPSG mechanisms. We will discuss some Japanese grammatical phenomena that are crucial to clarify properties involved in various constructions. These will also serve as a background of the discussion in later chapters. They are particularly relevant to the identification of the complex feature structures of complex predicate, hierarchical clause, information structure which reflect syntactic, semantic and pragmatic aspects of Japanese language.

We will provide an overview of some of the major concepts underlying the NAIST Japanese Phrase Structure Grammar (JPSG), developed by Ohtani et al. (2000b) and other recent studies. We will also pay attention to the computational aspects of such linguistic formalization from the point of view of parsing efficiency.

4.2 NAIST Japanese Phrase Structure Grammar

This section provides an overview of some of the major concepts underlying NAIST JPSG, based on HPSG (Pollard & Sag 1987, 1994, Sag, Wasow, & Bender 2003) and other recent studies. We will use HPSG as a tool for the formal representation of our analysis. Besides introducing a detailed background of feature structures of JPSG, we provide schemata and principles of the framework for linguistic knowledge representation adopted throughout the rest of the paper.

4.2.1 Universal Grammar and Japanese

In Pollard and Sag (1987, 1994, 1997), an HPSG theory of Universal Grammar (UG) and its relation to individual languages, e.g., English, is developed.

Assuming the notion of unification, Pollard and Sag (1987) note that if $P_1 \ldots P_n$ is the set of universal principles, $P_{n+1} \ldots P_{n+m}$ the set of language-specific principles, $L_1 \ldots L_p$ are the lexical signs, and $R_1 \ldots R_q$ are the grammar rules of the specific language, then the Japanese can be defined as shown in Figure 4.1

$$\begin{aligned} \text{UG} &= P_1 \wedge \ldots \wedge P_n \wedge P_{n+1} \wedge \ldots \wedge P_{n+m} \\ \text{Japanese} &= \text{UG} \\ & \quad \wedge \quad (L_1 \vee \ldots \vee L_p) \\ & \quad \wedge \quad (R_1 \vee \ldots \vee R_q) \end{aligned}$$

Figure 4.1: Universal Grammar and Japanese

A linguistic object is a Japanese sign just in case (i) it satisfies all the universal and Japanese-specific principles and (ii) either it is subsumed by one of the Japanese lexical signs or it is subsumed by one of the Japanese grammar rules.

The principles like the Head Feature Principle and the Valence Principle discussed in Section 2.3 are part of universal principles.

Pollard and Sag (1994) also suggest that grammar rules should be formulated as a disjunctive schemata as in the Immediate Dominance Principle. Note that all the principles are on a par and none takes precedence over any others. This means that the principles can be used in any order.

4.2.2 Linguistic Objects

ProFIT is an extension of Prolog which allows us to declare an inheritance hierarchy, features and templates. ProFIT compiles the typed feature terms into a Prolog term representation, so that no special unification algorithm is needed.

A ProFIT program consists of:

(1) i. Type Declarations
  ii. Feature Declarations
  iii. Templates

Type Declarations

In order to be able to use typed feature terms, the types and features must be declared in advance. The type declarations begin with a declaration of the most general type *top* and all subtypes not explicitly declared under other subtypes must be subtypes of *top*. The subtype declarations have the following syntax (2):

(2) *Supertype* > [*Subtype*$_1$, *Subtype*$_2$,...,*Subtype*$_n$]

The declaration in (2) states that every *Subtype*$_i$ is a subtype of *Supertype* and that all *Subtype*$_i$ are mutually exclusive, i.e., they are disjoint.[1] The crucial part of the type declarations of NAIST JPSG is in Figure 4.2.[2]

```
          top > [feat_struc].
   feat_struc > [synsem_struc,gram_cat,val_cat,pos,
                 sem_struc,pred,ind].
 synsem_struc > [phrase,lex_item]
                 intro [syn:gram_cat,sem:sem_struc,
                        morphon:morphon_struc].
       phrase > [np_struc,vp_struc,pp_struc]
                 intro [struct:struct_type].
     lex_item > [word,lxm].
          lxm > [const_lxm,infl_lxm].
    const_lxm > [noun_lxm,adn_lxm,adv_lxm,ptcl_lxm,
                 conj_lxm,excl_lxm].
     noun_lxm > [pron_lxm,pn_lxm,cn_lxm].
     infl_lxm > [verb_lxm].
     verb_lxm > [iv_lxm,tv_lxm].
       tv_lxm > [stv_lxm,dtv_lxm,ttv_lxm].
gram_cat intro  [head:pos,val:val_cat].
 val_cat intro  [subcat:synsem_struc_list,
                 adjacent:synsem_struc_list].
          pos > [noun,adnoun,adverb,ptcl,conj,excl,verb]
                 intro [case:case_type,mod:synsem_struc_list,
                        ana:boolean,arg_st:synsem_struc_list].
    verb intro  [infl:infl_type,form:form_type,suffix].
  struct_type > [lexical,comp_head,spec_head,modif_head,
                 coordination].
```

Figure 4.2: Type Declaration

Feature Declarations

Following the notion of appropriateness of Carpenter's (1992) typed feature structures, in a ProFIT program one must declare which features are introduced by each type. A feature is introduced only at the most general type for which that feature is appropriate and the features introduced by a type are inherited by all its subtypes. Each feature has a particular type as its value. When this type restriction is

[1]It is also possible to declare subtypes that are not mutually exclusive as in the case of multi-dimensional inheritance hierarchies. In this kind of hierarchies each dimension is declared as a separate list of subtypes connected by the operator $*$, as shown in (i):

(i) *Supertype* $>$ [*Subtype*$_1$,...,*Subtype*$_n$] $*\ldots*$ [*Subtype*$_{k.1}$,...,*Subtype*$_{k.m}$]

NAIST JPSG assumes multi-dimensional constraints but does not multiple inheritance hierarchy for its declaration. See 6.4.2.

[2]`sem_struc` and `morphon`$_s$`truc` are omitted. The former will be extensively discussed in the later sections. The latter is beyond this thesis.

omitted, then the feature value is assumed to be of type *top*. The syntax of feature declarations is given in (3):

(3) *Type* intro [*Feature*$_1$: *type restr*$_1$,…, *Feature*$_n$: *type restr*$_n$]

Feature declarations can also be combined with type declarations using the following syntax (4):

(4) *Type* > [*Subtype*$_1$,…] intro [*Feature*$_1$: *type restr*$_1$,…]

NAIST JPSG grammar follows Sag and Wasow's (1999) HPSG sign-based approach in which all signs, both phrasal and lexical, are modeled as typed feature structures. For each feature F_i in Figure 4.2, the appropriate type T_i of its value is declared with the syntax $F_i : T_i$. Thus, the ProFIT declaration for the type *synsem_struc* states that its immediate subtypes are *phrase* and *lex*$_i$*tem* and that the features appropriate for such a type are SYN, SEM and MORPHON.

Based on these declarations, the AVM representation for the type *synsem_struc* in NAIST JPSG has the structure shown in Figure 4.3.[3]

$$\begin{bmatrix} \textit{synsem\_struc} & \\ \text{MORPHON} & \textit{morphon\_struc} \\ \text{SYN} & \begin{bmatrix} \textit{syn} & \\ \text{HEAD} & \begin{bmatrix} \textit{head} & \\ \text{CASE} & \textit{case} \\ \text{ARG-ST} & \textit{list(synsem\_struc)} \\ \text{MOD} & \textit{list(synsem\_struc)} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \textit{val} & \\ \text{SUBCAT} & \textit{list(synsem\_struc)} \\ \text{ADJCNT} & \textit{list(synsem\_struc)} \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \textit{sem\_struc} \\ \text{CONX} & \textit{conx\_struc} \end{bmatrix}$$

Figure 4.3: Feature Structure

The *synsem_struc* type has attributes or features labeled MOR(PH-)PHON(OLOGY), SYN(TAX), SEM(ANTICS) and CON(TE)X(T). They serve to represent morph-phonological, syntactic, semantic and pragmatic properties of a word or phrase respectively.

A type assigned to the node also determines what attribute labels can appear in its feature structure. Thus a feature structure of type *syn* can have the attribute labels HEAD and VAL(ENCE).

A feature structure of type *head* has subtypes depending on its part of speech, such as *verb*, *noun* and *p(ar)t(i)cl(e)*, each of which may have some of the *head feature*, such as CASE for *noun*, ARG(UMENT)-ST(RUCTURE) for *verb*, and MOD(IFIER)

[3] To save space in matrices and to focus attention on the relevant features and types, the information in *synsem_struc* is abbreviated by omitting the features and type designations that are inferable.

for *verb* and *ptcl*. Some features, such as ARG-ST, have values, which are lists of objects represented as *list(synsem_struc)* here.[4] In the class of ARG-ST, MOD, SUBCAT(EGORIZATION), and ADJ(A)C(E)NT lists, the elements are *synsem_struc* object and the elements in RESTR(ICTION) list are *pred(icate)* object.

Lexical and Phrasal Signs

With some extensions, our type hierarchy follows the syntactic ontology developed in Sag and Wasow (1999). Templates in Figure 4.4 represent a verb 愛す *ais(u)* 'love'.

a.
```
@verb_ga_wo(愛す,(sit!Ind & reln!love
                        & lover!X
                        & loved!Y),Ind,X,Y).
```
b.
```
verb_ga_wo(Morph,Sem,Ind,X,Y) :=
hpsg_lexical_word(Morph,
 (<stv_lxm &
  morphon!morph!Morph &
  syn!(head!arg_st!@list2(@xp(<ga,_,X),@xp(<wo,_,Y)) &
       val!adjacent!<nil) &
  sem!(index!Ind & restr!@list1(Sem)))).
```
c.
```
hpsg_lexical_word(愛す,
 (<stv_lxm &
  morphon!morph!愛す &
  syn!(head!arg_st!@list2(@xp(<ga,_,X),@xp(<wo,_,Y)) &
       val!adjacent!<nil) &
       sem!(index!Ind &
            restr!@list1((sit!Ind & reln!love
                                  & lover!X
                                  & loved!Y))))).
```

Figure 4.4: *ais(u)* 'love': Some Templates

Templates are an abbreviatory device to encode frequently used structures. ProFIT templates are defined by expressions of the form shown in (5) and are called using the prefix @ (*@Name*).

(5) *Name* := *Definition*

[4] *list(α)* represents the list type whose elements are of type α. Templates are defined as follows:

(i)
```
list1(X)        := (first!X & rest!<nil).
list2(X,Y)      := (first!X & rest!(first!Y & rest!<nil)).
list3(X,Y,Z)    := (first!X & rest!(first!Y & rest!(first!Z
                      & rest!<nil))).
list4(W,X,Y,Z)  := (first!W & rest!(first!X & rest!(first!Y
                      & rest!(first!Z & rest!<nil)))).
```

In figures in the later sections, the elements of the lists are enclosed in angle brackets where the elements are listed from the left.

The *Name* may be a predicate whose arguments usually occur within the *Definition*. The *Definition* is a ProFIT term, consisting of a specification of a type (6a), a specification of a path using ! to list features and their values (6b) or a conjunction of terms using the sign & (6c):

(6) a. $<$*Type*

b. i. *Feature* ! *Value*

ii. *Feature* ! *Feature* ! *Value*

c. *Term* & *Term*

The *Definition* may also include variables and template calls.

The template for *ais(u)* in Figure 4.4 (a) is minimally specified for two kinds of information given by the features MORPHON and SEM. (b) states the general properties of a transitive verb which subcategorizes for *ga*-marked and *wo*-marked noun and particle phrases. Following the definition in (b), (a) expands into the feature (c) whose value is a complex object.

Figure 4.4 (c) further expands into the declaration in Figure 4.5, by replacing `@xp...` and `list*` by the template in Figure 4.6 and Fn.4, respectively.

```
hpsg_lexical_word(愛す,
 (<stv_lxm &
  morphon!morph!愛す &
  syn!(head!arg_st! & (first!(<phrase &
                               syn!(head!(case!<ga &
                                     mod!<nil &
                                     arg_st!_) &
                                     val!adjacent!<nil) &
                               sem!index!X)
                       & rest!(first!(<phrase &
                                       syn!(head!(case!<wo &
                                             mod!<nil &
                                             arg_st!_) &
                                             val!adjacent!<nil) &
                                       sem!index!Y)
                               & rest!<nil))
       val!adjacent!<nil) &
  sem!(index!Ind &
       restr!(first!(sit!Ind & reln!love
                             & lover!X
                             & loved!Y) & rest!<nil)))).
```

Figure 4.5: *ais(u)* ‘love’: Verb Lexeme

We will describe classes of linguistic objects using feature structures in which many of the features appropriate only for a subset of that class are omitted, and the sorts of some value may not be maximally specific.

Let us look at features of some *signs* that will also be referred to in the later discussion for phrasal *signs*. See Figure 4.7.

```
xp(Case,ArgList,Index) :=
   (<phrase &
     syn!(head!(case!Case &
                mod!<nil &
                arg_st!ArgList) &
                val!adjacent!<nil) &
     sem!index!Index).
```

Figure 4.6: Type Declaration

a.
$$\begin{bmatrix} \text{MORPHON} & \langle \textit{ais(u)} \rangle \\ \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{VFORM} & \textit{pres} \end{bmatrix} \\ \text{ARG-ST} & \langle \text{PP}[\textit{ga}]_i, \text{PP}[\textit{wo}]_j \rangle \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & l \\ \text{RESTR} & \left\langle \begin{bmatrix} \textit{love-rel} & \\ \text{SIT} & l \\ \text{LOVER} & i \\ \text{LOVED} & j \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

b.
$$\begin{bmatrix} \text{MORPHON} & \langle \textit{ken, ga} \rangle \\ \text{HEAD} & \begin{bmatrix} \textit{ptcl} & \\ \text{CASE} & \textit{ga} \end{bmatrix} \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & i \\ \text{RESTR} & \left\langle \begin{bmatrix} \textit{name-rel} & \\ \text{NAME} & \textit{Ken} \\ \text{NAMED} & i \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

Figure 4.7: Phrasal Signs for (a) *Ken ga* and (b) *aisu*

In 4.7a, we see that the SEM of *ais(u)* ‘loved’ is a semantic relation, *love-rel*, which will also be the SEM of entire sentence headed by *ais(u)*. However, the SEM in Figure 4.7a is (necessarily) incomplete, lacking the specification of the participants in the loving situation. This information is, of course supplied by the argument of *ais(u)* after unification.

The SEM of noun (particle phrase in precise), *Ken-ga* in Figure 4.7b contains the two attributes INDEX and RESTR(ICTION). The INDEX (a), for instance, provides a way to connect the use of the word *Ken-ga* to the person called *Ken* that the speaker is referring to.

4.2.3 Some Grammar Schemata

In the previous section, we have seen the feature structure of *signs*. We are ready to move on to their composition. NAIST JPSG is a constraint-based theory of Japanese grammatical competence. Not only its lexical entries but also phrasal representations, rules and even the universal principles assumed in HPSG are partial constraints on constructs used to model types of linguistic object.

Configurationality in HPSG

As illustrated in Section 2.3.2, HPSG does not postulate individual phrase structure rules for constructing well-formed sentences. In HPSG, the lexical information of subcategorization and a half dozen of universal schemata in the Immediate Dominance Principle replace the role played by such phrase structure rules posited in traditional syntactic theories. The following are two of the basic schemata which are used to form permissible local phrase structure trees for configurational languages including English.

(7) a. **Definition 26 (Head-Subject Schema (Schema 1))**
A phrase with DTRS *value of type head-subject-structure in which the* HEAD-DTR *value is a phrasal sign.*

b. **Definition 27 (Head-Complement Schema (Schema 2))**
A phrase with DTRS *value of type head-complement-structure in which the* HEAD-DTR *value is a lexical sign.*

Pollard and Sag (1994) suggest that free word order languages including Japanese and Korean might embody the following Schema 3.

(8) **Definition 28 (Head-Subject Schema (Schema 3))**
A saturated phrase with DTRS *value of sort head-complement-structure in which the* HEAD-DTR *value is a lexical sign.*

Let us take a Japanese example (8) and see how (8) function for constructing a well-formed sentence.

(9) Ken-ga Naomi-wo ai-su.
Ken-NOM Naomi-ACC love-do
'Ken loves Naomi.'

Figures 4.8 and 4.9 show the abbreviated AVM form and a conventional tree diagram for (8), respectively:

Given Schema 3 in (8), Japanese is analyzed as a non-configurational language which has the flat structure as shown in Figure 4.9.

Configurationality in NAIST JPSG

In the 1980s, several articles were devoted to the study of the configurationality of (Japanese) language. The motivation for the non-configurational analysis of Japanese mainly resolves itself into the following two points. One is a (relatively) free word order phenomena. The other is (apparent) lack of evidence for the constituency of VP.

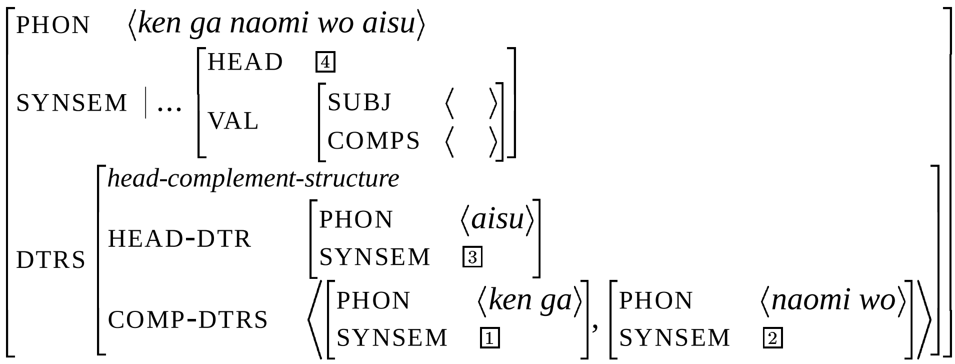


Figure 4.8: Feature Structure for Flat Structure

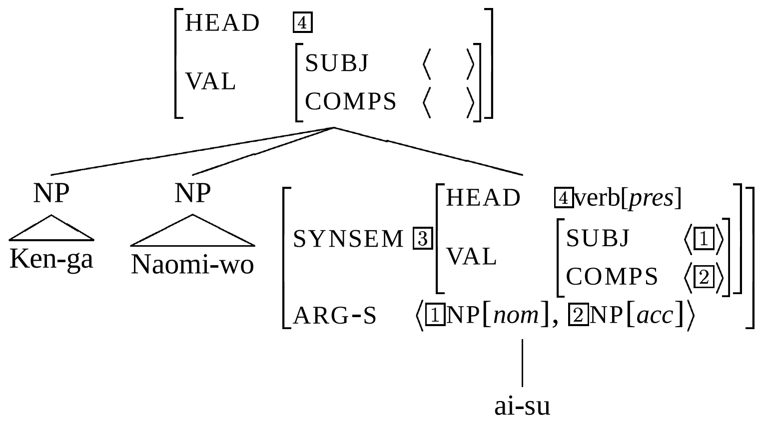


Figure 4.9: Non-configurational Tree

As for the word order, some of the recent HPSG approaches have adopted the so-called linearization model that assumes that natural language syntax can be characterized in terms of two interrelated, yet distinct, levels of representation: surface phrase structure and functor-argument structure (word order domain tree and syntax tree (Reape 1993, 1994, 1996), phenogrammar and tectogrammar (Curry 1963, Dowty 1996), order domain and composition structure (Pollard, Kasper, & Levine 1994, Kathol 1995, 2000).

While most current syntactic theories assume that word order variation arises from phrase structure, and that sentences are also characterized by their phrase structure,[5] NAIST JPSG adopts a SUBCAT approach (Gunji 1987) where any member of a SUBCAT can unify with a constituent if an appropriate one is supplied. We will see the mechanism in Section 4.3.1.

As for the constituency of VP, Hoji (1985), Saito (1985), Whitman (1986) and others, have made arguments for assuming such constituency in Japanese. Most of the evidence in the GB literature comes from subject/object asymmetries including binding, control, quantifier floating and so on. However, these phenomena are explained in HPSG by a non-configurational lexical account, and therefore the argument for a non-flat structure in GB theory seems not to support the structure when they are interpreted in HPSG terms.

In terms of wider research, Speas (1990) has carefully examined evidence for suggesting the lack of the VP node, and concluded, that none is compelling enough to abandon a non-flat structure. Moreover, it is not clear that the argument for a non-flat structure can really find a plausible account based on a flat structure. Thus there is no strong motivation for a flat structure.

NAIST JPSG assumes a non-flat, configurational structure for Japanese using its own schemata, discussed in the following section, instead of Schemata 1 and 2 of (7). It is not essential to assume a VP in Japanese for the present theoretical settings. The constituency information represented by the DTR feature in HPSG is also represented by the application of the schemata and the records of the applying the schemata and principles for parsing the sentences. The constituency information is contained within the GraDEUS's CKY table.

(0-)Complement-head-Schema

Let us now turn to some schemata and universal principles of HPSG, and see how they interact with the set of JPSG schemata shown in Table 4.1 where C, A, and H mean complement, adjunct, and head, respectively. X means any constituent.

Table 4.1: Schemata in NAIST JPSG

a.	complement-head schema:	[*phrase*]	→	C[*phrase*]	H
b.	adjunct-head schema:	[*phrase*]	→	A[*phrase*]	H[*phrase*]
c.	0-complement-head schema:	[*phrase*]	→	H[*word*]	
d.	pseudo-lexical-rule schema:	[*word*]	→	X[*word*]	H[*word*]

[5]As for the independent (level of) representation for surface strings, recent syntactic theories assume such a representation based on their own basic assumption.

Lexical-Functional Grammar (Kaplan & Bresnan 1982) posits three levels of representation for linguistic objects, and one of them, c(onstituent)-structure, defines the surface constituency.

Minimalist Program (Chomsky 1995) assumes the PF-representation, roughly defined as surface structure, which is the bundle of features relevant to the phonological (and morphological) information. At a certain point of derivation called Spell-Out, such information is extracted from core representation from the lexicon, and then goes into its independent derivation process.

In Table 4.1, we describe another set of schemata though HPSG (Pollard & Sag 1987, 1994) have assumed seven.

The Complement-head schema (a) includes Head-Subject, Head-Complement, and Head-Subject-Complement in HPSG. The Adjunct-head schema (b) corresponds to Head-Adjunct. 0-complement-head schema (c) and pseudo-lexical-rule schema (d) are newly introduced schemata necessary for explaining hierarchical clauses (Minami 1974), which has reflexes in Japanese syntax and semantics. We will discuss the constraints on the hierarchical clause in Chapter 6.

The Head-Filler in HPSG is not included since we have not decided to treat gaps in Japanese. The Head-Marker is abandoned since we treat both particles and complementizers as lexical heads.

Let us take a simple example to see how a sentence (9) is actually analyzed under the JPSG framework. (9) has a structure conventionally represented in a tree diagram as in Figure 4.10.

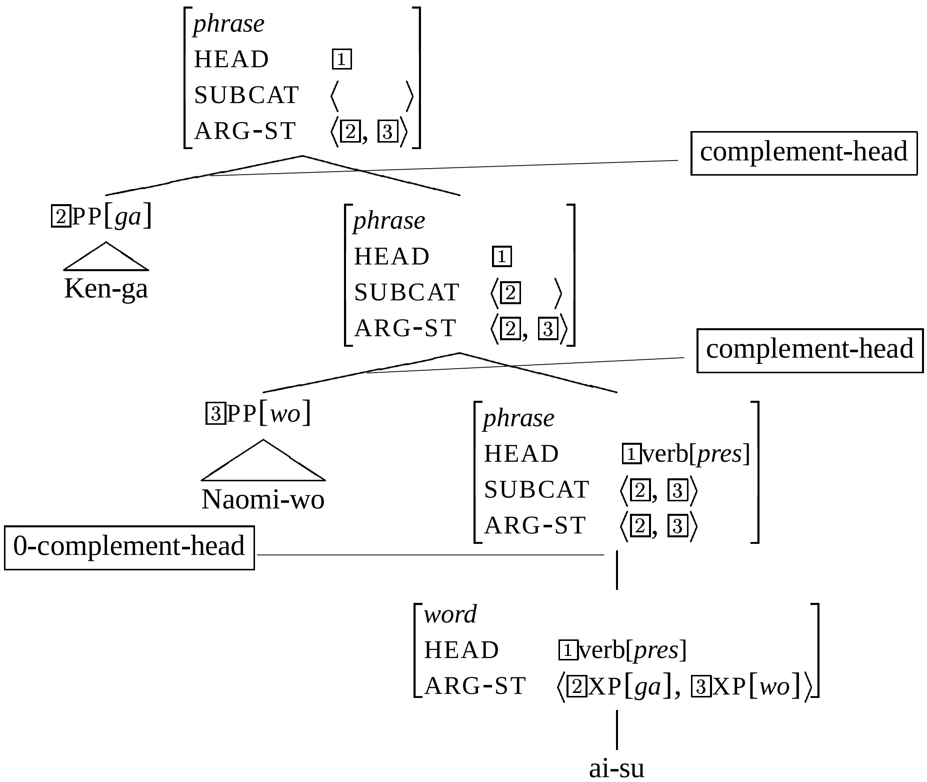


Figure 4.10: ‘*ken ga naomi wo aisu*’: Tree Diagram

JPSG grammar makes available a small set of a schemata which specify partial information about generally available types of phrase. As in GPSG, these schemata abstract from the order of daughter elements, leaving such matters to more general constituent ordering principles. In Figure 4.10, these two schemata are applied.

Phrases licensed by 0-complement-head schema consist of a lexical head daughter i.e., word (and no complement daughters). As in Categorial Grammar, phrase maximality is described via combinatoric saturation. That is, a lexical entry bears certain specifications that determine what elements it combines with syntactically. This schema also causes the elements of ARG-ST to be that SUBCAT feature in which such specifications are stated.

In Japanese nominals expressing major grammatical relations such as the subject and object of a sentence can simply be omitted, as shown in (10):

(10) a. ϕ ϕ ai-si-ta!
love-do-ASS
'(lit.) Someone loves someone!'

b. ϕ ϕ ai-s-e!
love-do-IMP
'(lit.) You love someone!'

(10) is also licensed by this schema. The complement-head schema licenses phrases consisting of a phrasal head daughter and both subject and object daughter.

Thus, we implement these schemata as a Prolog rule shown in Figure 4.11. [6]

```
a. sign(Mother) --> sign(HeadDtr),
   { structural_description(Mother,HeadDtr),
     word_constraint(HeadDtr),
     argument_realization_principle(HeadDtr),
     head_feature_principle(Mother,HeadDtr),
     vfp_for_complementation(Mother,HeadDtr),
     semantic_feature_principle_1(Mother,HeadDtr),
     semantic_feature_principle_3(Mother,HeadDtr) }.
b. sign(Mother) --> sign(CompDtr), sign(HeadDtr),
   { structural_description(Mother,CompDtr,HeadDtr),
     phrasal_constraint(CompDtr),
     head_feature_principle(Mother,HeadDtr),
     vfp_for_complementation(Mother,CompDtr,HeadDtr),
     semantic_feature_principle_1(Mother,CompDtr,HeadDtr),
     semantic_feature_principle_3(Mother,HeadDtr) }.
```

Figure 4.11: 0-Complement-head Schema (a) and Complement-head Schema (b)

The grammar comprises a set of Prolog grammar rules to be used with the GraDEUS's parser. These rules are essentially of the same form as DCG rules.

[6]Some templates which are not discussed in the later section are defined as follows:

(i)
```
structural_description(_,_).
structural_description(_,_,_).
word_constraint(<word).
word_constraint(<word,<word,<word).
phrasal_constraint(<phrase).
phrasal_constraint(<phrase,<phrase).
```

4.2.4 Subcategorization Principles

The Argument Realization Principle

At the heart of NAIST JPSG is the idea that grammars can be simplified quite radically if heads incorporate information about the categories with which they combine. 0-complement-head schema discussed in Section 4.2.3 includes the predicate `argument_realization_principle(HeadDtr)`. This is defined as in Figure 4.12.

```
a. argument_realization_principle(Sign) :-
     Sign=(syn!head!(<verb & arg_st!X) &
           syn!val!subcat!X), !.
b. argument_realization_principle(_).
```

Figure 4.12: The Argument Realization Principle

The principle declared in Figure 4.12 is theoretically defined in (11).[7]

(11) **Definition 29 (Argument Realization Principle)**

$$\begin{bmatrix} \text{VAL} & \begin{bmatrix} \text{SPR} & \boxed{A} \\ \text{SUBJ} & \boxed{B} \\ \text{COMPS} & \boxed{C} \end{bmatrix} \\ \text{ARG-ST} & \boxed{A} \oplus \boxed{B} \oplus \boxed{C} \end{bmatrix}$$

In Chapter 9 of Pollard and Sag (1994), a revised version of HPSG is proposed in which subjects and complements are distinguished by distinct corresponding features SUBJ and COMPS. They are in the VAL(ENCE) attribute which replaces SUBCAT.

Pollard and Sag (1994) also suggest that the VAL feature takes care of the syntactic realization, while the SUBCAT feature (renamed as ARG-ST) takes care of the binding. Recognizing the separate roles they play, Pollard and Sag (1994) assume that the SUBCAT (ARG-ST) feature is simply the list concatenation of the values for VAL features (SUBJ, COMPS and SP(ECIFIE)R) in due order.

However NAIST JPSG assumes a single attribute, SUBCAT (VALENCE) feature, since prominent (surface) subjectivity, as observed in English, does not exist in Japanese. The (logical) subject corresponds to the least oblique element in the SUBCAT list as has traditionally been assumed.

The Valence Feature Principle

In Figure 4.10, the SUBCAT list of the head *aisu* 'love' contains two elements which are to match the *synsem_struc* value of both *Ken-ga* and *Naomi-wo*. The Valence Feature Principle in Figure 4.13 tells us that the list must consist of the SUBCAT list of the whole phrase.

[7] $\oplus$ means concatenation of the two lists that does not preserve the order of each element.

a. vfp_for_complementation(M,H) :-
   M=(syn!val!(subcat!Subcat & adjacent!<nil)),
   H=(syn!val!(subcat!Subcat & adjacent!<nil)).

b. vfp_for_complementation(M,C,H) :-
   M=(syn!val!(subcat!Rest & adjacent!<nil)),
   C=(syn!val!adjacent!<nil),
   H=(syn!val!(subcat!Subcat & adjacent!<nil)),
   adjoin(C,Rest,Subcat).

c. vfp_for_complementation(M,C,H) :-
   adjacent_principle(M,C,H).

d. vfp_for_modification(M,Mod,H) :-
   M=(syn!val!(subcat!Subcat & adjacent!<nil)),
   Mod=(syn!head!mod!@list1(H)),
   H=(syn!val!(subcat!Subcat & adjacent!<nil)).

Figure 4.13: The Valence Feature Principle

The Adjacent Feature Principle

One development concerning subcategorization has been the distinction between verbal complements and nonverbal complements, which have been treated uniformly within the COMPS (or SUBCAT) list.

As shown in Figure 4.13, NAIST JPSG's Valence Feature Principle includes the Adjacent Feature Principle declared in Figure 4.14. [8]

```
adjacent_principle(M,A,H) :-
 M=(syn!val!(subcat!Subcat & adjacent!Rest)),
 A=(syn!val!adjacent!<nil),
 H=(syn!val!(subcat!Subcat & adjacent!Adjcnt)),
 adjoin(A,Rest,Adjcnt).
```

Figure 4.14: The Adjacent Feature Principle

Gunji (1999) proposes in his analysis of Japanese Causative that it is useful to make this distinction, introducing the feature ADJACENT to represent the verbal complements. He distinguishes between complex predicates with auxiliary verb *(s)ase* 'cause' and others, with his ADJACENT feature that reflects the morphological characteristics of the Japanese.[9]

[8]The predicate `adjoin` which are required for adjacent_principle are defined as follows:

(i)
```
adjoin(Elem,Rest,<nil) :- !, fail.
adjoin(Elem,Rest,(first!Elem & rest!Rest)).
adjoin(Elem,(first!Elem0 & rest!Rest),(first!Elem0 & rest!Rest0)) :-
    adjoin(Elem,Rest,Rest0).
```

[9]We will see the application of the adjacent feature to some complex predicate in the later chapter.

4.2.5 Other Universal Principles

The Semantic Feature Principle

HPSG's Semantic Feature Principle is roughly stated as follows:

(12) **Definition 30 (The Semantic Feature Principle)**
The SEM *value of the mother will be structure-shared with the* SEM *value of the semantic head, which is the* ADJUNCT-DTR *specification in any structure of type head-adjunct, and the* HEAD-DTR *specification otherwise.*

To satisfy the principle, along with the grammar schemata in Table 4.1, we show the implementation of the principle in Figure 4.15.[10]

a.
```
semantic_feature_principle_1(M,H) :-
  M=(sem!restr!Restr),
  H=(sem!restr!Restr).
```
b.
```
semantic_feature_principle_1(M,D,H) :-
  M=(sem!restr!Restr),
  D=(sem!restr!Restr1),
  H=(sem!restr!Restr2),
  fappend(Restr2,Restr1,Restr).
```
c.
```
semantic_feature_principle_2(M,D,H) :-
  M=(sem!restr!Restr),
  D=(sem!restr!Restr1),
  H=(sem!restr!(first!_ & rest!Restr2)),
  fappend(Restr1,Restr2,Restr).
```
d.
```
semantic_feature_principle_3(M,H) :-
  M=(sem!index!Index),
  H=(sem!index!Index).
```

Figure 4.15: The Semantic Feature Principle

```
sign(Mother) --> sign(ModDtr), sign(HeadDtr),
{ structural_description(Mother,ModDtr,HeadDtr),
  phrasal_constraint(ModDtr,HeadDtr),
  head_feature_principle(Mother,HeadDtr),
  vfp_for_modification(Mother,ModDtr,HeadDtr),
  semantic_feature_principle_2(Mother,ModDtr,HeadDtr),
  semantic_feature_principle_3(Mother,ModDtr) }.
```

Figure 4.16: Adjunct-head Schema

[10] `fappend` in Figure 4.15 is defined as follows:

(i)
```
fappend(<nil,List,List) :- !.
fappend((first!Elem & rest!Rest),List,(first!Elem & rest!Result)) :-
    fappend(Rest,List,Result).
```

When the headed structure is licensed by the Complement-head schema (or Pseudo-lexical-rule schema), the semantic head is identical to the syntactic head. On the other hand, the semantic head is the modifier when the headed structure is licensed by the Adjunct-head schema shown in Figure 4.16.

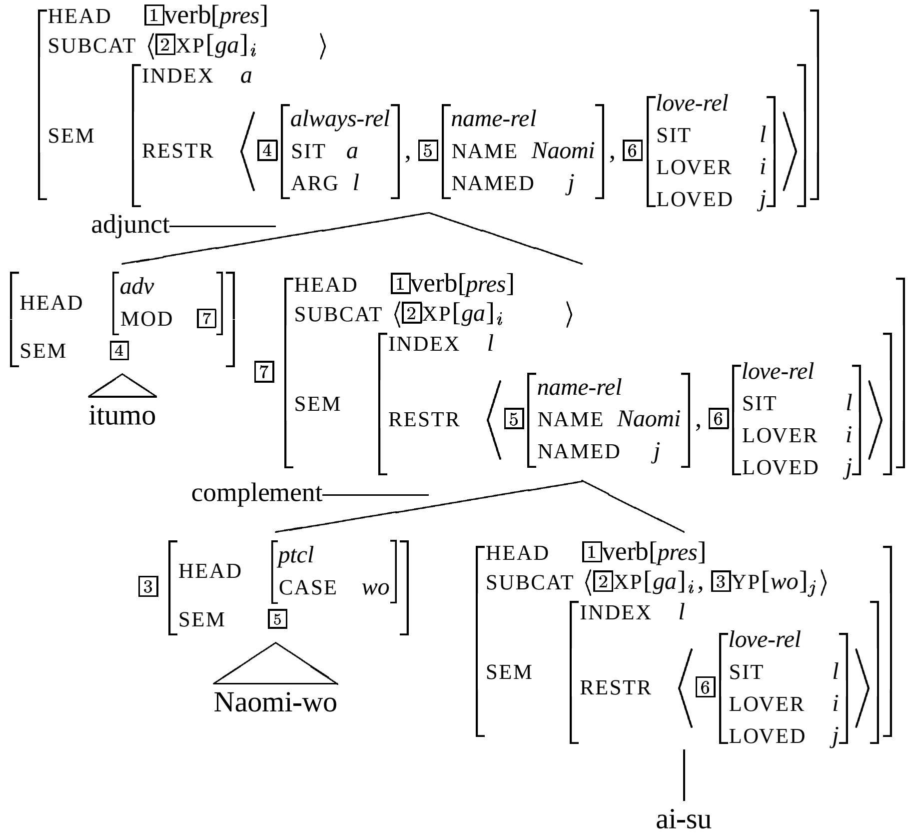


Figure 4.17: ‘*itumo naomi wo aisu*’: Tree Diagram

We introduce a HEAD feature MOD and the constraint that the MOD value of a word specifies the kind of thing the word modifies. Thus we can make it a lexical property of adverb *itumo* ‘always’ that it was [MOD VP].

The Head Feature Principle

The legitimate percolation of the HEAD feature between the head and its projection is simply implemented as in Figure 4.18

```
head_feature_principle(M,H) :-
 M=(syn!head!X),
 H=(syn!head!X).
```

Figure 4.18: The Head Feature Principle

4.3 A Fragment of Practical Japanese Grammar

4.3.1 A Note on the SUBCAT Feature

Scrambling

A few more remarks on the SUBCAT feature are necessary for the example in (9), repeated as in (13a), and the tree diagram in Figure 4.7.

(13) a. Ken-ga Naomi-wo ai-su.
Ken-NOM Naomi-ACC love-do
'Ken loves Naomi.'

b. Naomi-wo Ken-ga ai-su.
Naomi-ACC Ken-NOM love-do
'Ken loves Naomi.'

In addition to the canonical SOV word order, the word order of OSV is also possible in Japanese, as in (13b).[11] Figure 4.19 is the tree structure for (13b).

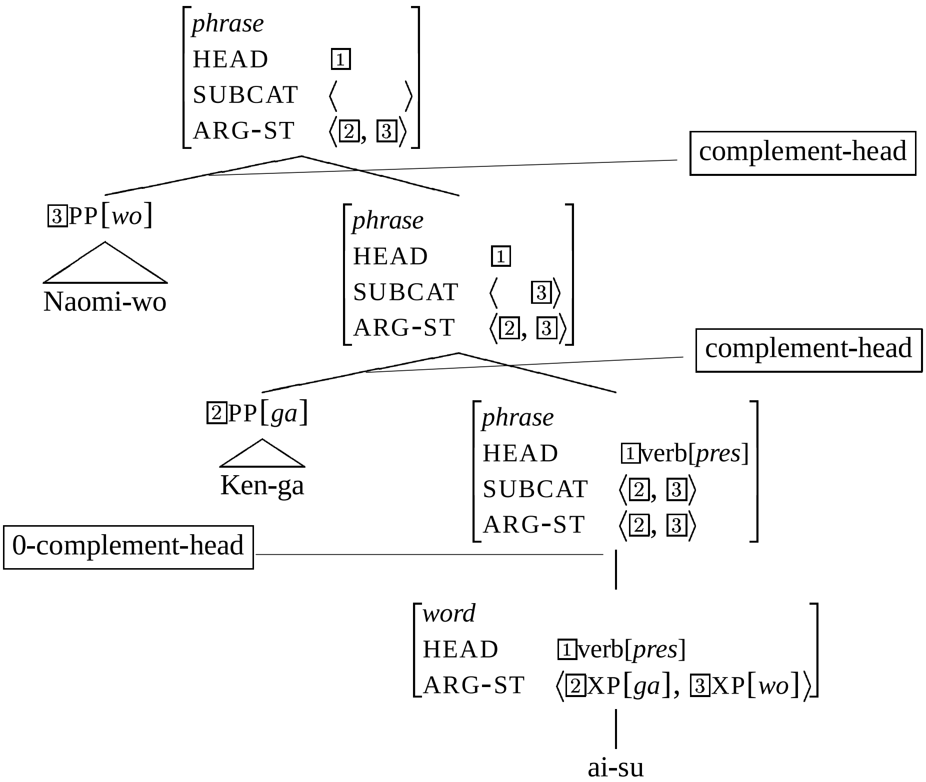


Figure 4.19: '*naomi wo ken ga aisu*': Tree Diagram

[11] The slight difference in meaning between (13a) and (13b) is the matter in discourse. See Section 10.5.2.

The SUBCAT feature and the associated complement-head schema and Valence Feature Principle are deliberately defined following Gunji's (1987) work so that we use it twice to get a phrase structure for (13b), which is shown in Figure 4.19.

Note that the structure is possible since we do not assume any predetermined order among PP. in the SUBCAT value. Thus, any member can unify with a constituent if an appropriate constituent is supplied. This is essentially how simple cases of scrambling are handled in NAIST JPSG.

Zero Pronoun

Once the lexical item unified with the `sign(HeadDtr)` in (0-)complement-head schemata in Figure 4.11 is determined, its SUBCAT is known, and hence not only the categories but also the number of the complements are determined.

If the `sign(HeadDtr)` is unified with *aisu* 'love' and complement-head schema is used once, we get the sentences in (14):

(14) a. Ken-ga ϕ ai-su.
Ken-NOM love-do
'Ken loves Someone.'

b. ϕ Naomi-wo ai-su.
Naomi-ACC love-do
'Someone loves Naomi.'

Note that not only the order but also the number of cancelling of the SUBCAT elements, against English-specific principles, may not correspond to the order and the number in which the corresponding complements are realized.

4.3.2 Some Remarks on the ADJACENT Feature

Case Marker Drop

NAIST JPSG proposes that in the analysis of the so called Case Marker Drop it is useful to formalize the phenomenon introducing the feature ADJ(A)C(E)NT to represent the common and different information about subcategorization. The crucial data are exemplified in (15) below.

(15) a. Ken-ga Naomi-ϕ ai-si-ta-no?
Ken-NOM Naomi love-do-PAST -Q

b. Ken-ϕ Naomi-wo ai-si-ta-no?
Ken Naomi-ACC love-do-PAST -Q

c. Ken-ϕ Naomi-ϕ ai-si-ta-no?
Ken Naomi love-do-PAST -Q
'Does Ken love Naomi?'

Our case system allows two ways of licensing a complement whose case information explicitly appears or implicitly included.

Compare the relevant part of the tree structures for PP object in Figure 4.20 and bare NP object in Figure 4.21, respectively.

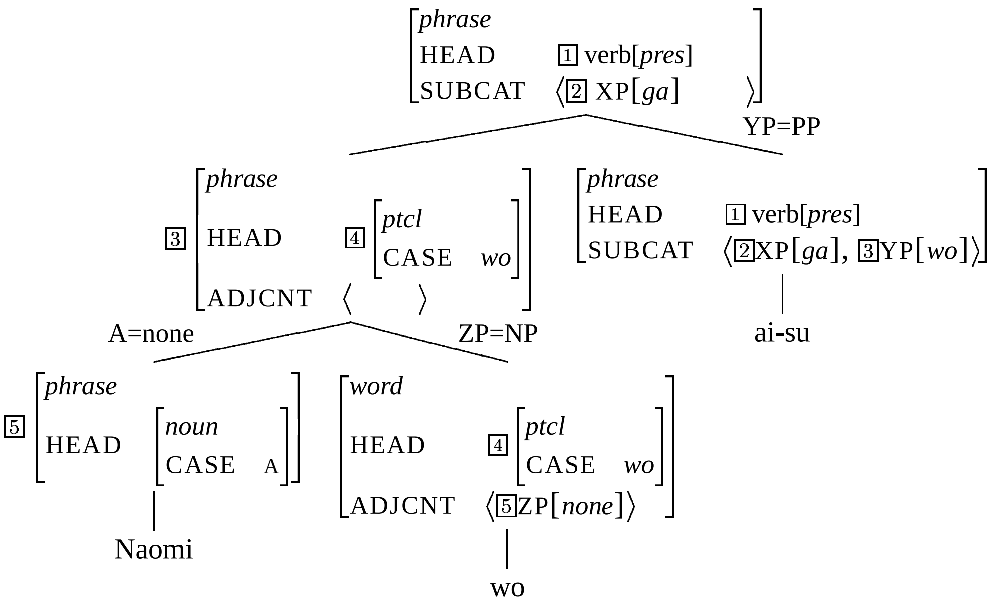


Figure 4.20: ‘*naomi wo aisu*’: Tree Diagram

In Figure 4.20, a case particle *wo* is a head of PP and subcategorizes for an NP *Naomi*. The CASE value of the NP is specified with *none* through cancellation of ADJCNT list of the particle, since the CASE feature value of a noun itself is assumed to be unspecified in our system. Moreover categorical information of YP is supplied by the object PP by unification. Particles *wo* has its own CASE value *wo* and YP[*wo*] is cancelled by PP[*wo*].

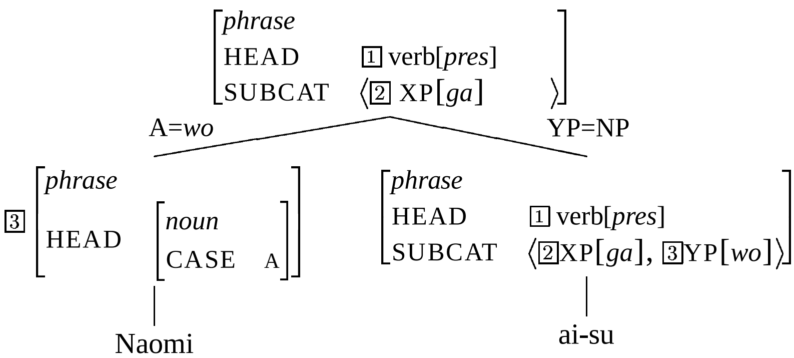


Figure 4.21: ‘*naomi aisu*’: Tree Diagram

In Figure 4.21, such unification and cancellation are applied between the head verb and its bare NP object.

Emphatic Particles

Our case system also treats some emphatic particles like *made, sae* ‘even’, *koso, nomi* ‘only’, *mo* ‘also’ and so on. Their meaning and distribution are too complicated that we cannot reduce all such properties to a lexical description of each particle. However NAIST JPSG assumes the lexical sign in Figure 4.22 for the present, and parse sentences like (16).

(16) Ken-made Naomi-wo ai-su.
Ken-even Naomi-ACC love-do-PRES
‘Even Ken loves Naomi.’

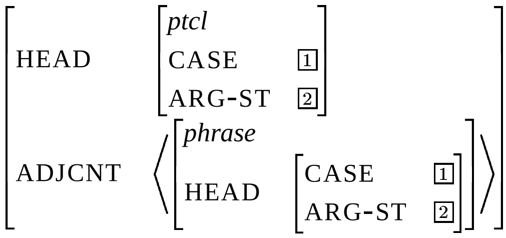


Figure 4.22: Sign for Emphatic Particle

The difference between emphatic particle in Figure 4.22 and case particle in 4.20 is their lexical specification of ADJCNT feature value.

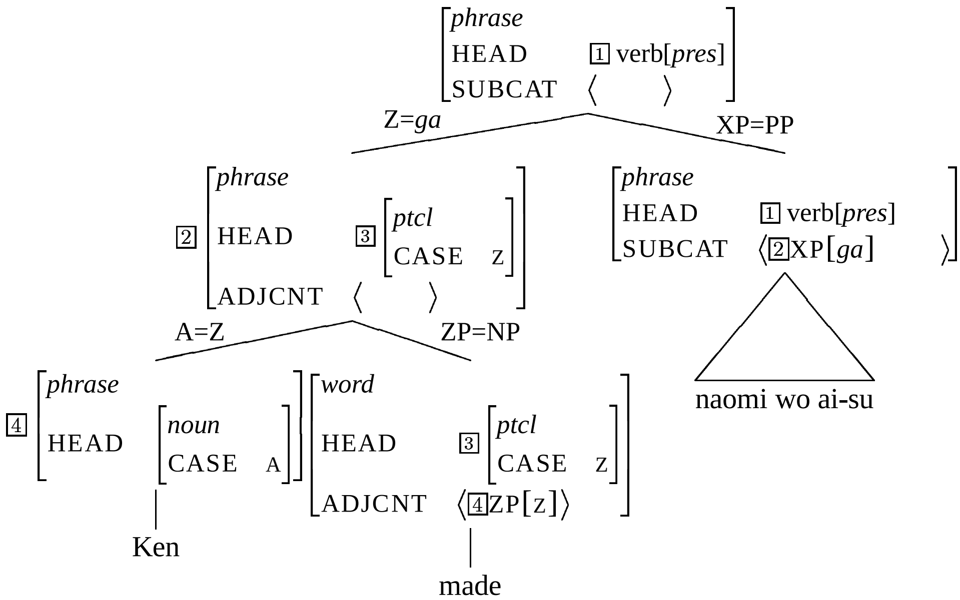


Figure 4.23: ‘*ken made naomi wo aisu*’: Tree Diagram

The emphatic particle given in 4.22 represents the structure-sharing of CASE (and ARG-ST) feature value between the particle head and its adjacent complement.

In Figure 4.23, through the cancellation of the complement, the feature is unified with the value *ga* lexically specified for XP complement in the SUBCAT feature of the verb head. As a result, the case value of the PP complement is determined.

Particle Juncture

Emphatic particles appear not only after NP but also after PP whose head is both case and emphatic particle. See (17) and (18) below:

(17) a. Ken-made-ga Naomi-wo ai-su.
Ken-even-NOM Naomi-ACC love-do-PRES
'Even Ken loves Naomi.'

b. *Ken-ga-made Naomi-wo ai-su.
Ken-NOM -even Naomi-ACC love-do-PRES

(18) a. *Ken-ga Naomi-mo-wo ai-su.
Ken-NOM Naomi-also-ACC love-do-PRES

b. Ken-ga Naomi-wo-mo ai-su.
Ken-NOM Naomi-ACC -also love-do-PRES
'Ken loves even Naomi.'

In general, the case particle *ga* is restricted to appearances at the end of PP but particle *wo* does not have such restriction.

The particle juncture is not restricted to the sequence of two particles. Three or more particles may appear if their compositional semantics get a valid interpretation.

(19) a. Ken-made-mo-ga Naomi-wo ai-su.
Ken-even-also-NOM Naomi-ACC love-do-PRES
'Even Ken loves even Naomi.'

b. *Ken-mo-made-ga Naomi-wo ai-su.

c. *Ken-made-ga-mo Naomi-wo ai-su.

d. *Ken-mo-ga-made Naomi-wo ai-su.

e. *Ken-ga-mo-made Naomi-wo ai-su.

f. *Ken-ga-made-mo Naomi-wo ai-su.

(20) a. ??Ken-ga Naomi-made-mo-wo ai-su.

b. *Ken-ga Naomi-mo-made-wo ai-su.

c. Ken-ga Naomi-made-wo-mo ai-su.
Ken-NOM Naomi-even-ACC -also love-do-PRES
'Ken loves even Naomi.'

d. *Ken-ga Naomi-mo-wo-made ai-su.

e. *Ken-ga Naomi-wo-made-mo ai-su.

f. *Ken-ga Naomi-wo-mo-made ai-su.

As for these data, we may have some constraints on the linearity like PTCL < GA, *made* < *mo* that are described as the constraint on ADJCNT feature. However, the origin of such linearity will be related not only to the syntactic adjacency but also to semantic interpretation, and therefore the constraint for each particle should strongly depend on its lexical nature and each specific description is very complex in the comprehensive case system.

The comprehensive description of the semantic nature of particles remains within our case system. However, the syntactic description in Figure 4.22 allow us to parse the sentence. Figure 4.24 is the relevant part of tree structure for (20c).

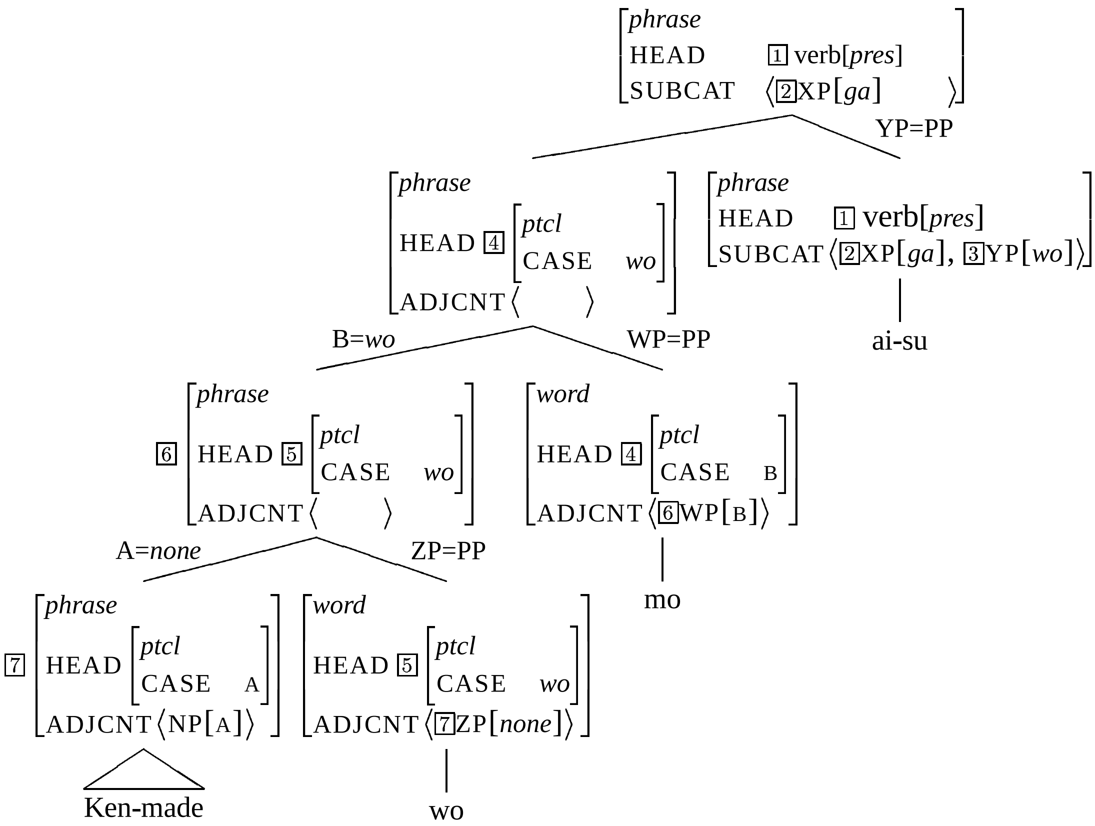


Figure 4.24: '*naomi made wo mo aisu*': Tree Diagram

The legitimate propagation of the HEAD feature specified with *none* or *wo* through cancellation of ADJCNT list of the particles is regulated by simple unification. This mechanism also prohibits particle juncture among case particles e.g., *ga-ga, ga-wo, wo-ga, wo-wo*.

With using the bracket parser discussed in Chapter 3, and applying the extended Subcategorization Principles introduced in Section 4.2.4, NAIST JPSG makes it possible to parse not only the long sentences included in newspapers but also colloquial style sentences which also appear in the text corpus.

4.4 Summary

This chapter sketched basic mechanisms for formalizing linguistic information within the framework of NAIST JPSG. We have not completely reviewed the essentials of the grammar, nor have we discussed the JPSG treatment of the fundamental constructions in Japanese.

In Parts II and III, we will use JPSG to demonstrate that some of the constructions which reflect the heart of Japanese grammar can be treated under the formal framework we propose in this chapter and its extensions.

Conclusion

The main purpose of Part I has been to demonstrate that typed feature structures formalisms enable us to develop an executable grammar system. The former half of this part briefly introduced the theoretical framework that our grammar and its development system are based on, The latter half then argued some grammatical phenomena that is crucial to clarify some properties involved in various constructions in Japanese.

To summarize, what we have discussed in this part, and especially in Chapter 4, is listed below:

1. The core of constraint-based Japanese grammar has been designed.
    (a) We introduce the idea that grammatical categories as well as the grammatical rules which make use of them should be thought of as linguistic objects that can have complex sets of properties associated with them. The information in these properties is represented by unification-based constraints.
    (b) In addition to introduce a background of feature structures of HPSG, language-specific feature, principles and schemata are tuned to Japanese language.
2. The efficient grammar has been developed.
    (a) GraDEUS enables us to edit constraint-based grammar easily.
    (b) The grammar itself has no bias for directionality in processing. Grammatical descriptions are ultimately achieved only by stating relationships in a local phrase structure.
3. An executable grammar-based parser for Japanese has been implemented.
    (a) The computational aspects of the linguistic analyses from the point of view of parsing efficiency were considered.
    (b) Some of the techniques of grammar engineering were illustrated by providing a detailed account of some grammatical constraints.

Part I has investigated how to develop the constraint-based for Japanese grammar. We have explored the theoretical significance and practical implementation of a Head-driven Phrase Structure Grammar approach to Japanese sentence processing.

However, we have not completely reviewed the essentials of the JPSG theory, nor have we discussed the JPSG treatment of various fundamental grammatical constructions in Japanese. Constraint-based formalisms also have other advantages that we have not covered in Part I, these include as the ability to model more complex phenomena than context-free grammars, and the ability to efficiently and conveniently compute semantics for syntactic representation. These topics will be discussed in Parts II and III.

Part I will serve as a background of discussions in the following part of this thesis.

Part II

Tuning a Grammar-based Parser
for
Fundamental Grammatical Constructions

Introduction

Part II explores fundamental grammatical constructions in Japanese. These posses various linguistic complexities which can cause the failure of Japanese sentence processing. To overcome this parsing problem, we will make some tuning adjustments to the grammar-based parser, JPSG, which was developed in Part I.

To examine how the syntactic structure of a sentence can be parsed, we have to consider both grammar and efficiency. The former is a formal specification of the sentence structure allowable in the language, and the latter is the method of analyzing a sentence to determine its structure according to the grammar. However, these cannot be clearly divided under the framework of constraint-based grammars.

HPSG and, of course, JPSG assume that various kinds of linguistic information are shared and cross-referenced by many components of the grammar, and moreover no directionality in processing needs to be assumed or stipulated. This is one of the advantages of constraint-based grammar approach, has over a derivation-based and process-based approach, which adopts simple context-free grammar.

For the purpose of efficient parsing with constraint-based formalisms, Part II considers methods of describing the structures of some of the fundamental grammatical constructions, and explores ways of characterizing the parsing of legitimate structures in Japanese.

This part is organized as follows:

Chapter 5 shows that the adjacent feature principle and the pseudo-lexical-rule schema treat a biclausal structure as a monoclausal structure. The former often causes the problem on long-sentence parsing failure but the latter can avoids such failure.

Chapter 6 shows that some subordinate clause modifications, which have been scarcely studied in the linguistic literature, can offer a consistent account by describing the lexical information of conjunctive particles in a local manner.

Chapter 7 deals with control and raising, with respect to the possibility of word order variation and the restriction of the complement predicate, which are not fully explained in the previous analyses.

Chapter 5

Causative Constructions and Pseudo Lexical Integrity

5.1 Introduction

The most perspicuous phenomenon that demonstrates the head-final property of Japanese is the particle and the sentence-final clusters of auxiliary verbs, i.e., complex predicates. In spite of its morphologically simple status, Japanese causatives headed by such auxiliary verbs exhibit complex characteristics syntactically and semantically.

Besides introducing a detailed background of the analysis of causatives, we propose a new head-driven account of Japanese causative, which introduces non-trivial extensions to ICOT JPSG and makes it possible to construct a practical parser. As an information-theoretic and constraint-based framework, the adjacent feature originally proposed by Gunji (1999) is well-suited for a formal treatment of complex predicate that simultaneously captures generalization in syntax and semantics as well as interactions between them.

5.2 Japanese Causatives

5.2.1 Adjacency of Complex Predicates

Lexical and Syntactic Analysis

The study of causatives such as (1), along with other complex predicates, has always revolved around the issue of the syntactic constituency of complex predicates.

(1) Ken-ga Naomi-ni utaw-ase-ta.
Ken-NOM Naomi-DAT sing-CAUSE-PAST
'Ken made Naomi sing a song.'

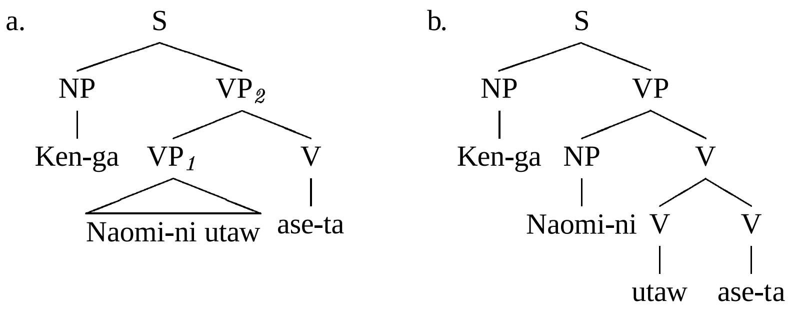


Figure 5.1: (a) Syntactic Analysis and (b) Lexical Analysis

Since the complex predicate is made up of more than one predicative element, it has been of great concern linguistically whether each of such elements functions independently as a predicate heading a clause in syntax or if they function as a single integrated one predicate.

The syntactic analysis, shown in Figure 5.1a, assumes that the complex predicate is indeed constructed by heading its own clause. The predicates do not form syntactic constituents and they are hierarchically organized.

The lexical analysis in Figure 5.1b, on the other hand, claims that the complex predicate is lexically integrated in the lexical component. It is mapped onto syntax as a single predicate and therefore the internal complexity of the complex predicate is inaccessible in syntax. The complex predicate as a whole heads one clause.

Ambiguity and Efficient Parsing

Recent development in the theory of syntax (Manning, Sag, & Iida 1999, Gunji 1999) no longer support the clear dichotomy discussed above. It has been known that some complex predicate constructions often show the properties of monoclausal structures and those of biclausal structures at the same time.

From the theoretical viewpoint, both analyses have the same explanatory power since they can construct the same argument and semantic structures. So from the implementation viewpoint the more efficient analysis should be adopted.

Figure 5.1a shows structural ambiguities and ‘inefficient’ parsing if there is an adverb between two NPs. In Figure 5.2, an adverb *nando-mo* ‘repeatedly’ between *Ken-ga* and *Mai-wo* can modify both VP$_1$ and VP$_2$ even though these interpretations have almost the same semantics.

Most of the ambiguities shown in Figure 5.2 are not only a matter of syntax and should be resolved by introducing not only syntactic regulation but also semantic and pragmatic restrictions which refer to the result of phase of the other processing. To structurally differentiate between the two cases results in increasing the total cost of parsing. The analysis shown in Figure 5.1b, on the other hand, can delay such disambiguation until ‘semantic’ or ‘pragmatic’ analyzing phase, though it requires some lexical rules that construct complex predicates.

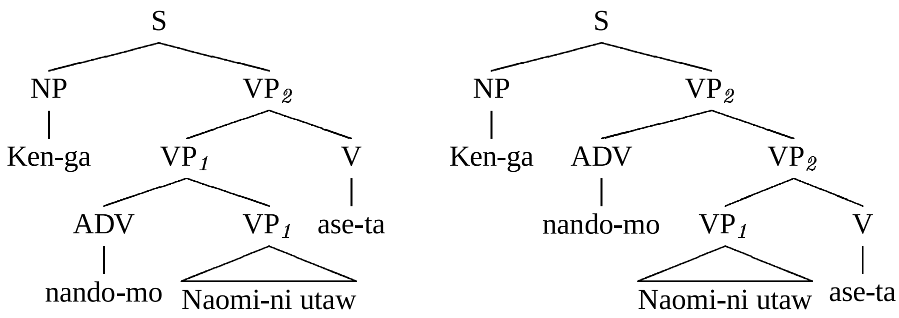


Figure 5.2: Structural Ambiguities of *nando-mo* ‘repeatedly’

NAIST JPSG adopts the latter solution and we will examine this in Section 5.5.1.

5.2.2 The So called Causative

Japanese causatives have provoked a great deal of controversy in studies not only of the characterization of causatives but also Japanese grammar. Japanese causatives are formed by a stem verb and a suffixal causative morpheme *(s)ase*.

When the original verb is transitive, the causativized verb has three arguments, marked with the nominative case *ga*, the dative case *ni*, and the accusative case *wo*:

(2) a. Naomi-ga keeki-wo tabe-ta.
Naomi-NOM cake-ACC eat-PAST
‘Naomi ate cakes.’

b. Ken-ga Naomi-ni keeki-wo tabe-sase-ta.
Ken-NOM Naomi-DAT cake-ACC eat-CAUSE-PAST
‘Ken made/let Naomi eat cakes.’

Since it is generally assumed that nominative, dative and accusative-marked arguments respectively correspond to subject, indirect object, and direct object, Japanese causatives seem to have properties of type 2 languages argued by Comrie (1976).[1]

5.2.3 Two Types of Causative

Ni- and *Wo*-causative

The Japanese causative is also well-known for having two types, so called *wo*-causatives and *ni*-causatives. The matrix subject is always marked with the nominative case *ga*. When the stem verb is intransitive as (3), the matrix object is marked with either the accusative case *wo* as (4a) or the dative case *ni* as (4b):

[1]See Section 5.3.1.

(3) Naomi-ga hatarai-ta.
Naomi-NOM work-PAST
'Naomi worked.'

(4) a. **o-causative**
Ken-ga Naomi-wo hatarak-ase-ta.
Ken-NOM Naomi-ACC work-CAUSE-PAST
'Ken made Naomi work.'

b. **ni-causative**
Ken-ga Naomi-ni hatarak-ase-ta.
Ken-NOM Naomi-DAT work-CAUSE-PAST
'Ken let Naomi work.'

The two types of causative in (4a) and (4b) are also captured in terms of a difference in meaning. (4a) has been characterized as coercive causative, and (4b) has been referred to as non-coercive causative. These two types are readily identifiable when the lower predicate is an intransitive verb.

However, this distinction is obscured when the original predicate is a transitive verb. These transitive-based causatives usually do not show evidence of two distinct types. They uniformly mark the matrix subject with nominative, the indirect object with dative, or the direct object with accusative. Since the indirect object is uniformly marked with dative, the transitive-based causatives are potentially ambiguous between the coercive and non-coercive interpretations.

(2) b. Ken-ga Naomi-ni keeki-wo tabe-sase-ta.
Ken-NOM Naomi-DAT cake-ACC eat-CAUSE-PAST
'Ken made/let Naomi to eat cakes.'

(5) *Ken-ga Naomi-wo keeki-wo tabe-sase-ta.
Ken-NOM Naomi-ACC cake-ACC eat-CAUSE-PAST

The unavailability of accusative-case marking on the indirect object in (5) has been ascribed to the double-*wo* constraint, which prohibits double-*wo* marking in a simple clause.[2]

[2] Shibatani (1973), Inoue (1976) and among others, argue that a simple clause cannot contain more than one accusative case in Japanese.

(i) a. Ken-ga eego-wo benkyoo-si-ta.
Ken-NOM English-ACC study-do-PAST
'Ken studied English.'

b. Ken-ga eego-no benkyoo-wo si-ta.
Ken-NOM English-GEN study-ACC do-PAST

c. *Ken-ga eego-wo benkyoo-wo si-ta.
Ken-NOM English-ACC study-ACC do-PAST

Two accusative cases can appear in separate finite clauses:

If the apparent lack of contrast between *wo*-causatives and *ni*-causatives based on transitive verbs is really due to the double-*wo* constraint, it is to be expected that a contrast appears when the constraint is not violated. This is indeed the case with transitive verbs like (6), which idiosyncratically mark the direct object with the dative:

(6) Ken-ga Naomi-ni sawat-ta.
Ken-NOM Naomi-DAT touch-PAST
'Ken touched Naomi.'

The causatives based on (6) allows the indirect object to be marked with either the accusative in (7a) or the dative in (7b) below:

(7) a. Anna-ga Ken-wo Naomi-ni sawar-ase-ta.
Anna-NOM Ken-ACC Naomi-DAT touch-CAUSE-PAST
'Anna made Ken touch Naomi.'

b. ?Anna-ga Ken-ni Naomi-ni sawar-ase-ta.
Anna-NOM Ken-DAT Naomi-DAT touch-CAUSE-PAST
'Anna let Ken touch Naomi.'

The data in (7) are taken as evidence for two syntactically distinct classes of causatives based on transitive verbs, even though the difference is not apparent on the surface.

Passivizability and Coercive Interpretation

It has been widely known since Kuno (1973) and Harada (1973) that direct passives of causatives only carry the coercive interpretation. The surface distinction between *wo*-causatives and *ni*-causatives of intransitives is obliterated under passivization, because the crucial argument is realized as the matrix subject, uniformly marked with the nominative case. See the following examples of direct passives based on intransitive-based causatives:

(8) a. Ken-ga Naomi-wo soko-e ik-ase-ta.
Ken-NOM Naomi-ACC there-to go-CAUSE-PAST
'Ken made/let Naomi go there."

b. Ken-ga Naomi-ni soko-e ik-ase-ta.
Ken-NOM Naomi-DAT there-to go-CAUSE-PAST
'Ken made/let Naomi go there."

(ii) Naomi-wa [Ken-ga eego-wo benkyoo-si-teiru to] iu uwasa-wo kii-ta.
Naomi-TOP Ken-NOM English-ACC study-do-PROG that said rumor-ACC hear-PAST
'Naomi heard the rumor that Ken studied English.'

(9) Naomi-ga Ken-ni soko-e ik-as(e)-(r)are-ta.
Naomi-NOM Ken-DAT there-to go-CAUSE-PASS-PAST
'Naomi was forced /*allowed by Ken to go there.'

The same holds true with transitive-based causatives. As mentioned above, transitive-based causatives have been noted as inherently ambiguous between coercive and non-coercive readings. However the ambiguity disappears when the causatives are passivized. They then uniformly bear the coercive interpretation:

(10) Naomi-ga Ken-ni keeki-wo tabe-sase-rare-ta.
Naomi-NOM Ken-DAT cake-ACC eat-CAUSE-PASS-PAST
'Naomi was forced /*allowed by Ken to eat cakes.'

The unavailability of the non-coercive interpretation and the obligatoriness of the coercive interpretation have provided motivation for some non-uniformists to propose two syntactic structures for transitive-based causatives, one which is passivizable, and the other which is not (Harada 1973, Kuno 1976, 1983, Rosen 1989, Terada 1990), though semantic solutions have also been suggested ((Inoue 1976, Marantz 1981).

5.2.4 Biclausality

Zibun-binding and Adverbial Scope

Besides case marking and passivizability, the syntactic difference between *wo*-causatives and *ni*-causatives is not as robust as the difference between direct passives and indirect passives.[3] Direct passives and indirect passives contrast in terms of *zibun* binding, the optionality of the Agent phrase and Subject Honorification. *wo*-causatives and *ni*-causatives, on the other hand, fail to display many of these distinctive properties. There are data that have motivated a biclausal structure for both types of causatives, *zibun* binding and adverbial scope.

Shibatani (1973) observes that the matrix object can bind a *zibun* phrase, whether it is marked with the accusative or with the dative:

(11) a. Ken$_i$-ga Naomi$_j$-wo zibun$_{i/j}$-no heya-ni hair-ase-ta.
Ken-NOM Naomi-ACC self-GEN room-to enter-CAUSE-PAST
'Ken made Naomi enter his/her own room.'

b. Ken$_i$-ga Naomi$_j$-ni zibun$_{i/j}$-no heya-ni hair-ase-ta.
Ken-NOM Naomi-DAT self-GEN room-to enter-CAUSE-PAST
'Ken let Naomi enter his/her own room.'

(12) a. Ken$_i$-ga Naomi$_j$-wo zibun$_{i/j}$-no kuruma-kara ori-sase-ta.
Ken-NOM Naomi-ACC self-GEN car-from get.out-CAUSE-PAST
'Ken made Naomi get out of his/her own car.'

[3] See Chapter 8.

b. Ken$_i$-ga Naomi$_j$-ni zibun$_{i/j}$-no kuruma-kara ori-sase-ta.
Ken-NOM Naomi-DAT self-GEN car-from get.out-CAUSE-PAST
'Ken let Naomi get out of his/her own car.'

As it has been traditionally assumed that the *zibun* phrase can only be bound by the subject, these data have provided strong evidence that causatives contain two (syntactic) subjects. Therefore they are biclausal.

Shibatani also provides data on adverbial scope to argue for the biclausality of the two types of causatives. He observes that subject-oriented adverbs can modify either the matrix subject or the matrix object in both the *wo*-causatives and *ni*-causatives:

(13) a. Ken-ga Naomi-wo damatte heya-ni hair-ase-ta.
Ken-NOM Naomi-ACC silently room-to enter-CAUSE-PAST
'Ken silently made Naomi enter his/her own room.'
'Ken made Naomi silently enter his/her own room.'

b. Ken-ga Naomi-ni damatte heya-ni hair-ase-ta.
Ken-NOM Naomi-DAT silently room-to enter-CAUSE-PAST
'Ken silently let Naomi enter his/her own room.'
'Ken made let silently enter his/her own room.'

On the assumption that these adverbial phrases are subject-oriented, Shibatani explains these data by appealing to the biclausality of the causatives of both types.

Passivizability

Another argument for biclausality comes from the passivizability of the lower object of causatives. In either the coercive or non-coercive interpretation, the lower object cannot be passivized (Farmer (1980), Marantz (1981)):

(2) b. Ken-ga Naomi-ni keeki-wo tabe-sase-ta.
Ken-NOM Naomi-DAT cake-ACC eat-CAUSE-PAST
'Ken made/let Naomi to eat cakes.'

(14) a. Naomi-ga Ken-ni(yotte) keeki-wo tabe-sase-rare-ta.
Naomi-NOM Ken-by cake-ACC eat-CAUSE-PASS-PAST
'Naomi was made by Ken to eat cakes.'

b. *Keeki-ga Ken-niyotte Naomi-ni tabe-sase-rare-ta.
cake-NOM Ken-by Naomi-DAT eat-CAUSE-PASS-PAST
'Cakes were made by Ken to be eat by Naomi.'

If causatives were indeed monoclausal, either the accusative-marked NP or the dative-marked NP should be able to undergo direct passivization.[4]

So this provides another strong piece of evidence for the biclausality of causatives.

[4] Japanese simple clauses allow both direct and indirect objects to be passivized.

Shibatani's (1973) argument for the biclausality of the causatives has been widely accepted in the literature except by the lexicalists. Even non-uniformists have assumed a biclausal structure for both *wo*-causatives and *ni*-causatives. Syntactic differences between them have been postulated in such a way as to explain the passivizability of *wo*-causatives, or the obligatory coercive interpretation of the passivized causatives. We will see in the next section how Japanese causatives have been analyzed in the literature.

5.3 Previous Analyses of Japanese Causatives

Causatives have been analyzed from a number of points of view. In this section, we will survey previous studies of Japanese causatives so as to outline how the problems concerning causatives need to be addressed.

5.3.1 Cross-linguistic Study of Causatives

Causative constructions are traditionally studied from various points of view. In a cross-linguistic survey of such a study, Comrie (1976) argues that morphological causativization increases the valency of an original verb. When the original verb is intransitive, the causativized verb has two arguments, a subject and a direct object. In the case of transitive, the causativized verb has three arguments, a subject, a direct object, and an indirect object. The direct object often corresponds to the direct object of the lower predicate, and the indirect object to the subject of the lower predicate.

This characterization of causatives remains a matter for debate. Since Marantz (1984), it has been recognized that there are at least two types of morphological causatives. The most obvious difference is observed when a transitive verb is embedded under a causative verb. Table 5.1 states this in terms of Grammatical Functions:[5]

[5]The languages that seems to have the type 1 causative are Turkish Aissen (1974), Malayalam (Mohanan 1983), Italian (Zubizarreta 1985, Burzio 1986), and dialect of Chichewa (Baker 1988).

According to Alsina and Joshi (1991), Malayalam shows a more complicated picture, and Alsina (1992) claims that Chichewa has two types of causative, type 1 here and type 3 like *faire par* constructions in Romance.

Type 2 languages display different patterns from type 1 languages. In addition to dialect of Chichewa Baker (1988), Chimwiini (Abasheikh 1979), Chamorro (Gibson 1980) and Sesotho (Machobane 1989) are also said to belong to this type.

Zubizarreta (1985), Rosen (1989), among others, report that the subject of the lower predicate in some Romance languages actually does not share many of the properties of ordinary direct or indirect object with the exception of case marking. In terms of their syntactic properties, such arguments are reported to behave similar to a subject.

Paul Kiparsky has also observed that in some languages honorification, binding and quantifier floating typically behave as they would if causatives were embedding construction; whereas case marking, agreement and word order phenomena all point to the analysis of causatives as single verb (Manning et al. 1999).

Table 5.1: Grammatical Function in Matrix Clause of Causatives

	type 1	type 2
external argument	oblique	object
internal argument	object	secondary object

Grammatical Function is a pre-theoretical cover term for certain properties and is rather imprecise. The diagnostics for the two types of causative that are used in the literature to identify the matrix object are passivization, case marking, and object agreement.

Japanese causatives have also provoked a great deal of controversy in studies of not only the characterization of causatives but also of Japanese grammar. The characterization argued by Comrie (1976) seems to apply to Japanese. The Japanese causative is formed by a stem verb and the suffixal causative morpheme *(s)ase*.

5.3.2 The Non-uniform Transformational Approach

In early transformational approaches, Japanese causatives are analyzed in a way similar to the periphrastic causatives of English where the causative morphemes are considered as independent verbs, and the causative is derived through a syntactic operation such as Equi-NP deletion. Most of the these approaches advocate a *non-uniform analysis*. Kuroda (1965a), Kuno (1973), Shibatani (1973), Inoue (1976) among others, argue that *wo*-causatives and *ni*-causatives are syntactically distinct.

Kuno (1973) argues that both *wo*-causatives and *ni*-causatives take a sentential complement. This accommodates Shibatani's (1973) observations on the biclausality of the causatives referring to *zibun*-binding and adverbial scope.[6]

Kuno claims that *wo*-causatives have a control structure in which the direct object of the matrix clause triggers Equi-NP Deletion of the subject of the embedded sentence:

(8) a. Ken-ga Naomi-wo (soko-e) ik-ase-ta.
Ken-NOM Naomi-ACC there-to go-CAUSE-PAST
'Ken made Naomi go there.'

In Figure 5.3, a direct object in S_0 corresponds to the lower subject in S_1. Being the direct object of the causative morpheme, it is likely to receive accusative case, and carry a Patient-like thematic role which induces coercive interpretation.[7]

Kuno (1976, 1983) argues that the direct object of *wo*-causatives can be raised to the subject position through passivization, because it is a direct object argument of the causative morpheme.

[6] See Section 5.2.4.

[7] As mentioned in Section 5.2.4, the direct object in S_0 (the matrix clause) is marked with dative due to the double-*wo* constraint, when the embedded verb is transitive and its object is marked with accusative. Harada (1973), Kuno (1976, 1983) account for the obligatory coercive interpretation of direct-passivized causatives in terms of the structure of *wo*-causatives.

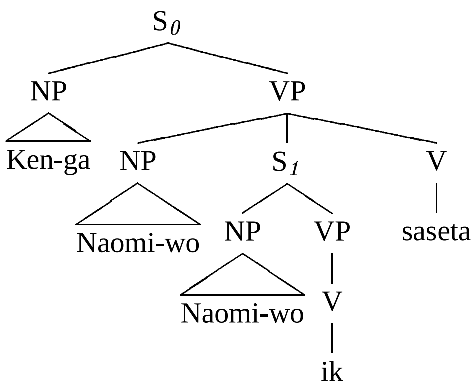


Figure 5.3: *Wo*-Causative: The Non-uniform Transformational Approach

In *ni*-causatives, on the other hand, the higher predicate is intransitive and the lower subject has no role in the matrix clause:

(8) b. Ken-ga Naomi-ni (soko-e) ik-ase-ta.
Ken-NOM Naomi-DAT there-to go-CAUSE-PAST
'Ken let Naomi go there.'

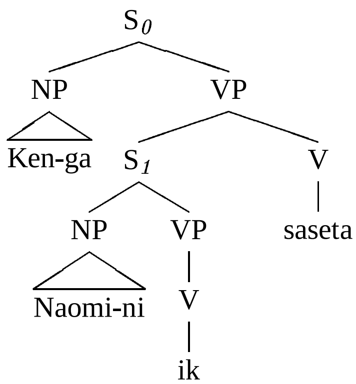


Figure 5.4: *Ni*-Causative: The Non-uniform Transformational Approach

Kuno (1976, 1983) also argues that direct objects carry a more Agent-like thematic role, more actively involved in bringing about the caused event, which induces non-coercive interpretation, since causee is not an argument of the causative morpheme. Furthermore, the direct object cannot be passivized because it is located inside S^1 and has no corresponding NP in S^0 at the underlying structure. Thus the distinct structures for the two types of causatives are motivated by the difference in both semantic interpretation and passivizability.

5.3.3 The Uniform Lexical Approach

In the early 1980, Miyagawa (1980a) and Farmer (1980, 1984) proposed lexical approaches. In contrast with transformational approaches, the lexical approach argues for a *uniform analysis* of causatives. They posit sentential complements for causatives and assume that causative predicates are derived in the lexicon by means of a morphological rule of affixation. The core operation of causativization increases the valency of the original verb, adding the matrix (causer) subject.

Miyagawa (1980a) argues that the unavailability of accusative case marking on the direct object implies that the causative sentence is monoclausal, so long as the double-*wo* constraint applies in a single clausal domain.[8]

Farmer (1984) argues that the causative morpheme has a predicate argument structure (PAS) of the form in Figure 5.5) below:

(____ (____) *(s)ase*)

Figure 5.5: '*(s)ase*': Predicate Argument Structure

The position indicated by the inner brackets is filled by the PAS of the stem verb. The composite PAS of the causative predicate is exemplified in Figure 5.6, where the stem verb is *tabe* 'eat':

(____ (____ ____ *tabe*) *sase*)

Figure 5.6: '*tabe sase*': Predicate Argument Structure

The leftmost slot in Figure 5.6 is for the matrix (causer) subject. Under Farmer's analysis, the case marking on each slot is carried out by a set of case-linking rules, which are summarized as follows:

(15) **Definition 31 (The Regular Case Linking Rules Link)**

a. Nominative case is linked to the lefimost argument slot.

b. Accusative case is linked to the rightmost argument slot.

c. Dative case is linked to all other slots.

Note that intransitive-based causatives always mark the the direct object with accusative according to (15b). To derive the *ni*-causatives, Farmer stipulates a special, semantic-based, dative case marking rule which precedes the regular case linking rules.

Thus, the differences between *wo*-causatives and *ni*-causatives, under the lexical approach, are solely semantic, and the difference in case marking does not point to any syntactic difference.

[8] See Fn. 2.

5.3.4 Movement Approaches

The Affix Raising Approach

Kitagawa (1986) proposes an affix raising approach which reconciles early transformational approaches and lexical approaches. Under Kitagawa's framework, biclausality of the former and monoclausality of the latter are attained at the different phrase structures of the different stages of derivation.

Let us illustrate Kitagawa's analysis through the derivation of (2b), schematically illustrated in Figure 5.7.

(2) b. Ken-ga Naomi-ni keeki-wo tabe-sase-ta.
Ken-NOM Naomi-DAT cake-ACC eat-CAUSE-PAST
'Ken made/let Naomi eat cakes.'

The stem verb and the causative morpheme (affix) are derived in the lexicon as a complex predicate. They start out as a constituent forming a V^{0}, and maintain their constituency until S-structure, shown in Figure 5.7a. By LF, however, the causative affix is raised out of the V^{0}.

The data arguing for biclausality assumed since Shibatani (1973) are explained on the basis of the LF structure shown in Figure 5.7c, which involves two maximal projections of both *tabe* 'eat' and *(s)ase* 'cause'. The data arguing for the monoclausality are readily accommodated as well, since the causative predicates are lexically derived as one predicate in his approach.

a. S-structure

b. Pre-LF

c. LF

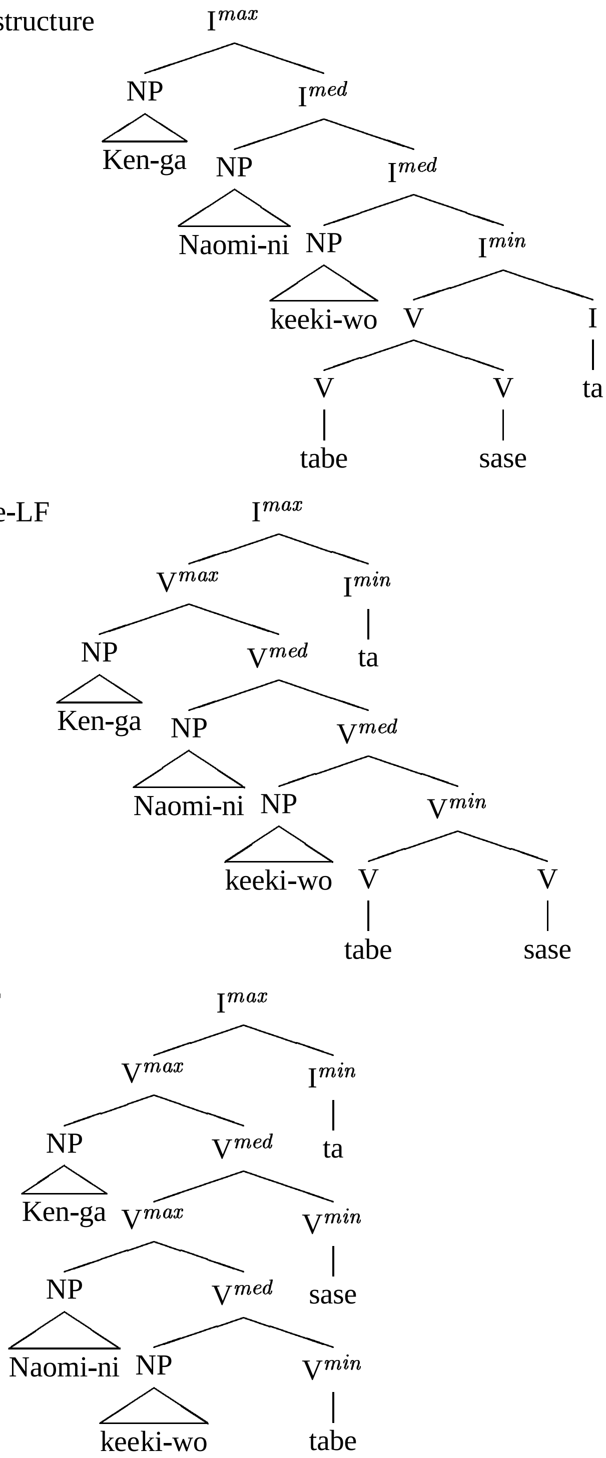


Figure 5.7: Derivation of the Affix Raising Approach

The Incorporation Approach

Terada (1990) proposes a verb incorporation analysis following the line of Baker (1988),[9] where the stem verb and the causative morpheme form a complex predicate through verb affixation, i.e., verb incorporation. Terada recognizes a syntactic difference between *wo*-causatives and *ni*-causatives. Let us first consider the S-structure of the *wo*-causative represented in Figure 5.8.

(2) b. Ken-ga Naomi-ni keeki-wo tabe-sase-ta.
Ken-NOM Naomi-DAT cake-ACC eat-CAUSE-PAST
'Ken made Naomi to eat cakes.'

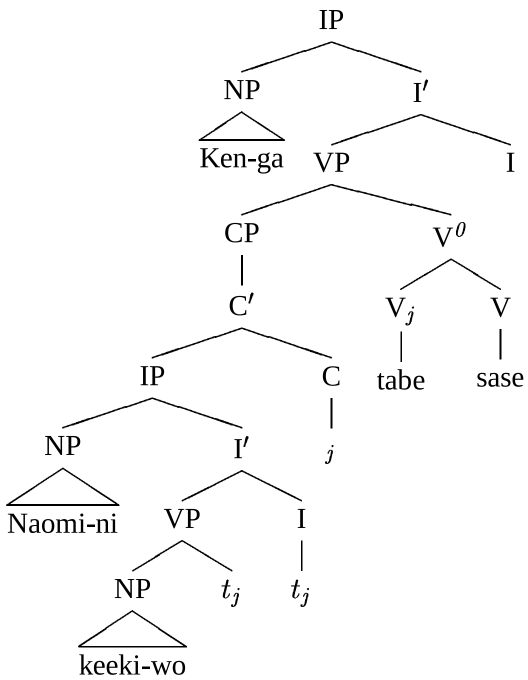


Figure 5.8: *Wo*-Causative: The Incorporation Approach

The causative morpheme and the stem verb form a V^0 after verb incorporation operating from D- to S-structure. Since *wo*-causative is a transitive under Terada's analysis and *ni*-causative is also a transitive as shown in Figure 5.9), V^0 eventually has two structural cases, which are assigned as accusative on the lower object *keeki-wo* and as dative on the higher object *Naomi-ni*.[10] Crucially, as this instance of the dative case is a structural case, it can be absorbed under direct passivization.

[9] Based on the research of Marantz (1984), Baker (1988) has explored the universality of underlying structures. In his system, morphological causatives are no different from periphrastic causatives at D-structure. The differences are derived by the incorporation of the stem verb into the causative morpheme, controlled by general principles of grammar, such as the ECP, Case Theory, and so on.

[10] The structure of the *wo*-causatives varies according to the transitivity of the stem verbs.

Ni-causatives, on the other hand, have a control structure:

(2) b. Ken-ga Naomi-ni keeki-wo tabe-sase-ta.
Ken-NOM Naomi-DAT cake-ACC eat-CAUSE-PAST
'Ken let Naomi to eat cakes.'

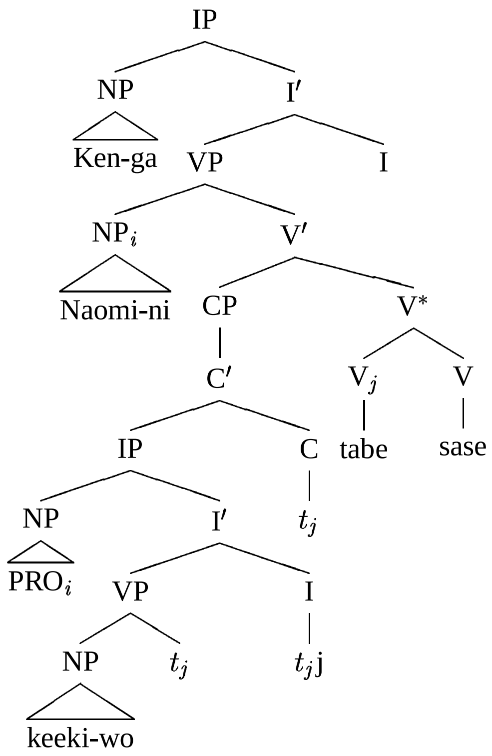


Figure 5.9: *Ni*-Causative: The Incorporation Approach

The embedded subject PRO is controlled by the direct object of the causative morpheme which carries the dative case.[11]. The embedded VP in Figure 5.9 can be either an intransitive verb phrase [$_{VP}$ V], or a transitive verb phrase [$_{VP}$ NP-wo V]. This accommodates the common observation that *ni*-causatives are formed based either on intransitive or on transitive verbs. The verb incorporation has to wait untill PF because, otherwise, the PRO would be governed by the causative morpheme due to the Government Transparency Corollary. The dative case on the

(i) a. intransitive-based
NP-ga [NP-wo V] sase
b. transitive-based
NP-ga [NP-ni NP-wo V] sase

The first NP inside the square brackets in (ib) is marked with dative case due to the double-*wo* constraint.

[11]Terada proposed indirect passives also have a control structure. See Section 8.3.4

argument controlling the PRO is claimed to be an inherent case, and hence cannot be absorbed. This explains why *ni*-causatives cannot be passivized.

Baker (1988) and [12] Terada (1990) argue that the V affixation of a higher clause cannot precede that of a lower clause. The operation at PF cannot precede the operation at D- to S-structure. Thus Terada's (1990) system predicts that *ni*-causatives cannot be direct passivized, while *wo*-causatives can be direct passivized because both of the incorporation operations take place at D-S structures.[13]

5.3.5 The Argument Structure Merger Approach

Since Marantz (1984) argued the analysis of morphological causatives assuming that the causative morpheme (verb) and the stem verb can merge at different levels of derivation,[14] this idea has been explored in Baker's (1988) incorporation approach[15] and the following Approach of Rosen's (1989).

Rosen (1989) develops the idea of Marantz's (1984) argument merger with Romance and Japanese causatives. Rosen claims that the causative morpheme (verb) and the stem verb are merged at the level of a(rgument)-structure preceding D-structure. The following is the characteristics of Rosen's (1989) merger:

(16) **Definition 32 (Merger)**

a. is a process of merge whereby an a-structure of a stem verb replaces the event argument of the stem verb.

b. is optional.

c. is either partial or total.

When the merger does not apply, periphrastic causatives result. In the case of total merger, the argument structures of the two predicates are completely merged together, and a two or three-place predicate is newly created. In the case of partial merger, on the other hand, although the a-structure collapses and the a-structure of the stem verb becomes part of that of the causative morpheme, the stem verb still retains its own internal structure.

Rosen (1989) proposes that Japanese causative is an instance of partial merger, just like Spanish and French causatives. It has a VP-complement structure. The following represents the process of Japanese causativization:

The causative morpheme *(s)ase* 'make' takes two arguments, *w* standing for the (causer) external argument and *x* for a (caused) event. The stem verb *tabe* 'eat'

[12] Baker (1988) claims the restriction on incorporation that verb incorporation proceeds in a bottom-up fashion.

[13] The specification of the levels of verb incorporation makes an interesting prediction on the interaction of different complex predicates discussed in the previous chapters. However, level ordering of verb incorporation makes wrong predictions in some cases. See Uda (1992) for the detailed discussion.

[14] He argues that at the l(ogico)-s(emantic) level, and all types of causatives have exactly the same universal structure.

[15] See Fn. 9.

$$\left.\begin{array}{lll} \textit{-sase} & \text{'make'} & [w\ (x)]<e> \\ \textit{tabe} & \text{'eat'} & [y\ (z)]<e> \end{array}\right\} \rightarrow \textit{-sase tabe}\ [w\ [y\ (z)]]<e><e>$$

Figure 5.10: '*tabe sase*': Partial Merger

is also a two-place predicate, *y* standing for the external argument, and *z* for the internal argument. When the causativization occurs, the argument *x* is replaced by the a-structure of the stem verb, [*y* (*z*)]. Being an instance of partial merger, the argument structure of the embedded predicate is retained, which is indicated by the presence of the inner square brackets.[16] The two merged $<e>$ means that the (complex) causative predicate has only one event, in the sense of Higginbotham (1985) entailing that the whole structure needs only one I^{0}.

Under Rosen's (1989) system, the passivization of the partial merger construction is explained as the passivization of the causative predicate before the merger process with the stem verb.[17] (10) shows the passivizability of the direct object in *wo*-causatives, which carry a coercive interpretation:

(10)	Naomi-ga	Ken-ni	keeki-wo	tabe-sase-rare-ta.
	Naomi-NOM	Ken-DAT	cake-ACC	eat-CAUSE-PASS-PAST
	'Naomi was made/*let by Ken to eat cakes.'			

The a-structure of the causative morpheme *(s)ase* is passivized, before it merges with the a-structure of verb stem *tabe* 'eat.' See Figure 5.11.

Partial Merger for passivized causative predicate *tabe-sase-rare*

$$\left.\begin{array}{lll} \textit{-sase-rare} & \text{'be make'} & [w\text{-}\phi\ (x)]<e> \\ \textit{tabe} & \text{'eat'} & [y\ (z)]<e> \end{array}\right\} \rightarrow$$

$$\textit{-sase-rare tabe}\ [w\text{-}\phi\ [y\ (z)]]<e><e>$$

Figure 5.11: '*tabe sase rare*': Partial Merger

The causative morpheme in (10) undergoes both the affixation of *rare* and the suppression (ϕ) of external argument.

According to Rosen (1989), unpassivizability of *ni*-causatives is accounted for in terms of a case assigning ability. Rosen proposes that the causative morpheme of *wo*-causatives can assign (accusative) case but that of *ni*-causatives lack the ability. Under her framework, they cannot undergo passivization since they have no case to assign before merger.[18]

[16]Following Grimshaw and Mester (1988), and Grimshaw (1990), Rosen (1989) assumes a hierarchical argument structure. An external argument is defi ned as the most prominent argument which is represented as the outermost argument in the structure.

[17]Rosen (1989) shows this is indeed the case in Japanese as well as in Spanish/French.

[18]Rosen (1989) assumes that dative case is assigned by default. So the object which has failed to receive any case from the causative morpheme eventually get dative. She also suggests that there is some connection between the case-assigning ability of the verb, its transitivity, and its ability to passivize. However, She does not work out the details.

5.3.6 The Phrase Structure Approach

Gunji (1987) proposes a phrase structure analysis of causatives whereby the causatives are analyzed, essentially, as control structures. The causative morpheme is just another kind of control verb except that it is a bound morpheme; it subcategorizes for a subject, an object and a complement VP.

The distinction between *wo*-causatives and *ni*-causatives is not made in terms of phrase structure. The different case marking on the controller, which corresponds to the causee, is accommodated by adding the relevant information to the lexical structure of the causative morphemes.

(s)ase: {POS V; SUBCAT {PP[SUBJ], PP[OBJ; wo], VP[−AO]}; SEM CAUS'}

Figure 5.12: *Wo*-Causative Verb '*(s)ase*': The Phrase Structure Approach

The feature AO (for accusative object) in Figure 5.12 is assumed to be a HEAD feature. The specification [-AO], therefore, means that the embedded VP cannot have an object marked with the accusative case. The effect of this feature is the same as the double-*wo* constraint; when the lower object is marked with accusative case, the controller (causee) cannot be marked with the accusative.

(s)ase: {POS V; SUBCAT {PP[SUBJ], PP[OBJ; ni], VP[+SC]}; SEM CAUS'}

Figure 5.13: *Ni*-Causative Verb '*(s)ase*': The Phrase Structure Approach

The feature SC (for self-control) in Figure 5.13 specifies that the embedded predicate in *ni*-causatives has to be a self-controllable action. Except for these features on the embedded VP, the causative structure in Gunji's (1987) system is essentially the same as the structures of the indirect passive and benefactive.

For Gunji (1987), *wo*-causatives and *ni*-causatives are distinguished, not on passivizability and the semantic property of coerciveness but on case marking and the semantic property of self-controllability. We essentially agree with Gunji's analysis on this point, and we will further discuss this matter and argue against other approaches in the later sections.

5.4 Coerciveness and Self-controllability

In the previous section, we have surveyed some of the studies of Japanese causatives presented in the literature. In this section, we will argue that coerciveness is not the correct concept for distinguishing the two types of causative, and claim that the real difference between the *wo*-causatives and *ni*-causatives can be derived from their structural difference, relating SEM feature.

5.4.1 Coerciveness

Obligatory Coercive Interpretation

It has been widely known since Kuno (1973) and Harada (1973) that direct passives of causatives only carry the coercive interpretation:

(4)	a.	Ken-ga	Naomi-wo	hatarak-ase-ta.
		Ken-NOM	Naomi-ACC	work-CAUSE-PAST
		'Ken made Naomi work.'		
	b.	Ken-ga	Naomi-ni	hatarak-ase-ta.
		Ken-NOM	Naomi-DAT	work-CAUSE-PAST
		'Ken let Naomi work.'		

(17)	Naomi-ga	Ken-ni	hatarak-as(e)-(r)are-ta.
	Naomi-NOM	Ken-DAT	work-CAUSE-PASS-PAST
	'Naomi was forced /*allowed by Ken to work.'		

The surface distinction between *wo*-causatives and *ni*-causatives of intransitives is obliterated under passivization, because the crucial argument is realized as the matrix subject, uniformly marked with the nominative case. However, coercive interpretation is not a cancellable preference. The obligatoriness has found a syntactic explanation, whereby only *wo*-causatives have a passivizable structure (Kuno 1973).

The direct passives of the transitive-based causative sentence also only carry the coercive interpretation:

(2)	b.	Ken-ga	Naomi-ni	keeki-wo	tabe-sase-ta.
		Ken-NOM	Naomi-DAT	cake-ACC	eat-CAUSE-PAST
		'Ken made/let Naomi eat cakes.'			

(10)	Naomi-ga	Ken-ni	keeki-wo	tabe-sase-rare-ta.
	Naomi-NOM	Ken-DAT	cake-ACC	eat-CAUSE-PASS-PAST
	'Naomi was forced /*allowed by Ken to eat cakes.'			

(2b) has been associated with two distinct structures; one for coercive interpretation, which is passivizable, and the other for non-coercive interpretation, which is not passivizable. Though semantic accounts have also been offered to the obligatory coercive interpretation (Inoue 1976), followed particularly by uniformists (Marantz 1981, Kitagawa 1986), syntactic explanations have been attempted in recent works (Rosen 1989, Terada 1990).

Self-controllability

Most of the approaches in the literature assume that accusative case marking on the causee is associated with a coercive interpretation, and dative case marking with a non-coercive interpretation. However, the coerciveness is not really adequate to distinguish between *wo*-causatives and *ni*-causatives.

Tonoike (1978) discusses that the semantic contrast between coercion and non-coercion does not adequately characterize the distinction between *wo*-causatives and *ni*-causatives. He points out that *wo*-causatives can have a non-coercive interpretation, and *ni*-causatives are compatible with a coercive interpretation:

(18) a. Ken-ga Naomi-wo hutyuuide kegas-ase-ta.
Ken-nom Naomi-ACC carelessly be injured-CAUSE-PAST
'Ken carelessly cased Naomi to be injured.'

b. Ken-ga Naomi-ni muriyari soko-e ik-ase-ta.
Ken-nom Naomi-DAT forcefully there-to go-CAUSE-PAST
'Ken forced Naomi to go there.'

c. Keesatu-ga Naomi-ni saibansyo-ni syutoos-ase-ta.
police-nom Naomi-DAT court-LOC appear-CAUSE-PAST
'The police made Naomi make an appearance at the court.'

(18a) is a *wo*-causative sentence, but it does not involve a coercive causation. That is, the referent of the matrix subject *Ken* did not force the causee *Naomi* to get injured. In (18b) and (18c), on the other hand, the causation is coercive, though the sentences are *ni*-causatives.

Tonoike (1978) and his followers (Gunji 1987, Terada 1990) claim that the difference between *wo*-causatives and *ni*-causatives is more appropriately captured by the concept of self-controllability or protagonist control.

As Harada (1973) first notes, *ni*-causatives are possible only when the causee holds control over the action he/she performs. Consider below:

(19) a. Hana-ga sai-ta.
flower-NOM bloom-PAST
'The flower has bloomed.'

b. Ken-ga Hana-wo sak-ase-ta.
Ken-NOM flower-ACC bloom-CAUSE-PAST
'Ken made the flower bloom.'

c. *Ken-ga Hana-ni sak-ase-ta.
Ken-NOM flower-DAT bloom-CAUSE-PAST

(20) a. Naomi-ga kizetusi-ta.
Naomi-NOM faint-PAST
'Naomi fainted.'

b. Ken-ga Naomi-wo kizetus-ase-ta.
Ken-NOM Naomi-ACC faint-CAUSE-PAST
'Ken made Naomi faint.'

c. *Ken-ga Naomi-ni kizetus-ase-ta.
Ken-NOM Naomi-DAT faint-CAUSE-PAST

In the above examples, ‘to bloom’ and ‘to faint’ are usually not considered as self-controllable actions. (19) and (20) clearly demonstrate that only self-controllable actions can form *ni*-causatives. In particular, *ni*-causatives of (20) are possible only in such a context that *Ken* is, for example, a movie director and he makes the actress *Naomi* act as he directs. In other words, *ni*-causatives require a context where the action ‘faint’ can felicitously be construed as self-controllable.

Like Tonoike (1978), we assume that both the *ni*-causatives and *wo*-causatives are ambiguous in terms of coerciveness. The actual condition for distinguishing the two types of causatives should be self-controllability. we claim that semantic ambiguity between the coercive and the non-coercive reading provides no good evidence for positing two distinct structures for causatives.

5.4.2 Self-controllability and Control in Syntax

The question is whether the difference in self-controllability between *wo*-causatives and *ni*-causatives has any syntactic, structural basis. We suggest that the requirement of self-controllability derives from syntactic control structure: predicates which denote non-self-controllable action, *sak* ‘bloom’ and *kizetus* ‘faint’, etc., cannot have a *ni*-causative sentence because they cannot enter into a syntactic control structure.

The controller must have control over the action denoted by the controlled VP. This constraint seems to be valid in Japanese as the following sentences with *meizi(ru)* ‘order’, and *yakusokusu(ru)* ‘promise’ show:

(21) a. ??Ken-ga Hana-ni saku yoo meizi-ta.
Ken-NOM flower-DAT bloom -MOD order-PAST
‘Ken ordered the flower to bloom.’

b. ??Ken-ga Naomi-ni kizetusu-ru yoo meizi-ta.
Ken-NOM Naomi-DAT faint-PRES -MOD order-PAST
‘Ken ordered Naomi to faint.’

(22) a. ??Ken-ga Hana-ni saku yoo yakusokusi-ta.
Ken-NOM flower-DAT bloom -MOD promise-PAST
‘Ken promised the flower to bloom.’

b. ??Ken-ga Naomi-ni kizetusu-ru yoo yakusokusi-ta.
Ken-NOM Naomi-DAT faint-PRES -MOD promise-PAST
‘Ken promised Naomi to faint.’

All the sentences in (21) and (22) are anomalous. In (21b) and (22b), they are judged grammatical only when Ken can intentionally faint, i.e., pretending or acting in a play.

Note that this is exactly the same semantic restriction for *ni*-causatives. Therefore, we assume that the semantic difference between *wo*-causatives and *ni*-causatives derives from the structural differences between them. The restriction on the latter that the caused event must be controllable by the causee is inherent in the syntactic control structure.

5.5 Controllability and Pseudo Lexical Integrity

This section proposes an HPSG approach to Japanese causatives. We claim that Japanese causatives are divided into two types, control causatives and adversity causatives, and relate them to the semantic distinction between coercion vs. non-coercion. In this point, we depart from the traditional view where *wo*-causative and *ni*-causatives relate to coercion and non-coercion interpretation, respectively. We also propose that both control causatives and adversity causatives have a syntactic embedding structure but only the former involves syntactic control structure.

5.5.1 Control Causatives

Obligatory Object Control

We propose that *ni*-causatives have a syntactic control structure. The causative morpheme *(s)ase* is a bound form, but it syntactically functions as a verb. See the feature structure in Figure 5.14.

$$\begin{bmatrix}
\text{MORPHON} & \langle \textit{(s)ase} \rangle \\
\text{SUBCAT} & \langle \boxed{1}\ \text{PP}[\textit{nom}]_i \oplus \boxed{2}\ \text{PP}[\textit{dat}]_j\ (\oplus \boxed{3}\ \text{PP}) \rangle \\
\text{ADJCNT} & \boxed{4} \left\langle \text{V} \begin{bmatrix} \text{SUBCAT} & \langle \boxed{5}\ \text{PP}_j\ (\oplus \boxed{3}\ \text{PP}_k) \rangle \\ \text{ARG-ST} & \langle \boxed{5} \oplus \boxed{3} \rangle \\ \text{SEM} & \boxed{6} \begin{bmatrix} \textit{act-und-rel} & \\ \text{ACT} & j \\ \text{UND} & k \end{bmatrix} \end{bmatrix} \right\rangle \\
\text{ARG-ST} & \langle \boxed{1} \oplus \boxed{2} \oplus \boxed{4} \rangle \\
\text{SEM} & \begin{bmatrix} \textit{cause-rel} & \\ \text{CAUSER} & i \\ \text{CAUSEE} & j \\ \text{EVENT} & \boxed{6} \end{bmatrix}
\end{bmatrix}$$

Figure 5.14: ‘*(s)are*’: Control Causative Morpheme

In Figure 5.14, the causative morpheme *(s)ase* is essentially a control verb as *meizir(u)* ‘order’ and *yakusokus(u)* ‘promise’, subcategorized for two PP arguments and a VP, which is controlled by the first object PP. We assume, following Davis (2001), that *act(or)-und(ergoer)-ref* and its attribute ACT(OR) and UND(ERGOER). *act-und-ref* is a supertype of the semantic relation represented by transitive verb like *taberu* ‘eat’. See Wechsler (1995) and Davis (1996, 2001).

Control entails that the unexpressed subject of the VP is coreferential with the first object PP. Controller selection is based on the semantics of the causative morpheme. Control theory in HPSG refers to the semantic class of the control predicate, as shown below (Sag & Pollard 1991):

(23) **Definition 33 (HPSG's Control Theory)**
Given an infinite VP or predicative complement C, whose semantic content C′ is the soa-arg of a soa s whose relation is R, the unexpressed subject of C is linked to:

i. the influenced participant of s, if R is of influence type,

ii. the committor participant of s, if R is of commitment type,

iii. the experiencer participant of s, if R is of orientation type.

Object control is a property characteristic of verbs belonging to the influence class. The *influence-type* verbs specify a relation in which an Agent-like participant exerts influence on another participant so that a particular action will be brought about. The influenced participant is the performer of the action. Since such a participant in Figure 5.14 is an ACTOR, the causative relation fits this semantic class, qualifying for the object control structure. The coindexing relation with index *j* above, therefore, is guaranteed by the semantics of the causative relation.

Example (2) shows a control causative whose feature structure is represented in Figure 5.15.

(2) b. Ken-ga Naomi-ni keeki-wo tabe-sase-ta.
Ken-NOM Naomi-DAT cake-ACC eat-CAUSE-PAST
'Ken made Naomi eat cakes.'

The PP in the SUBCAT list which corresponds to the CAUSEE role receives dative case, and the PP which corresponds to the UND/EATEN role receives accusative case by structure-sharing.

Passivizability

Now, let us consider what our analysis of control causatives predicts concerning the passivization of causatives. The crucial data are as follows:

(14) a. Naomi-ga Ken-ni(yotte) keeki-wo tabe-sase-rare-ta.
Naomi-NOM Ken-by cake-ACC eat-CAUSE-PASS-PAST
'Naomi was made by Ken to eat cakes.'

b. *Keeki-ga Ken-niyotte Naomi-ni tabe-sase-rare-ta.
cake-NOM Ken-by Naomi-DAT eat-CAUSE-PASS-PAST
'Cakes were made by Ken to be eat by Naomi.'

(7) a. Anna-ga Ken-wo Naomi-ni sawar-ase-ta
Anna-NOM Ken-ACC Naomi-DAT touch-CAUSE-PAST
'Anna made/let Ken touch Naomi.'

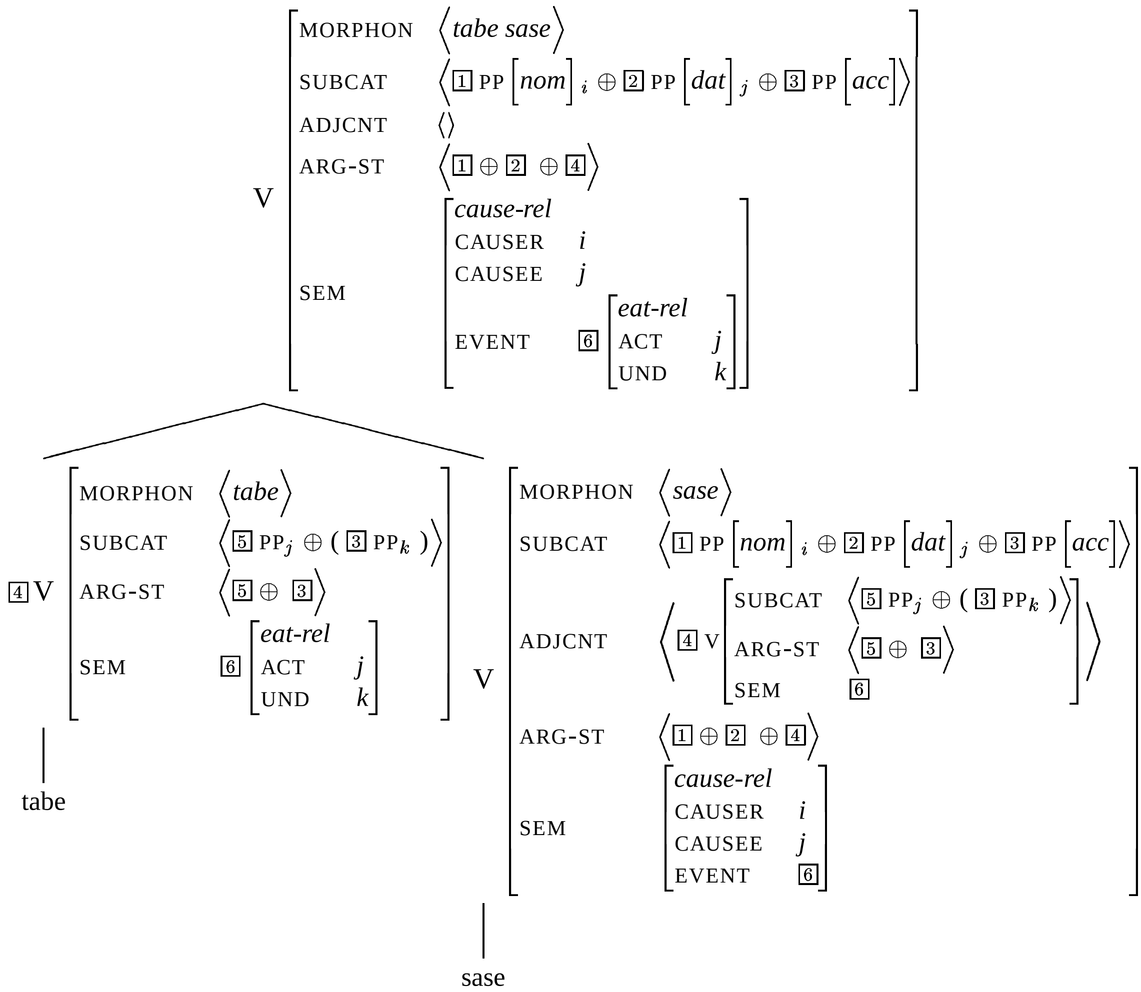


Figure 5.15: ‘*tabe sase*’: Feature Structure with Tree Convention

(24) a. Ken-ga Anna-ni(yotte) Naomi-wo sawar-as(e)-(r)are-ta
Ken-NOM Anna-by Naomi-ACC touch-CAUSE-PASS-PAST
'(lit.) Ken was made Anna to touch by Ken.'
'Ken was made touch Naomi by Anna.'

b. *Naomi-ga Anna-ni(yotte) Ken-wo sawar-as(e)-(r)are-ta
Naomi-NOM Anna-by Ken-ACC touch-CAUSE-PASS-PAST
'(lit.) Naomi was made Anna to touch by Ken.'

In Section 5.2.4, We have mentioned that the lower object of either the coercive or non-coercive causatives cannot be passivized (Farmer 1980, Marantz 1981). We have also mentioned that direct passives of the causatives only carry the coercive interpretation (Kuno 1973, Harada 1973). Let us look at these feature structures shown in Figure 5.14, and consider the application of the following direct passive lexical rule:

$$\begin{bmatrix} \text{MORPHON} & \langle \textit{V-(s)ase} \rangle \\ \text{SUBCAT} & \langle \boxed{1} \oplus \boxed{2}\ \text{PP}_i \oplus \boxed{3} \rangle \\ \text{ADJCNT} & \boxed{4} \left\langle \text{V} \begin{bmatrix} \text{SUBCAT} & \boxed{5}\ \text{PP}_i \oplus \boxed{3} \\ \text{ARG-ST} & \boxed{5} \oplus \boxed{3} \end{bmatrix} \right\rangle \\ \text{ARG-ST} & \langle \boxed{1} \oplus \boxed{2} \oplus \boxed{4} \rangle \end{bmatrix}$$

$$\rightarrow \begin{bmatrix} \text{MORPHON} & \langle \textit{V-(s)ase-rare} \rangle \\ \text{SUBCAT} & \langle \boxed{2}\ \text{PP}_i \oplus \boxed{6} \left(\text{PP} \left[\textit{niyotte} \right]_j \right) \oplus \boxed{3} \rangle \\ \text{ADJCNT} & \boxed{4} \left\langle \text{V} \begin{bmatrix} \text{SUBCAT} & \boxed{5}\ \text{PP}_i \oplus \boxed{3} \\ \text{ARG-ST} & \boxed{5} \oplus \boxed{3} \end{bmatrix} \right\rangle \\ \text{ARG-ST} & \langle \boxed{2} \oplus \boxed{3} \oplus \boxed{4} \oplus \boxed{6} \rangle \end{bmatrix}$$

Figure 5.16: '*V (s)ase rare*': Direct Passive

First, let us examine the passivizability of the first object shown above. Notice that there is nothing in the feature structure in Figure 5.14 that prevents it from undergoing direct passivization as in Figure 5.16. When the control causative undergoes the direct passivization as in Figure 5.16, $\boxed{2}$ PP in ARG-ST list becomes the least oblique argument and then $\boxed{2}$ PP in SUBCAT is realized as the first element of the list.

Thus, the present analysis predicts the passivizability of direct object shown in (14a) and (24a).[19] It is theoretically possible to make a direct passive from control

[19]Note that the dative-marked argument of object-control structures is generally allowed to be passivized, as shown below:

(i) a. Ken-ga Naomi-ni keeki-wo tabe-ru yoo meizi-ta.
Ken-NOM Naomi-DAT cake-ACC eat-PRES -MOD order-PAST
'Ken ordered Naomi to eat cakes.'

b. Naomi-ga Ken-ni keeki-wo tabe-ru yoo meizi-rare-ta.
Naomi-NOM Ken-DAT cake-ACC eat-PRES -MOD order-PASS-PAST
'Naomi was ordered by Ken to eat cakes.'

causatives, and here we claim, contrary to the traditional view on passivization of causatives, that only the causee of *ni*-causatives can be direct-passivized based on the observation of (24a).

The ungrammaticality of (14b) and (24b) also follows from our analysis. Direct-passivization of the lower object is predicted to be impossible, and this prediction is borne out by data. With reference to the feature structure in Figure 5.14. Notice that the $\boxed{3}$ is structure-shared with the object of the stem verb listed in the SUBCAT list, but not in ARG-ST list, which is also the target feature of direct passive lexical rule. The object of the stem verb is not accessible for passivization. Thus, the present analysis also predicts the unpassivizability of indirect object shown in (14b) and (24b).

Notice that the (un)passivizability without regard to the accusative and dative case distribution provides the answer to the question of why direct passives of causatives only carry the coercive interpretation. This is because only the VP controller object can be the target of the passivization.

5.5.2 Adversity Causatives

Adversity Interpretation

Oehrle and Nishio (1981), Ritter and Rosen (1993), Washio (1993, 1995) discussed that there are some instances of causatives. Some examples of this are (25):

(25) a. Naomi-ga kodomo-wo sin-ase-ta.
Naomi-NOM child-ACC die-CAUSE-PAST
'Naomi had her child die on her.'

b. Ken-ga keeki-wo kusar-ase-ta.
Ken-NOM cake-ACC stale-CAUSE-PAST
'Ken had some cakes become stale on him.'

In each cases, *(s)ase* is interpreted as experience rather than causation.

Unpassivizability

In contrast to the control causatives, this type of causative cannot be passivized, even though the object NP is marked with accusative case marker *wo*. The crucial date are shown in (26).

(26) a. *Kodomo-ga Naomi-ni sin-ase-rare-ta.
child-NOM Naomi-DAT die-CAUSE-PASS-PAST

b. *Keeki-ga Ken-ni kusar-ase-rare-ta.
cake-NOM Ken-DAT break-CAUSE-PASS-PAST

Thus, we will call this type of causative an adversity causative and claim that their morphemes have the feature structure shown in Figure 5.17.

$$\begin{bmatrix} \text{MORPHON} & \langle \textit{(s)ase} \rangle \\ \text{SUBCAT} & \langle \boxed{1}\ \text{PP}[\textit{nom}]_i \oplus \boxed{2}\ \text{PP}[\textit{acc}] \rangle \\ \text{ADJCNT} & \boxed{3} \left\langle \text{V} \begin{bmatrix} \text{SUBCAT} & \boxed{2}\langle \text{PP}_j \rangle \\ \text{ARG-ST} & \boxed{2} \\ \text{SEM} & \boxed{4} \begin{bmatrix} \textit{und-rel} & \\ \text{UND} & \text{J} \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{ARG-ST} & \boxed{1} \oplus \boxed{3} \\ \text{SEM} & \begin{bmatrix} \textit{affect-rel} & \\ \text{AFFECTEE} & i \\ \text{EVENT} & \boxed{4} \end{bmatrix} \end{bmatrix}$$

Figure 5.17: Adversity Causative Morpheme '*(s)ase*'

The adversity causative morpheme *(s)ase* is also a bound form, and syntactically functions as a verb as control causative morpheme. Notice that among the arguments of *(s)ase*, $\boxed{2}$ PP in the SUBCAT list is structure-shared with the subject of the stem verb. This is raising controller, playing no semantic role with respect to the causative predicate *(s)ase*. This is the reason why adversity causatives cannot be passivized.

We propose that this semantic relation be tentatively referred to as *affect-rel* with two features, AFFECTEE and EVENT. Since adversity passive exemplified in (27) also has the same semantic entailment, we will consider the SEM feature of the adversity causative in Chapter 8.

(27) a. Ken-ga ame-ni hur-are-ta.
Ken-NOM rain-DAT fall-PASS-PAST
'Ken was affected by rain's falling on him.'

b. Ame-ga hut-ta.
rain-NOM fall-PAST
'It rained.'

Non-obligatoriness of Adversity

It is noteworthy that an adversity interpretation is not obligatory. As shown in Section 5.2.4, transitive verbs which idiosyncratically mark the direct object with dative have both *wo*-causatives and *ni*-causatives, as repeated in (28).

(28) a. Anna-ga Ken-wo Naomi-ni sawar-ase-ta.
Anna-NOM Ken-ACC Naomi-DAT touch-CAUSE-PAST
'Anna made/let Ken touch Naomi.'

b. ?Anna-ga Ken-ni Naomi-ni sawar-ase-ta.
Anna-NOM Ken-DAT Naomi-DAT touch-CAUSE-PAST
'Anna made/let Ken touch Naomi.'

We find another example which has no adversity interpretation.

(1) Ken-ga Naomi-wo utaw-ase-ta.
Ken-NOM Naomi-ACC sing-CAUSE-PAST
'Ken made Naomi sing a song.'

The generalization seems to be that when *(s)ase* is combined with an unaccusative verb, as shown in (25), it cannot be used as a causative verb. The relevant characteristic of unaccusatives is that they have no external argument, and therefore the control relation relate two events as control causative.

(29) a. *Naomi-ga kodomo-ni sin-ase-ta.
Naomi-NOM child-DAT die-CAUSE-PAST
'Naomi had her child die on her.'

b. *Ken-ga keeki-ni kusar-ase-ta.
Ken-NOM cake-DAT stale-CAUSE-PAST
'Ken had some cakes become stale on him.'

The causative with a transitive verb (28) and with an intransitive verb (1), on the other hand, have an external argument, and therefore they also have control causative counterparts.

5.5.3 Pseudo Lexical Integrity

Let us now turn to some schemata and principles of NAIST JPSG, and examine how they interact with the feature structure discussed in this section.

Pseudo Lexical Rule Schema

Pseudo-lexical-rule schema in Table 5.2d is newly introduced one to reduce structural ambiguities discussed in Section 5.2.1.

Table 5.2: Schemata in NAIST JPSG

a.	complement-head schema:	[*phrase*]	→	C[*phrase*]	H
b.	adjunct-head schema:	[*phrase*]	→	A[*phrase*]	H[*phrase*]
c.	0-complement-head schema:	[*phrase*]	→	H[*word*]	
d.	pseudo-lexical-rule schema:	[*word*]	→	X[*word*]	H[*word*]

By restricting an auxiliary verb so as to subcategorize for the *word* as the left adjacent sister, the schema contributes to represent both monoclausal and biclausal nature of complex predicate in Japanese.

We implement the schema as a simple Prolog rule shown in Figure 5.18.

```
sign(Mother) --> sign(AdjDtr), sign(HeadDtr),
{ structural_description(Mother,AdjDtr,HeadDtr),
  word_constraint(Mother,AdjDtr,HeadDtr),
  head_feature_principle(Mother,HeadDtr),
  adjacent_principle(Mother,AdjDtr,HeadDtr),
  semantic_feature_principle_1(Mother,AdjDtr,HeadDtr),
  semantic_feature_principle_3(Mother,HeadDtr) }.
```

Figure 5.18: Pseudo-lexical-rule Schema

Valence Principles and Configurational Structure

Figures 5.19 and 5.20 show JPSG's valence principles.

In Figure 5.19, the Adjacent Feature Principle requires SUBCAT to be inherited from the head daughter to the mother without cancellation.

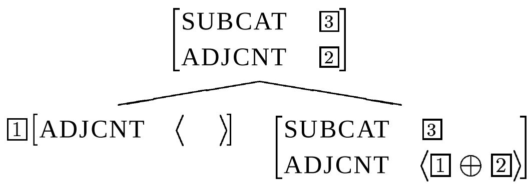


Figure 5.19: The Adjacent Feature Principle

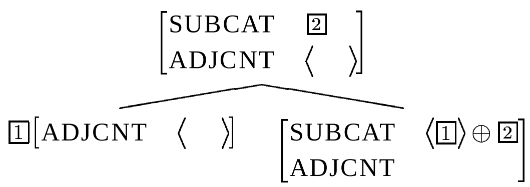


Figure 5.20: The Subcat Feature Principle

In Figure 5.20, the Subcat Feature Principle requires ADJCNT to be empty. And in both principles, ADJCNT of the complement daughter is required to be empty. These specifications of valence constraints contribute to represent Japanese configurational information as (lexical) integrity, (constituent) locality. We will see another configurational restriction in Chapter 6.

Now, let us take a simple example to see how a sentence (1) is actually analyzed under JPSG framework.

(1) Ken-ga Naomi-ni utaw-ase-ta.
Ken-NOM Naomi-DAT sing-CAUSE-PAST
'Ken made Naomi sing a song.'

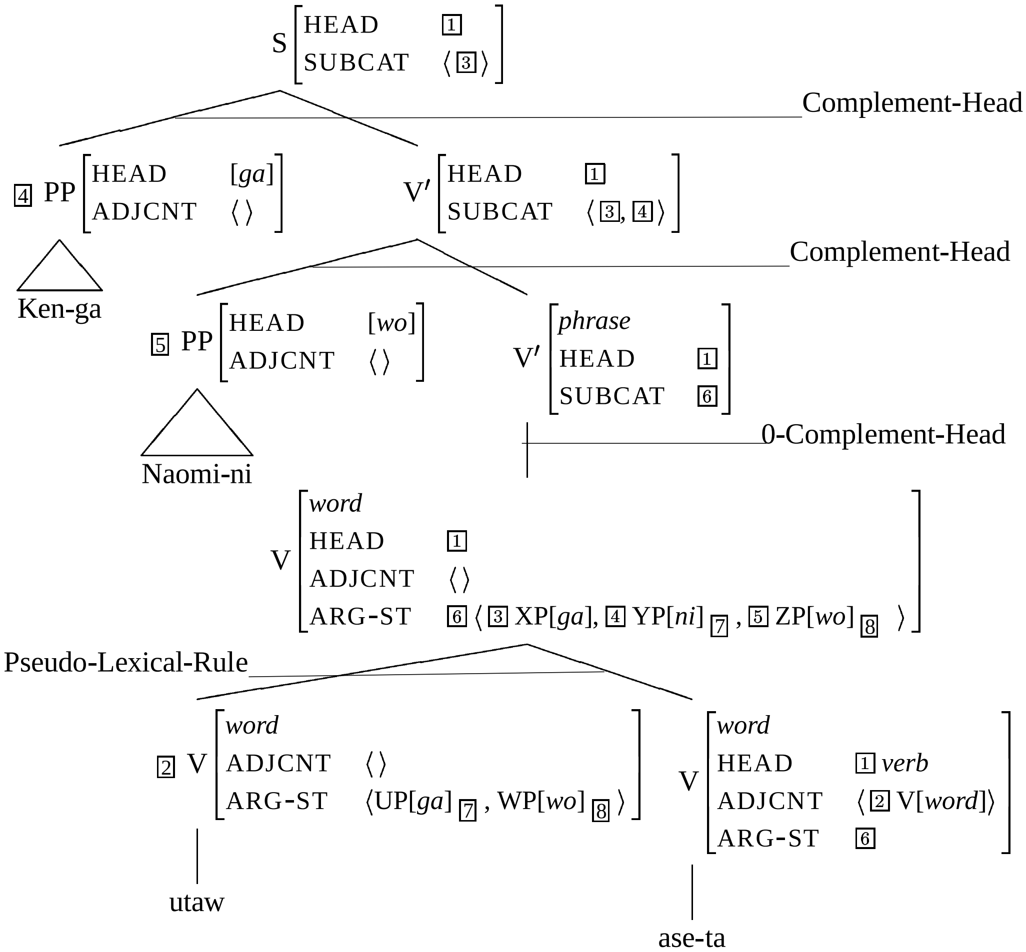


Figure 5.21: '*ken ga naomi ni utaw ase ta*': Tree Diagram

The Pseudo-lexical rule schema allows the higher constituent of the complex predicate to inherit the argument structure of the lower predicate, and as a result, the schema makes the two predicates form a constituent in syntax. In Figure 5.21, matrix verb *utaw* 'sing' and causative verb *(s)ase* appear adjacent to each other when they are linearized on the surface.

Note that the ADJCNT feature of *(s)ase-ta* 'caused' is not empty while the ADJCNT feature of the mother is empty. The Adjacent Feature Principle ensures that a VP containing more than two auxiliary verbs forms a left-branching parse tree, this principle only requires the complement daughter to have empty ADJCNT.

This complex predicate formation makes a parser work more efficient, since the structural ambiguities discussed in Section 5.2.1 are avoided. In other words, syntactic analysis and lexical analysis have been assimilated to a large extent, and they are no longer contrastive under NAIST JPSG's framework.

5.5.4 A Note on Blocking Effect

Let us call attention to another causative, which also has one accusative marked object. Consider the data in (30).

(30) a. Ken-ga zisyoku-wo niow-ase-ta.
Ken-NOM resignation-ACC smell-CAUSE-PAST
'Ken hinted registration.'

b. *Zisyoku-ga nio-u.
resignation-NOM smell-PRES
'Registration is hinted.'

In (30b), the verb *niow* 'smell' itself does not contain the sense of 'to be hinted'. The meaning 'to hint' associated with its causative counterparts is therefore non-compositional (Miyagawa 1980a). As such, this causative verb may plausibly be viewed as being formed in the lexicon, where such idiosyncrasies are common.

If the situation were simply limited to the syntactic or lexical distinction, we only posit the distinction between syntactic and lexical causatives and introduce a lexical rule for the latter. However, the problem discussed here is not so simple. There is a phenomenon called blocking (Miyagawa 1980a, 1984, 1986, 1989). Consider the following data:

(31) a. Me-ga hikar-u.
eye-NOM sine-PRES
'Eyes shine.'

b. Naomi-ga me-wo hikar-ase-ta.
Ken-NOM eye-ACC sine-CAUSE-PAST
'Naomi was envious.'

(32) a. ... hirogar-u.
widen-PRES
'... widen.'

b. ... kao-wo hiroger-u.
face-ACC widen-PAST
'... become well known.'

c. *... kao-wo hirogar-ase-u.
face-ACC widen-CAUSE-PAST

As the intransitive verb *hikar(u)* in (31a) 'shine' has no transitive counterpart, its causative verb *hikar-as(u)* in (31b) 'cause to shine' takes on lexical property where it can appear in idiom. On the other hand, the intransitive verb *hirogar(u)* 'widen' in (32a) has the transitive counterpart *hiroger(u)* 'widen' in (32b) . It is the transitive verb, and not the causative verb with intransitive stem verb in (32c), that participates in idiomatization. This might suggest that the syntactic causatives knew whether there is a competing stem verb in the lexicon.

Notice that this is a state of affairs which is not allowed in the model of grammar assuming grammatical components connected by the derivation with transformation (Chomsky 1965, 1981, 1995). In order to capture the blocking effect, it is necessary to locate both the syntactic and the lexical causatives in one component of the grammar. We take this situation as an advantage of an HPSG/JPSG approach over other approaches. Under the framework of NAIST JPSG, the relevant lexical information is pushed into one lexical component, making it possible for syntactic operations to access lexical information at various specified stages of the derivation.

How to derive the causatives appearing in idiom is, however, a question which must be put aside as beyond the scope of the present discussion.

5.6 Summary

In this chapter, we have proposed that Japanese causatives are divided into two types, control causatives and adversity causatives, but have not related them to the semantic distinction between coercion vs. non-coercion. Instead of coerciveness which is not the correct concept for distinguishing the two types of causative, we have claimed that the real difference between the *wo*-causatives and *ni*-causatives can be derived from their structural difference, relating to be SEM feature.

We have also proposed that both control causatives and adversity causatives have an VP embedding structure but only the former involves syntactic control structure.

Although biclausal structures often cause problem of long-sentence parsing failure, we have shown that the adjacent feature principle and the pseudo-lexical-rule schema treat the structure as a monoclausal structure, avoid the problem and parse such sentences efficiently.

Chapter 6

Subordinate Clause Modification and Hierarchical Clauses

6.1 Introduction

The most apparent phenomenon that demonstrates the head-final property of Japanese is the phrase-final cluster of particles and verbs. So far have devoted our discussion to the analysis of particle conjuncture in Chapter 4 and complex predicate formation with *sase* in Chapter 5. Auxiliary verbs and conjunctive particles such as *nagara* are related to the hierarchical clause structure that has been discussed in the literature of Japanese linguistics. Hierarchical complexities have also been one of the major causes of the failure of long sentence parsing in the field of natural language processing.

To overcome this parsing problem, we need to extend the theory of NAIST JPSG, which is a partial implementation of ideas from recent developments in constraint-based grammar formalism and grammar-based sentence processing. This chapter concentrates on the subordinate clause modification.

6.2 Hierarchical Clauses in Japanese

6.2.1 Complexity of Hierarchical Clauses

The hierarchical clause in Japanese is a phenomenon that has reflexes in syntax and semantics. Although there is a large body of descriptive work on this topic (see Minami (1974) and references cited there), there has been little attempt to provide a formal analysis of the phenomenon. The important part of the semantics of complex sentences with hierarchical clauses may be captured as semantic relations between main clause and its subordinate clauses, respectively.

However if we admit many combinatory relations between clauses, the amount of computation to identify the semantic relations that hold in a given sentence will be extremely large.

Table 6.1: Minami's Four Levels

level		elements
A	i.	predicate
	ii.	phonologically null nominative NP, complement
	iii.	manner adverb
	iv.	subordinate clauses lead by conjunctives *te*(mode), *nagara*(parallel), *tutu*, *tameni*(purpose), *mama*, *youni*(purpose), . . .
B	i.	tense, (negation)
	ii.	nominative NP whose role is actor
	iii.	restrictive modifier
	iv.	subordinate clauses lead by conjunctives *te*(reason, time), *nagara*(but), *reba*, *tara*, *kara*(reason), *tameni*(purpose for action), *node*, *youni*(cotrast), . . .
	v.	instance of level A
C	i.	modal element
	ii.	topic NP
	iii.	non-restrictive modifier
	iv.	subordinate clauses lead by conjunctives *kara*(reason of judgement), *node*, *ga*, *keredo*, *si*, *te*(parallel), . . .
	v.	instance of level B
D	i.	sentence-final particle(s)
	iii.	vocative
	iv.	subordinate clauses lead by conjunctive *to*, *toiu*
	v.	instance of level C

6.2.2 Hierarchy as Sentence Levels

Minami's Four-Levels Hierarchical Structure

Minami (1974) draws four levels A, B, C, and D classification within Japanese clause structure from the view of co-occurrence of various sentence element. Table 6.1 summarizes characteristics of those levels with slight modification.

These levels form a hierarchical ordering where level A is the lowest and level D is the highest ($A \subset B \subset C \subset D$). The level of the (subordinate) clause is defined by the head of the clause, its conjunctive particle.

These conditions, for example, disambiguate the structure of the sentence in (1), which is bracketed as (2a) and (2b).

(1) Ken-ga (terebi-de) naitaa-wo mi-nagara,
Ken-NOM TV-with night game-ACC watch-while
razio-wo kii-tei-ta-yo.
radio-ACC listen-PROG -PAST VOC
'Ken listened to the radio, watching the night game '

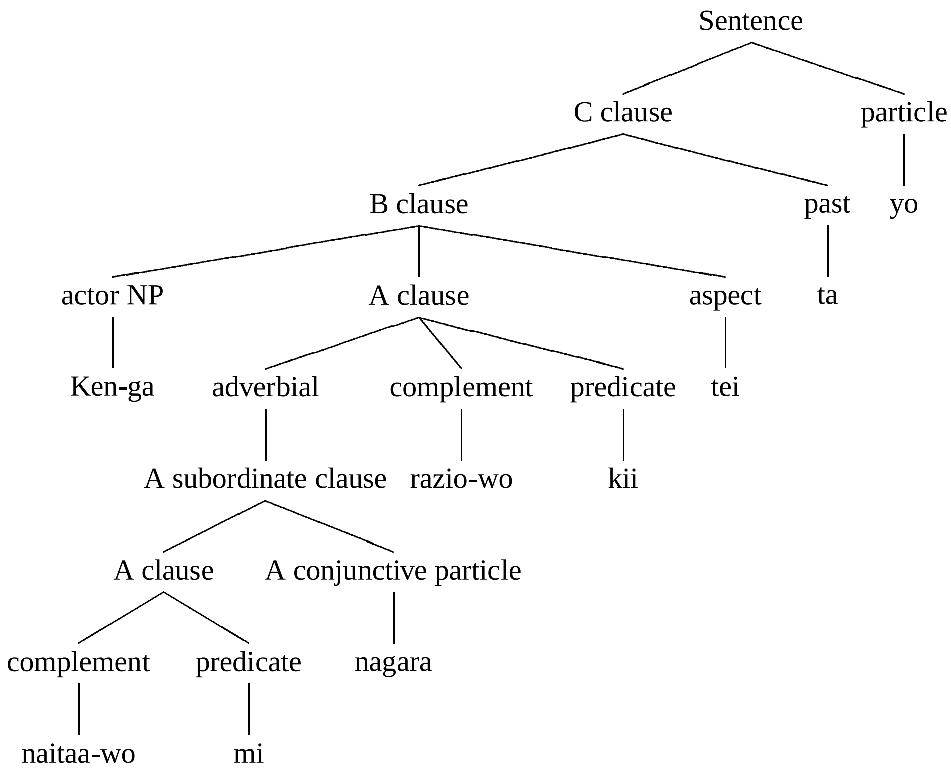


Figure 6.1: '*ken ga naitaa wo mi nagara, razio wo ki tei ta yo*': Four Level

(2) a. $[_B$ $[_B$ Ken-ga] $[_A$ $[_A$ naitaa-wo mi-nagara], razio-wo kii-]-tei-]-ta-yo.
'... Ken is watching the night game '

b. *$[_A$ $[_B$ Ken-ga] naitaa-wo mi-nagara], razio-wo kii-tei-ta-yo.
'... Someone except Ken is watching the night game '

In (2a), the person who is watching night game is *Ken*. This interpretation is predicted by the hierarchical constraints in Table 6.1. The more precise structural constraints are conventionally represented in a tree diagram as in figure 6.1.

A clause α(=A) can be embedded as a subordinate clause into a matrix clause β(=B), if and only if α is a member of the same level or on a lower level than that which β belongs to. In (2a) and Figure 6.1, the conjunctive particle *nagara* 'while' leads to a subordinate clause in level A. Level A is the innermost layer of the sentential hierarchy and it cannot contain a level B subordinate clause as in (2b). (3) is almost same as (1), but the conjunctive particle is *node* 'since'.

(3) $[_B$ $[_B$ Ken-ga (terebi-de) naitaa-wo mi-ta-node],
Ken-NOM TV-with night game-ACC watch-PAST -since
$[_B$ ϕ] razio-wo kii-ta].
(someone) radio-ACC listen-PAST
'(Lit.) Since Ken watched the night game, someone listened to the radio.'

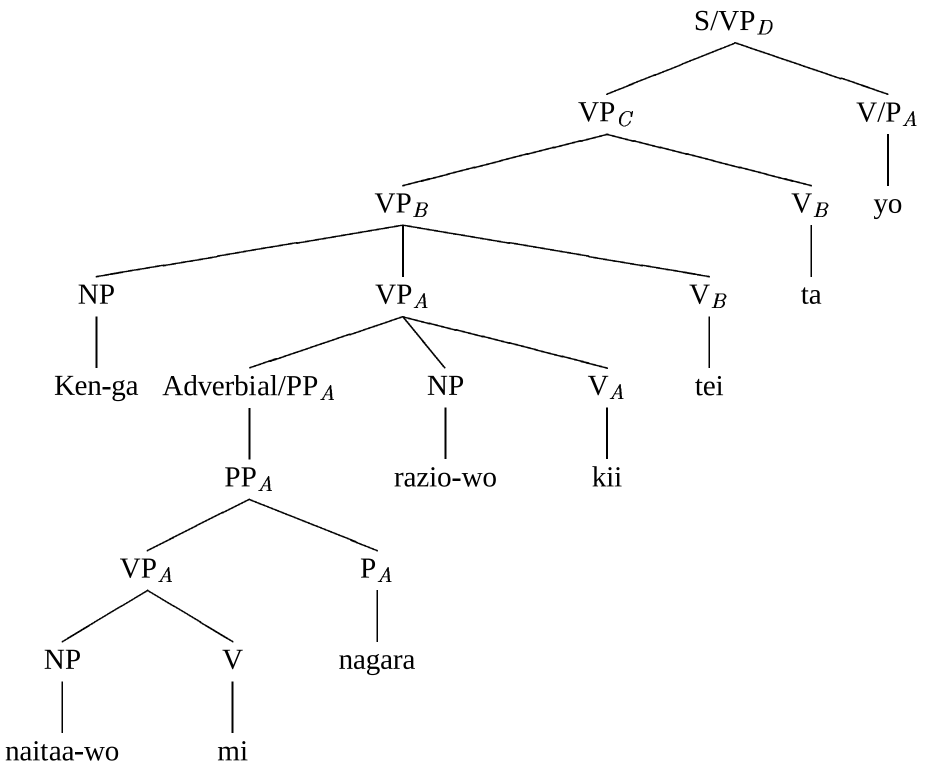


Figure 6.2: ‘*ken ga naitaa wo mi nagara, razio wo ki tei ta yo*’: Tree Diagram

Since *node* is a conjunctive particle in level B, the subordinate clause can include and modify an instance of B.

As shown above, Minami’s description gives a rough sketch of conditions of combinatorial nature of clause level.

Constraint for Hierarchical Information

Figure 6.1 shows that Minami’s hierarchical clause seems to be a unit of complex linguistic information that has reflexes mainly in syntax and semantics. If we represent such information only from the view of syntax, Figure 6.2 replaces with Figure 6.1.

To construct and constrain a structure like Figure 6.2, we have to elaborate at least two types of relations: head-head relation and head-modifier relation headed by sentence-final clusters of auxiliary verbs and conjunctive particles, which are exemplified in some kind of complex predicate and subordinate clause, respectively.

However our grammar is still not sufficient for regulating of auxiliary verb conjuncture as *kii-tei-ta-(yo)* and hierarchical modification of adverbials depending on the class of conjunctive particles. There is no problem with principles and schemata themselves but the specified values of the feature are not fully specific.

As shown in Figure 6.2, syntactic information tells us that the structure is a VP-layered structure which is roughly constrained as in 6.3.

a. [ADJCNT ⟨VP⟩]
b. [MOD ⟨VP⟩]

Figure 6.3: Layered VP Specification

In Figure 6.3, both the adjacent feature and the modification feature specify their value VP only. 6.2 however includes a number of VPs layered hierarchically. Given the formalization of Figure 6.3, we cannot easily express the specification where past tense *ta* subcategorizes for the whole of the VP headed by matrix predicate, or a certain adverbial only modifies such VP.

The simplest solution is to constrain the structure by reformulating Minami's hierarchy with the introduction of an ad hoc 'hierarchy feature' which can take values A, B, C or D. However this formalization only captures the surface ranking for such combinations of clauses by using rather tentative levels. To promote grammar development, we should describe the linguistic object that is the origin of hierarchical clause.

There is a strong need for the formalization of linguistic objects, constraints and heuristics from the view of grammar engineering. They efficiently restrict the inclusion among those types of clauses when a system parses long and complex sentences. In order to refine the tentative conditions or heuristics into more well-grounded rules, a linguistic explanation that reveals the mechanism behind the hierarchy among these levels is required.

6.3 Previous Analyses

Several Japanese linguists have already proposed the general structure of Japanese hierarchical clauses (Mikami 1972, Minami 1974, Takubo 1987, Gunji 1990).

6.3.1 Sentence Categorization

Mikami (1972) categorized Japanese clauses into three classes.

(4) i. open
ii. semi-open
iii. closed

The categorization in (4) indicates how freely the content of a clause interacts with the outside of that clause. They are, for example, categorized by the degree of possibility of coreference between zero pronouns inside the subordinate clause and nominals or topics that appear in the main clause.

Following Mikami and others, Minami proposed the four levels discussed in Section 6.2.2.

6.3.2 Sentence Levels

Following Minami (1974) and modifications by Takubo (1987), Gunji (1990) proposed the schematic hierarchy in Figure 6.4 for sentence in (5) from the functional point of view.

(5) Ano-ko-wa mina-ni kawaigar-arete-i-ru-desyoo-ka?
that-child-TOP everyone-by love-PASS-PROG -PRES -MOOD-Q
'(Lit.) Is that child loved by everyone?'

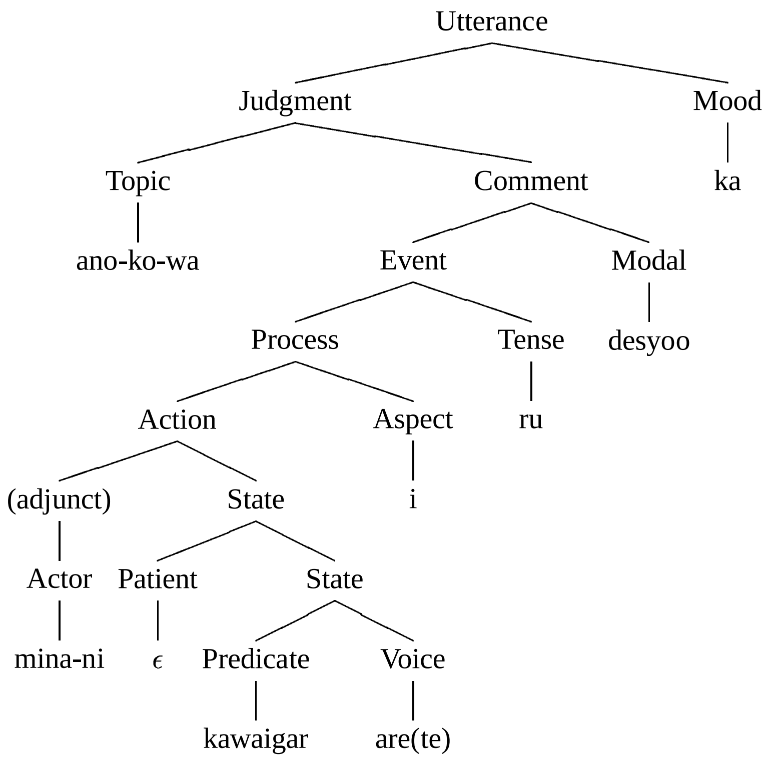


Figure 6.4: '*ano ko wa mina ni kawaigar arete i ru desyoo ka*': Tree Diagram

Gunji (1990) recognized early that the most perspicuous phenomenon in Japanese (syntax) that demonstrates this head-final property of this language is the sentence-final cluster of markers. The adjacency feature originally proposed by Gunji is suitable for capture such a properties.

Gunji's study has much insight into almost all the aspects of Japanese sentence hierarchy. We will return to his study in Section 6.4.1 and discuss our own approach based on Gunji's insight.

Table 6.2: Gunji's Markers for Verb Stem

function	marker	complement
voice	*(r)are* (passive), *sase* (causative), ...	predicate
aspect	*i* (progressive, resultative or experiential), *simaw* (perfective), ...	action/state
tense	*ru* (present), *ta* (past), ...	process
modal	*daroo* (supposition), ...	event

6.3.3 Other HPSG Approaches

Nakagawa and Nishizawa's (1994) approach is also based on Gunji's study. This extends the framework and represents the semantics of complex sentence in Japanese. Nakagawa and Nishizawa introduce new pragmatic roles called *observer* and *motivated* respectively to bridge semantic roles of subordinate and those of main clauses.

Yoshimoto, Nakamura, and Mori (2000) also proposed a formal treatment of Minami's hierarchy under the framework of HPSG and Discourse Representation Theory. However, their analysis focused only on the interpretation of the temporal relation between the events described in subordinate clause and matrix clauses. Their analysis simply reformulates Minami's hierarchy as 'hierarchy feature' which can take value A, B, C, and D.

6.4 The Semantic Feature Revisited

HPSG and, of course, NAIST JPSG are an information-theoretic and constraint-based frameworks, well-suited for a formal treatment of hierarchical clauses in Japanese which simultaneously captures generalization not only in syntax but also in semantics and the interactions between them. Building on the work of Gunji (1990), we propose a head-driven account of hierarchical clause which introduces non-trivial extensions to JPSG and makes it possible to construct a practical parser.

6.4.1 Markers, Complements and Adjunct of Levels

This section provides an overview of some of the major concepts underlying Gunji's (1990) sentence levels, shown in Figure 6.4, which are based on Minami's (1974) four-levels.

Level A, B, C

Table 6.2 shows markers that the verb stem includes.

Each of the markers in Table 6.2 takes a distinct level of sentential complements. All higher levels including ‘process’, ‘event’, ‘comment’, and ‘judgment’ are realized as sentences headed by these respective markers. Thus if a sentence is headed by a tense marker, it is sentence of the ‘event’ level.

Each of these functional levels is also syntactically realized as a verbal category. For example, the ‘action’ is realized as either a transitive or an intransitive verb phrase, and the ‘state’ as a sentence.

NAIST JPSG is able to capture this syntactic information. However, it apparently lacks the specification of functional and semantic information summarized in Table 6.2. Thus we elaborate the value of the adjacency feature to specify a more complex linguistic object that reflects the information in Table 6.2.

Level D

At the ‘communication’ level, the categorial status of the ‘mood’ markers is somewhat unclear. The mood markers in Figure 6.4 include those for question *ka* or *no* (colloquial), for the speaker’s sex *wa* (female speakers), for confirmation *ne,* etc. Traditionally, these are classified as postpositions, but the functions of these markers are quite different from other typical postpositions, nominative and accusative markers.

They all contribute to endow the sentence with some kind of communicative power. Some studies (Yamada 1936, Tokieda 1950, Watanabe 1971) in traditional Japanese grammar have stressed the importance of these *tinzyutu-zi* ‘statement markers’ and put them in the center of their theories.

However we do not know enough about the ‘mood’ marker to be able to describe its lexical entry. Moreover sentences that appear in dialogue or communicative situations innately contain much gapping and scrambling which causes processing complexity. Though JPSG supplies schemata for parsing those phenomena, we cannot treat colloquial sentences as written language.

Thus issues concerning level D are beyond our current study.

Adjuncts

Adjuncts also adjoin to some of the levels. For example, manner adverbials may adjoin to ‘action’, restrictive sentential adverbials to ‘event’, and nonrestrictive sentential adverbials to ‘judgment’, etc.

Minami’s (and Yoshimoto’s) work seems to capture a surface ranking for such adjunction and modification by using somewhat tentative levels, and there is no answer to the question: which linguistic information is the origin of the level of hierarchy. On the other hand, Gunji’s sentence levels represented by functional/semantic information tells us the reason why there are restrictions of co-occurrence of adverbials and so on.

Thus NAIST JPSG adopts functionally organized linguistic objects as the values specified by modification feature.

6.4.2 Hierarchical Semantic Feature

Semantic and Functional Ontology by Type

In order to be able to use typed feature terms, these types and features must be declared in advance. With some modifications from the view of theoretical and computational formalisms, our semantic type hierarchy is developed in Figure 6.5.

```
              top > [feat_struc].
       feat_struc > [synsem_struc,gram_cat,val_cat,pos,
                     sem_struc,pred,ind].
     synsem_struc > [phrase,lex_item]
                     intro [syn:gram_cat,sem:sem_struc,
                            morphon:morphon_struc].

   sem_struc intro  [mode_:mode_type,index:ind,
                     restr:pred_list].
             pred > [proposition,property,relation,
                     modification].
 proposition intro  [sit:ind,process:process,
                     tense:tense_list].
    property intro  [reln,name,named:ind].
    relation intro  [reln,instance:ind].
modification intro  [reln,arg1:ind,arg2:ind].

              top > [process,soa,act].
          process > [event,act0]
                     intro [aspect:aspect_list].
            event > [action,state] intro [event:soa].
        act0 intro  [event:act].
         soa intro  [reln,agent:ind,patient:ind,theme:ind].
         act intro  [reln,actor:ind,event:ind].

              top > [tense,aspect].
            tense > [ru,ta].
      aspect intro  [reln,arg:ind].
```

Figure 6.5: Type Declaration for Hierarchical Semantic Feature

The crucial part of NAIST JPSG's type declarations is in Figure 6.5. The types in 6.5 are mainly declared for a semantic ontology which reflects the origin of functional hierarchy in Figure 6.4. However, with the features defined by these types, NAIST JPSG allows us to represent the phenomena with reference to multi-dimensional constraints.

Semantic Feature Declarations

Based on the declarations in Figure 6.5, the AVM representation for the type *synsem_struc* in NAIST JPSG has the structure shown in Figure 6.6.

```
[synsem_struc
 MORPHON   morphon_struc
 SYN       [syn
            HEAD  [head
                   CASE     case
                   ARG-ST   list(synsem_struc)
                   MOD      list(synsem_struc)]
            VAL   [val
                   SUBCAT   list(synsem_struc)
                   ADJCNT   list(synsem_struc)]]
 SEM       [sem_struc
            INDEX  index
            RESTR  list( [pred
                          PROCESS  [proc
                                    EVENT    event
                                    ASPECT   list(aspect)]
                          TENSE    list(tense)] )]
 CONX      conx_struc]
```

Figure 6.6: Semantic Feature Structure

The *synsem_struc* type has features labeled SYN(TAX) and SEM(ANTICS). A revised SEM feature serves to represent semantic properties of words, phrases and hierarchical clauses. A type assigned to a node determines what attribute labels can appear in its feature structure. Thus a feature structure of type *pred* has the attribute labels PROCESS and TENSE. Feature structure *proc(ess)* include the attribute EVENT and ASPECT. It is noteworthy that the *event* feature has subtypes relating to its syntactic realization, i.e., *intransitive verb*, *transitive* and *ditransitive*, each of which may have some of the argument which is also reflected in the contents of ARG-ST feature.

```
                   top > [synsem_struc_list,
                          pred_list,tense_list,aspect_list].
     synsem_struc_list > [synsem_struc_cons,nil].
synsem_struc_cons intro  [first:synsem_struc,
                          rest:synsem_struc_list].
             pred_list > [pred_cons,nil].
        pred_cons intro  [first:pred,rest:pred_list].
            tense_list > [tense_cons,nil].
       tense_cons intro  [first:tense,rest:tense_list].
           aspect_list > [aspect_cons,nil].
      aspect_cons intro  [first:aspect,rest:aspect_list].
```

Figure 6.7: List Structure Declaration

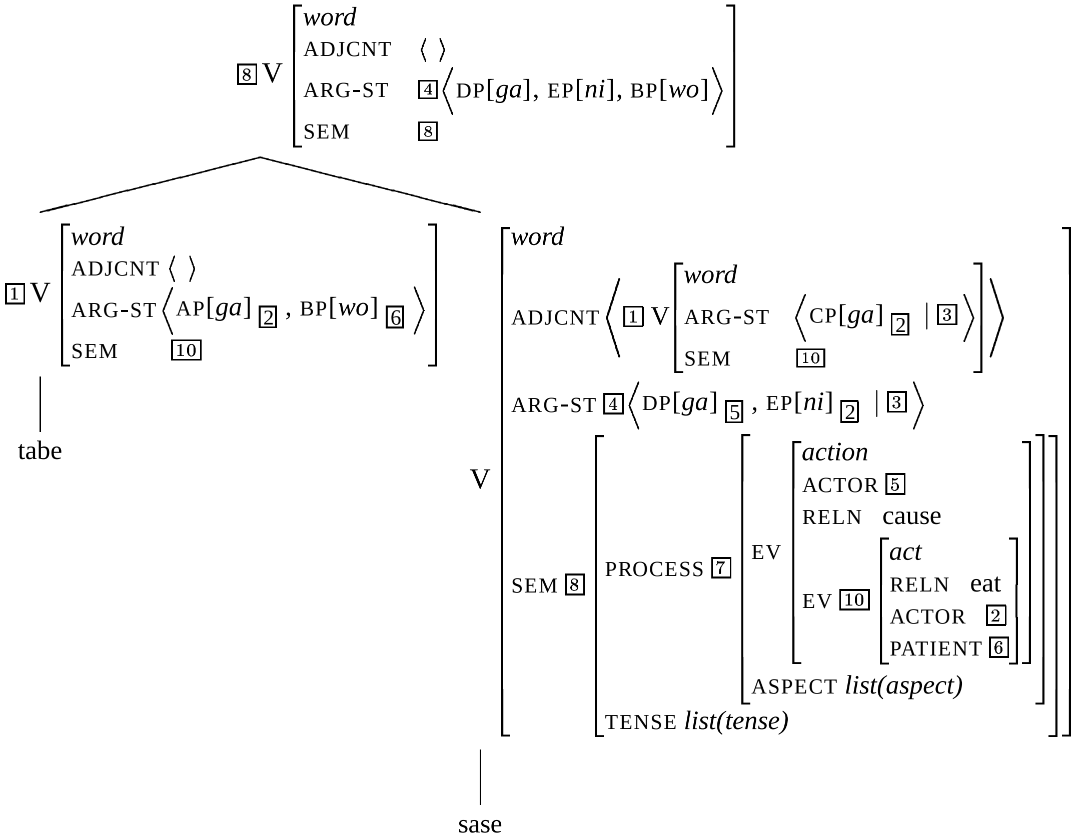


Figure 6.8: ‘*tabe sase*’: Feature Structure with Tree Diagram

In the class of MOD and ADJCNT lists, the elements are *synsem_struc* object and the elements in RESTR(ICTION) list are *pred* object. However MOD and ADJCNT can specify *pred* since it is subtype of *synsem_struc*. Thus JPSG is extended to be an integrated theory of not only syntax but also in semantics.

6.4.3 Complex Predicate with Complex Semantics

Self-controllability Revisited

Let’s take the example of a control causative sentence in (6) which was formalized in Section 5.5.1.

(6) Ken-ga Naomi-ni keeki-wo tabe-sase-ta.
Ken-NOM Naomi-DAT cake-ACC eat-CAUSE-PAST
‘Ken made/let Naomi to eat cakes.’

We are now able to specify the value of ADJCNT. The simplified tree diagram in Figure 6.8 represent the essential part of our extension of SEM feature.

As shown in Figure 6.8 the adjacent feature of *sase* 'cause' takes [10] as its value. [10] is a value of semantic feature of the matrix predicate. In Chapter 5, we constrain the predicate only syntactically and pay attention to, at most, its subcategorization information. As for the self-controllability, we also seek an explanation from HPSG's syntactic control theory. However, the theory itself is based on the notion of semantic type and we introduce semantic-based subcategorization.

It is noteworthy that this semantic specification has an important role for regulating the relation between the self-controllability of the predicate and its causativization. The crucial date is exemplified as follows.

(7) Hana-ga sai-ta.
flower-NOM bloom-PAST
'The flower has bloomed.'

(8) a. Ken-ga Hana-wo sak-ase-ta.
Ken-NOM flower-ACC bloom-CAUSE-PAST
'Ken made the flower bloom.'

b. *Ken-ga Hana-ni sak-ase-ta.
Ken-NOM flower-DAT bloom-CAUSE-PAST

(9) a. ??Ken-ga Hana-ni saku yoo meizi-ta.
Ken-NOM flower-DAT bloom -MOD order-PAST
'Ken ordered the flower to bloom.'

b. ??Ken-ga Hana-ni saku yoo yakusokusi-ta.
Ken-NOM flower-DAT bloom -MOD promise-PAST
'Ken promised the flower to bloom.'

In Chapter 5, we explained the ungrammaticality of both (8b) and (9) by HPSG's control theory shown uniformly in (10).

(10) **Definition 34 (HPSG's Control Theory)**
Given an infinite VP or predicative complement C, whose semantic content C′ is the soa-arg of a soa s whose relation is R, the unexpressed subject of C is linked to:

i. the influenced participant of s, if R is of influence type,

ii. the committor participant of s, if R is of commitment type,

iii. the experiencer participant of s, if R is of orientation type.

However, their grammaticality slightly differs, if we compare them directly. This is not predicted from (10), since both causatives and control verbs belong to *influence-type*.

We think HPSG's control theory is on the right track especially from the view of formal linguistics, but the explanation for the semantic compatibility between matrix predicate and control predicate need more specific information from the view of computational linguistics. If we assume (10), we have to design a type hierarchical lexicon based on the semantic class as in (10).

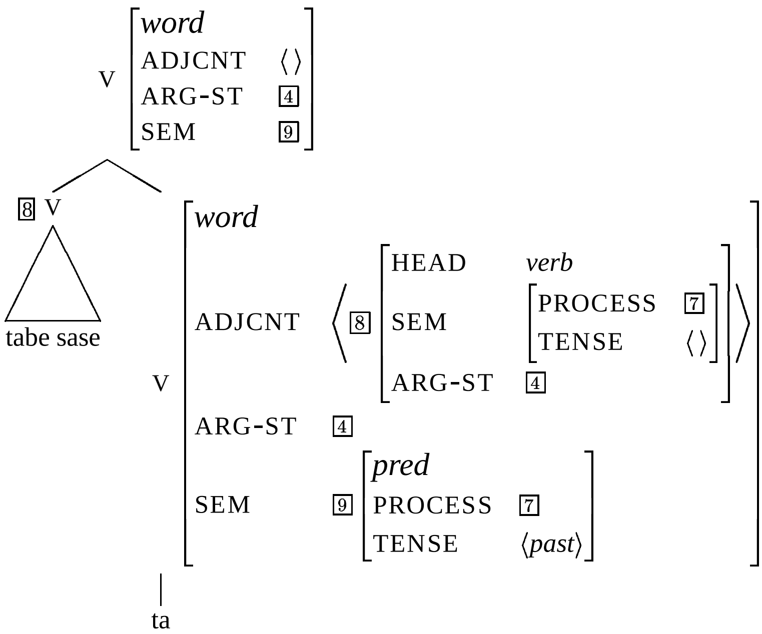


Figure 6.9: ‘*tabe sase ta*’: Feature Structure with Tree Diagram

Complex Aspect and Tense Constraint

Figure 6.9 exemplifies the case where the tense marker selects VP which reflects *pred*.

In Figure 6.6, we have defined the value of TENSE and ASPECT as a list. This specification is used for rejecting the ungrammatical sentences in (11b).

(11) a. Ken-ga hasiri-tuzuke-ta.
Ken-NOM run-continue-PAST
‘Ken continued to run.’

b. *Ken-ga sini-tuzuke-ta.
Ken-NOM die-continue-PAST
‘Ken continued to die.’

Verbs, and also some auxiliary verbs, innately contain aspect (and tense) information and aspect markers. The auxiliary verb *tuzuke* ‘continue’ in (11) primarily means progressive. The meaning of verb *hasiru* ‘run’ is compatible with progressive, while that of verb *sinu* ‘die’ is not. The verb *sinu* in Japanese is instantaneous.

At the current stage of our grammar development, we can predict and explain the compositional meaning of (11a) and the ungrammaticality of (11b) linguistically, but we don’t have specific constraints for expressing such a difference computationally. Therefore we tentatively assume the value of ASPECT and TENSE as a list and the features appearing in the sequence of verbs is stored.

There is another difficulty for describing the interpretation of aspect (and tense).

(12) Heisi-ga sini-tuzuke-ta.
soldier-NOM die-continue-PAST
'(Lit.) Soldiers continued to die.'

When the subject in (11b) is plural as an example in (12), the 'die event' becomes repeatable though the event participants differ in each events. In fact, aspect markers generally have various meanings as some theoreticians in traditional Japanese grammar have stressed. So this formalization is retained.

6.5 Subordinate Clause Modification

6.5.1 Subordinate Clause as Modifier

Adjunct-Head Schema and the Modifier Feature Principle

Adjunct-head schema in Figure 6.10 constrains modification or adjunction between two elements, such as adverb and verb, and adjective and noun.

```
sign(Mother) --> sign(ModDtr), sign(HeadDtr),
{ structural_description(Mother,ModDtr,HeadDtr),
  phrasal_constraint(ModDtr,HeadDtr),
  head_feature_principle(Mother,HeadDtr),
  vfp_for_modification(Mother,ModDtr,HeadDtr),
  semantic_feature_principle_2(Mother,ModDtr,HeadDtr),
  semantic_feature_principle_3(Mother,ModDtr) }.
```

Figure 6.10: Adjunct-head Schema

This schema involves Modifier Feature Principle in Figure 6.11d.

a.
```
vfp_for_complementation(M,H) :-
  M=(syn!val!(subcat!Subcat & adjacent!<nil)),
  H=(syn!val!(subcat!Subcat & adjacent!<nil)).
```
b.
```
vfp_for_complementation(M,C,H) :-
  M=(syn!val!(subcat!Rest & adjacent!<nil)),
  C=(syn!val!adjacent!<nil),
  H=(syn!val!(subcat!Subcat & adjacent!<nil)),
  adjoin(C,Rest,Subcat).
```
c.
```
vfp_for_complementation(M,C,H) :-
  adjacent_principle(M,C,H).
```
d.
```
vfp_for_modification(M,Mod,H) :-
  M=(syn!val!(subcat!Subcat & adjacent!<nil)),
  Mod=(syn!head!mod!@list1(H)),
  H=(syn!val!(subcat!Subcat & adjacent!<nil)).
```

Figure 6.11: The Valence Feature Principle

Figure 6.11 has a structure conventionally represented in a tree diagram as in Figure 6.12.

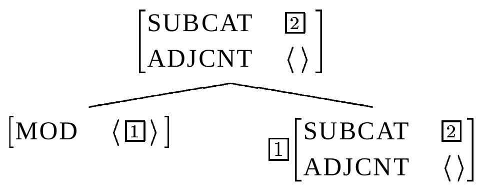


Figure 6.12: The Modifier Feature Principle

As is required by Subcategorization Feature Principle in Figure 6.13, the ADJCNT feature of the head daughter must be empty.

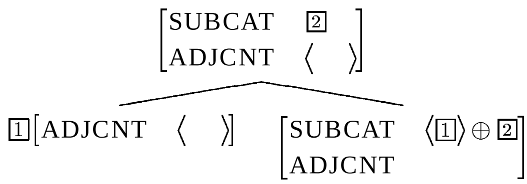


Figure 6.13: The Subcat Feature Principle

The modifier Feature Principle avoids structural ambiguities which would be caused by an adverb *nandomo* ‘repeatedly’ intervening between *Naomi-ni* and *utaw* in Figure 6.14a.

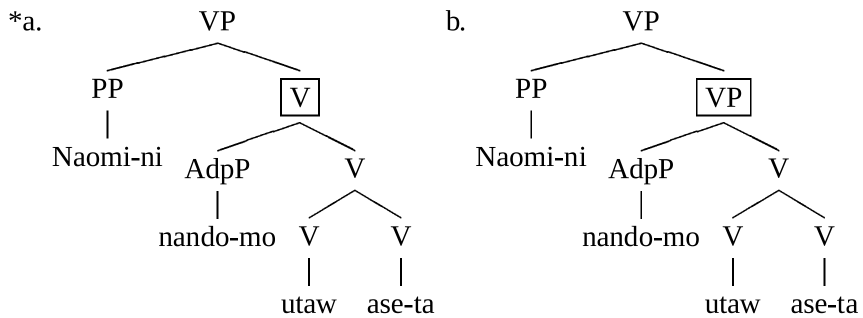


Figure 6.14: Adverb Modification: (a) V-Adjunction (b) VP-Adjunction

Since we adopted lexical analysis in Chapter 5, we have to regulate adjunction to word type elements. To differentiate structurally between the two cases results in decreasing the total cost of parsing.

In the structure in Figure 6.14b, the SUBCAT feature of the head daughter is inherited by the mother. This allows argument *naomi-ni* and modifier *nandomo* to be scrambled one another.

A Note on the Semantic Feature Principle

In Section 4.2.5, we introduced the Semantic Feature Principle shown in Figure 6.16.

```
a. semantic_feature_principle_1(M,H) :-
     M=(sem!restr!Restr),
     H=(sem!restr!Restr).
b. semantic_feature_principle_1(M,D,H) :-
     M=(sem!restr!Restr),
     D=(sem!restr!Restr1),
     H=(sem!restr!Restr2),
     fappend(Restr2,Restr1,Restr).
c. semantic_feature_principle_2(M,D,H) :-
     M=(sem!restr!Restr),
     D=(sem!restr!Restr1),
     H=(sem!restr!(first!_ & rest!Restr2)),
     fappend(Restr1,Restr2,Restr).
d. semantic_feature_principle_3(M,H) :-
     M=(sem!index!Index),
     H=(sem!index!Index).
```

Figure 6.15: The Semantic Feature Principle

The application of the principle divided into two cases in Figure 6.16 where operator $\oplus$ indicates an ordinary list concatenation.

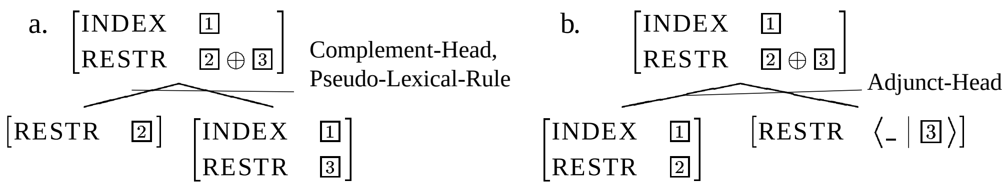


Figure 6.16: The Semantic Feature Principle: (a) Complement (b) Adjunct

When the headed structure is *complement-head* (or *pseudo-lexical-rule*), the semantic head is identical to the syntactic head. On the other hand, the semantic head is the modifier when the headed structure is *modifier-head*.

Subordinate Clause as Adverbial

We analyze the subordinate clause as a modifier to the matrix clause. Figure 6.17 illustrates analysis of (13), where adjunct-head schema in Figure 6.10 and Modifier Feature Principle discussed in the previous section play an important role.

(13) Ken-ga osokunat-ta node isogi nagara sitakusi-ta.
Ken-NOM be-late-PAST because be-hurried while prepare-PAST
'Ken prepared as being hurry since he was late for something.'

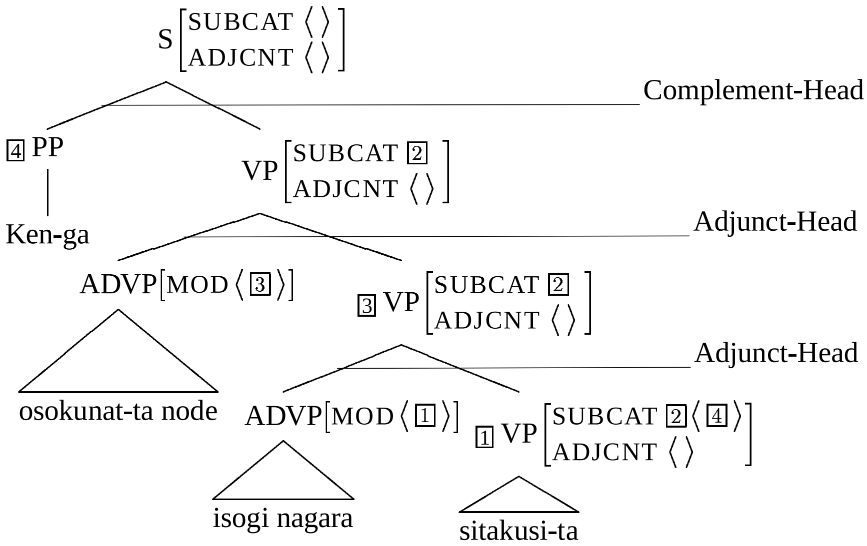


Figure 6.17: Adjunct-Head Structures with Subordinate Clauses

In Figure 6.17, each subordinate clause is analyzed as an adverbial phrase (ADVP). Their MOD features specify their sisters as VPs. On the other hand, the SUBCAT feature of the lowest VP, *sitakusi-ta*, is propagated up to the mothers and is canceled by the higher PP.

As discussed in the previous sections, hierarchical clause structure in Japanese has the following characteristics:

1. Co-occurrence between subordinate and matrix clauses concerns the conjunctives, which are their heads/markers.

2. Each conjunctive constrains the existence of tense and aspect in their complement verb phrase.[1]

Minami treated these two characteristics as a single hierarchy, whose levels are distinguished by labels A, B, C, and D. A close observation, however, indicates that they concern different structures: modification and adjacency which is a special case of complementation.

Moreover, these two characteristics entail the hypothesis that co-occurrence of the clauses should have (indirect) relation with existence of tense and aspect within themselves.

[1]We do not commit ourselves whether *-ru* and *-ta* convey tense information or not. Although we place them within tense feature for the simplicity, the following discussion depends only on the existence of *-ta* and distinction between *-ru* and *-ta*. For the same reason, we neither commit ourselves whether *-(te)i* and non *-(te)i* form of verb convey aspect information or not though they are described in aspect feature. See also Section 6.4.3.

6.5.2 A Constraint-base Approach to Subordinate Clause Modifier

Embeddedness

To formalize the hierarchical clause, we must also reformulate ‘embeddedness’ in Minami’s notion into (our) phrase structure.

Suppose that a given sentence has two subordinate clauses VP$_1$-conj$_1$ and VP$_2$-conj$_2$ and also has matrix clause VP. We then assume the correspondence between Minami’s embeddedness and phrase structure as shown in Table 6.3.

Table 6.3: Minami’s Embeddedness and Phrase Structure

Minami’s Embeddedness	Phrase Structure
VP$_1$-conj$_1$ is embedded within VP$_2$-conj$_2$	(((VP$_1$-conj$_1$ VP$_2$) conj$_2$) VP)
VP$_1$-conj$_1$ is not embedded within VP$_2$-conj$_2$	(VP$_1$-conj$_1$ (VP$_2$-conj$_2$ VP))

Regarding conj$_2$, the difference between embeddedness is identified by modification of VP$_2$ with/without VP$_1$-conj$_1$.

The Lexical Entry of Conjunctive Particles

These considerations lead us to introduce the lexical entries of conjunctives in Figure 6.18 and 6.19, which have ADJCNT and MOD features to state the above characteristics.

In Figure 6.18 and 6.19, $\otimes$ means some kind of ‘composition’ that merges the aspects/tenses of subordinate and matrix clauses. Since the detail of this operation does not concern the following discussion, we only assume that the result of the operation be a list.[2]

As Minami pointed out, level A clauses cannot contain tense markers. ADJCNT feature in *nagara* specifies that the adjacent VP does not have tense. On the other hand, level B clauses must contain tense markers, so the ADJCNT feature in *node* is specified as such. The crucial data are listed below:

(2) a. [$_B$ [$_B$ Ken-ga] [$_A$ [$_A$ naitaa-wo mi-nagara], razio-wo kii-]-tei-]-ta-yo.
‘... Ken is watching the night game ’

b. *[$_A$ [$_B$ Ken-ga] naitaa-wo mi-nagara], razio-wo kii-tei-ta-yo.
‘... Someone except Ken is watching the night game ’

(3) [$_B$ [$_B$ Ken-ga (terebi-de) naitaa-wo mi-ta-node],
Ken-NOM TV-with night game-ACC watch-PAST -since
[$_B$ ϕ] razio-wo kii-ta].
(someone) radio-ACC listen-PAST
‘(Lit.) Since Ken watched the night game, someone listened to the radio.’

[2] See Section 6.4.3.

$$\begin{bmatrix} \text{HEAD} & \textit{adv} \\ \text{ADJCNT} & \left\langle \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SEM} & \begin{bmatrix} \text{RESTR} & \left\langle \begin{bmatrix} \text{EVENT} & \begin{bmatrix} \text{ACTOR} & \boxed{2} \end{bmatrix} \\ \text{ASPECT} & \boxed{5}\left\langle \textit{aspect} \right\rangle \\ \text{TENSE} & \langle\, \rangle \end{bmatrix} \mid \_ \right\rangle \end{bmatrix} \\ \text{SUBCAT} & \left\langle \text{XP}[\textit{ga}]\,\boxed{2} \mid \_ \right\rangle \end{bmatrix} \right\rangle \\ \text{SUBCAT} & \langle\, \rangle \\ \text{MOD} & \left\langle \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & \boxed{6} \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{EVENT} & \boxed{1}\begin{bmatrix} \text{ACTOR} & \boxed{2} \end{bmatrix} \\ \text{ASPECT} & \boxed{3} \\ \text{TENSE} & \boxed{4} \end{bmatrix} \mid \_ \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & \boxed{6} \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{EVENT} & \boxed{1} \\ \text{ASPECT} & \left\langle \text{nagara}_{asp} \mid \boxed{5} \otimes \boxed{3} \right\rangle \\ \text{TENSE} & \boxed{4} \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

Figure 6.18: ‘*nagara*’: Feature Structure

$$\begin{bmatrix} \text{HEAD} & \textit{adv} \\ \text{ADJCNT} & \left\langle \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SEM} & \begin{bmatrix} \text{RESTR} & \left\langle \begin{bmatrix} \text{ASPECT} & \boxed{4} \\ \text{TENSE} & \boxed{5}\left\langle \textit{tense} \right\rangle \end{bmatrix} \mid \_ \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{SUBCAT} & \langle\, \rangle \\ \text{MOD} & \left\langle \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & \boxed{6} \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{EVENT} & \boxed{1} \\ \text{ASPECT} & \boxed{2} \\ \text{TENSE} & \boxed{3} \end{bmatrix} \mid \_ \right\rangle \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{SEM} & \begin{bmatrix} \text{INDEX} & \boxed{6} \\ \text{RESTR} & \left\langle \begin{bmatrix} \text{EVENT} & \boxed{1} \\ \text{ASPECT} & \left\langle \text{node}_{asp} \mid \boxed{4} \otimes \boxed{2} \right\rangle \\ \text{TENSE} & \boxed{5} \otimes \boxed{3} \end{bmatrix} \mid \_ \right\rangle \end{bmatrix} \end{bmatrix}$$

Figure 6.19: ‘*node*’: Feature Structure

Note that this specification does not exclude non-*ta*-forms of the VP adjacent to *node* since we define it as an underspecification of tense. Although we simply describe the semantics of subordinate clause headed by *nagara* and *node* as aspects in the matrix clause, we do not commit ourselves to this description. The following discussion does not rely on how the semantics of subordinate clauses is represented within the semantics of the matrix clause.

Modification Constraints on Subordinate Clauses

Figure 6.20 illustrates the interaction among various schemata and principles.

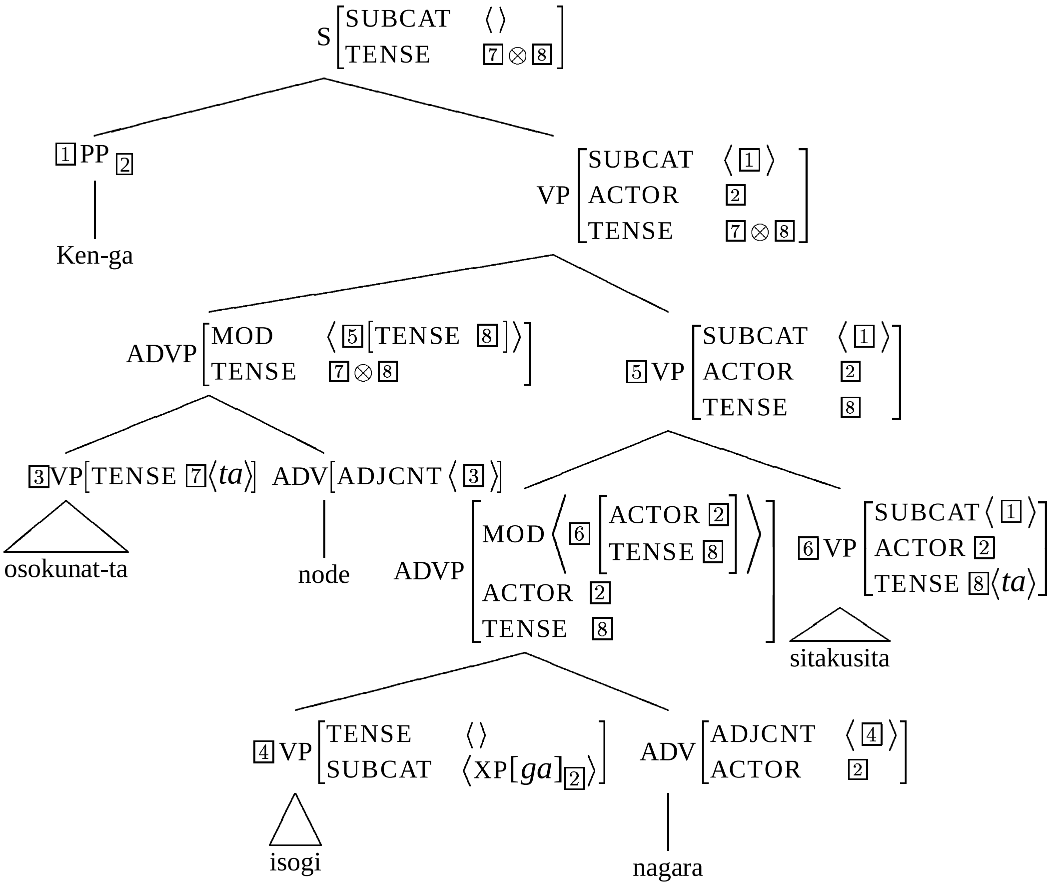


Figure 6.20: ‘*ken ga osokunat ta node isogi nagara sitausi ta*’: Tree Diagram

In contrast to the ADJCNT feature, the MOD feature specifies the property of the phrase to be modified. The first element of the MOD feature of the subordinate clause should be unified with the phrasal sign of matrix clause due to the Modifier Feature Principle. Constraints on the ADJCNT and MOD features eliminate improper parses (14b) and (14c).

(14) a. [Ken-ga [[osokunat-ta node]
Ken-NOM be-late-PAST because
[[isogi nagara] sitakusi-ta]]].
be-hurried while prepare-PAST

b. ∗ [[[Ken-ga osokunat-ta] node] isogi] nagara] . . . .
Ken-NOM be-late-PAST because be-hurried while

c. ∗ [Ken-ga [[osokunat-ta node] [isogi nagara]]] . . . .
Ken-NOM be-late-PAST because be-hurried while

As mentioned in Minami (1974), subordinate clause followed by *nagara* cannot contain a nominative NP. This property is captured by the ADJCNT feature of *nagara*. See the lexical entry for *nagara* in Figure 6.18 and the parse tree in Figure 6.20. The first element of ADJCNT is unified with the phrasal sign immediately preceding *nagara*. The element specifies the SUBCAT feature as the list whose first element is a phrase marked by *ga*-marked nominal. This means that a nominative NP is not saturated in the subordinate clause followed by *nagara*.

The ADJCNT feature of *nagara* also accounts for another property. The subordinate clause followed by *nagara* cannot have a tense which is represented by *ru* and *ta*. The empty list of the TENSE feature in the ADJCNT feature reflects this property. (14b) violates these two constraints on the feature of *nagara*. (14c) violates the constraint that the HEAD feature specification in MOD feature be of type *verb*.

In contrast to the ADJCNT feature, the MOD feature specifies the property of the phrase to be modified. The first element of the MOD feature of *nagara* should be unified with the phrasal sign of matrix clause due to Modifier Feature Principle. This unification ensures that the missing subject of the subordinate clause is identical to the subject of the matrix clause, since the semantic contents of the missing subject (represented as variable [2] in Figure 6.18) is shared with ACTOR features (i) in the first element of ADJCNT feature and (ii) in the first element of MOD feature. Figure 6.20 illustrates this situation where the SEM feature of the argument in the subordinate clause *isogi* ‘be-hurried’ and ACTOR feature in the matrix clause *sitakusita* ‘prepared’ share their contents.

As illustrated in Figure 6.19, the subordinate clause followed by *node* can contain a nominative NP and it must exhibit tense. These are represented by the lack of constraints on SUBCAT feature and the non-empty value of the TENSE feature in the ADJCNT feature, respectively.

Note that the properties of *nagara*: (i) absence of nominative and tense of the subordinate clause, (ii) co-indexing between nominative of the subordinate clause and subject of matrix clause and the properties of *node*: (i) arbitrary presence of nominative and (ii) obligatory presence tense for subordinate clause are described as lexical information in local manner. These constraints form interaction among constraints expressed in the lexical entries. Thus there is no need to assume tentative labels A, B, C, and D of subordinate clauses.

6.6 Summary

In this chapter, we have extended the framework of NAIST JPSG for constructing a practical parser to overcome the problem on long-sentence parsing. The principles, schemata and features are designed through consideration of various aspects of Japanese and describing regularities among them as a set of local constraints. Especially, we reformulate the functional view of Japanese complex hierarchy as organized hierarchical semantic feature. There still remain many problems since complicated interactions occur in clause structure in Japanese. However we have provided a more fine-grained explanation for the constraints in hierarchical clause than that proposed by Minami, and our explanation is based only on the information within lexical entries and would be applicable to other conjunctive particles that are not mentioned here.

Chapter 7

Raising and Control Verbs and the Word Order of Complex Sentences

7.1 Introduction

English epistemic verbs like *consider* can take at least three kinds of complement clause, a full clause in (1a), an infinitive (1b), and a so called small clause (1c):[1]

(1) a. I consider [(that) he is intelligent].
b. I consider [him to be intelligent].
c. I consider [him intelligent].

There has been much debate in the literature about the structure of (1b) whose propositional content is virtually equivalent to (1a). Postal (1974), Postal and Pullum (1988), Lasnik and Saito (1991) among others argue that sentences like (1b) are derived by the raising-to-object (hereafter RTO) movement.

Chomsky (1972a, 1981, 1986a), on the other hand, argues that (1b) involves an exceptional case-marking (hereafter ECM) process under S′-deletion or IP complementation. ECM analysis, for example, suggests the structure in Figure 7.1.

The accusative case-marking of *him* is exceptionally done through government by *consider*, although *him* is not θ-marked by the case-assigner.[2]

7.2 Japanese RTO/ECM Construction

7.2.1 Japanese Counterpart of Raising Constructions

Kuno (1976), Abe (1991), Tanaka (1992) and Sakai (1996) among others strongly argue that Japanese has a counterpart of (1b), which is also derived by RTO move-

[1] In this paper, we are not concerned with the so called small clauses.

[2] See Chomsky (1981, 1986a) for the definition of *government* and its related principles.

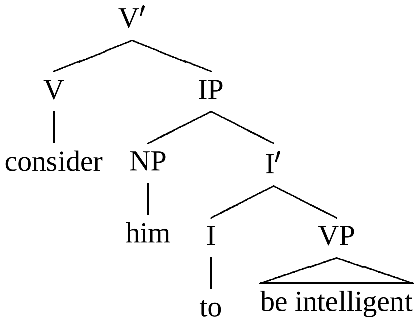


Figure 7.1: Exceptional Case Marking Analysis: Tree Diagram

ment:[3]

(2) a. Ken-wa [Naomi-ga kasikoi to] omo-ttei-ta.
Ken-TOP Naomi-NOM intelligent that think-PROG -PAST
'Ken thought that Naomi was intelligent.'

b. Ken-wa Naomi-wo [kasikoi to] omo-ttei-ta.
Ken-TOP Naomi-ACC intelligent that think-PROG -PAST
'Ken thought Naomi to be intelligent.'

Kaneko (1988) and Ueda (1988), on the other hand, argue that (2b) also involves ECM process under full CP and C′ complementation.

7.2.2 Scramblability of Accusative-marked NP

There can be no doubt that the RTO/ECM phenomenon exists in Japanese, but there are at least two questions that cannot be explained by previous analyses.

One of the problems is concerned with the position of an accusative-marked NP, which can be generally scrambled. Compare (3) with (4) below:

(3) a. Yamada-wa Tanaka-wo baka da to omo-ttei-ta.
Yamada-TOP Tanaka-ACC fool is that think-PROG -PAST
'Yamada thought Tanaka to be a fool.' (Kuno (1976): 24)

b. *Yamada-wa baka da to Tanaka-wo omo-ttei-ta.
Yamada-TOP fool is that Tanaka-ACC think-PROG -PAST
(Kuno (1976): 35)

[3]In French and Italian, sentences corresponding to (1b) are ungrammatical.

(i) a. *Je croyais Marie être intelligent.
b. *Io ritenevo Mary essere intelligente.
'I believe Mary to be intelligent.'

See Kayne (1981) and Authier (1991) for detailed discussion.

(4) a. Yamada-wa Tanaka-no koto-wo baka da to omo-ttei-ta.
Ken-TOP Tanaka-GEN matter-ACC fool is that think-PROG -PAST
'Yamada thought Tanaka to be a fool.'

b. Yamada-wa baka da to Tanaka-no koto-wo omo-ttei-ta.
Yamada-TOP fool is that Tanaka-GEN thing-ACC think-PROG -PAST

Note that Kuno's observation indicates that an *wo*-marked NP in (3a), *Tanaka-wo*, cannot to be located to the right of the complement clause as in (3b), while *Tanaka-no koto-wo* in (4a) can be as is shown in (4b). Though the judgment in (3b) is subtle, most speakers we consulted recognize the expected unscramblability regarding (5) below:

(5) a. Ken-wa Osaka-wo omosiroi to omo-ttei-ta.
Ken-TOP Osaka-ACC interesting that think-PROG -PAST
'Ken thought Osaka to be interesting.'

b. *Ken-wa omosiroi to Osaka-wo omo-ttei-ta.
Ken-TOP interesting that Osaka-ACC think-PROG -PAST
(Judgment is mine.)

The question arising from the difference between (3b) and (4b) is: How can we derive the difference between *Naomi-wo* and *Naomi-no koto-wo* concerning their scramblability?

7.2.3 Restriction of Complement Predicates

Another question comes from the restriction of complement predicate. Kuno argues that it is limited to either adjectives or 'nominal + copula *da*' (Kuno (1976) p. 33). Now consider (6) below:

(6) a. *Ken-wa Naomi-wo Tokyo-ni kita to omo-tta.
Ken-TOP Naomi-ACC Tokyo-DAT came that think-PAST
'Ken thought that Naomi came to Tokyo.'

b. Ken-wa Naomi-wo hutotta to omo-tta.
Ken-TOP Naomi-ACC had.gained.weight that think-PAST
'Ken thought that Naomi had gained weight.' (p.c. Takao Gunji)

As shown in (6a), RTO/ECM is not licensed, in this case, with *kita* as Kuno's restriction predicts. However, it is licensed in the case with *hutotta* in (6b), though the complement predicate is neither adjectives nor 'nominal + copula *da*'. The question arising immediately from this contrast is: How can we define the nature of the predicates allowing RTO/ECM?

In the following sections, we will seek the answer to these questions, examining how RTO/ECM phenomenon can be dealt with within the framework of JPSG.

7.3 Previous Analyses of Raising Verb Constructions

7.3.1 Raising-to-Object Approaches

RTO with Perceptual Verb

Most of the transformational approaches to Japanese *perceptual* verb constructions advocate a raising-to-object analysis (Kuno 1976, Abe 1991, Lasnik & Saito 1991, Tanaka 1992, Sakai 1996). In particular, Kuno (1976) aruges that Japanese also exhibits a RTO phenomenon. Consider the following sentences:

(7) a. Yamada-wa Tanaka-ga baka da to omo-ttei-ta.
Yamada-TOP Tanaka-NOM fool is that think-PROG -PAST
'Yamada thought that Tanaka was a fool.' (Kuno 1976: 23-24)

b. Yamada-wa Tanaka-wo baka da to omo-ttei-ta.
Yamada-TOP Tanaka-ACC fool is that think-PROG -PAST
'Yamada thought Tanaka to be a fool.' (Kuno 1976: 24)

(8) a. Yamada-wa Tanaka-ga hannin da to danteisi-ta.
Yamada-TOP Tanaka-NOM culprit is that determine-PAST
'Yamada determined that Tanaka was the culprit.' (Kuno 1976: 24)

b. Yamada-wa Tanaka-wo hannin da to danteisi-ta.
Ken-TOP Tanaka-ACC culprit is that determine-PAST
'Yamada determined Tanaka to be the culprit.' (Kuno 1976: 24)

As these glosses show, (7) and (8) show essentially the same alternation phenomenon as the one found in English. Let us summarize some of Kuno's (1976) arguments for RTO.

Word Order and Support Fact

Owing to the relatively free word order in Japanese, the subject-oriented adverb may appears in various positions. In (9b), however, the adverb *orokanimo* 'stupidly' which is a constituent of the main clause cannot be placed inside the embedded clause:

(9) a. Orokanimo, Yamada-wa Tanaka-ga tensai da to
stupidly Yamada-TOP Tanaka-NOM genius is that
omo-ttei-ta.
think-PROG -PAST
'Stupidly, Yamada thought that Tanaka was a genius.'
(Kuno 1976: 25)

b. *Yamada-wa [Tanaka-ga orokanimo tensai da] to
Yamada-TOP Tanaka-NOM stupidly genius is that
omo-ttei-ta.
think-PROG -PAST (Kuno 1976: 25)

When the complement subject is marked with the nominative case-marker *ga* as in (9b), the adverb cannot modify the matrix subject in the intended reading as (9a). But if it is marked with the accusative case marker *wo*, the adverb can modify the matrix verb as shown below:

(10) a. Orokanimo, Yamada-wa Tanaka-wo baka da to omo-ttei-ta.
stupidly Yamada-TOP Tanaka-ACC fool is that think-PROG -PAST
'Stupidly, Yamada thought Tanaka to be a fool.' (Kuno 1976: 25)

b. Yamada-wa Tanaka-wo orokanimo baka da to omo-ttei-ta.
Yamada-TOP Tanaka-ACC stupidly fool is that think-PROG -PAST
(Kuno 1976: 25)

This can be accounted for given the assumption that *Tanaka-wo* in (10b) is a matrix constituent.

A Japanese *zibun* phrase can be coreferential with its clause-mate subject but a third person pronoun cannot be coreferential with the subject as shown in (11):

(11) a. Yamada$_i$-wa zibun$_i$-wo hihansi-ta
Yamada-TOP self-ACC criticize-PAST
'Yamada$_i$ criticized himself$_i$.' (Kuno 1976: 28)

b. *Yamada$_i$-wa kare$_i$-wo hihansi-ta
Yamada-TOP he-ACC criticize-PAST
'Yamada$_i$ criticized him$_i$.' (Kuno 1976: 28)

Compare (11a) and (11b) with (12) and (13), respectively:

(12) a. Yamada$_i$-wa zibun$_i$-ga tensai da to omo-ttei-ta.
Yamada-TOP self-NOM genius is that think-PROG -PAST
'Yamada$_i$ thought that he$_i$ is a genius.' (Kuno 1976: 29)

b. Yamada$_i$-wa zibun$_i$-wo tensai da to omo-ttei-ta.
Yamada-TOP self-ACC genius is that think-PROG -PAST
'Yamada$_i$ thought him$_i$ to be a genius.' (Kuno 1976: 29)

(13) a. ?Yamada$_i$-wa kare$_i$-ga tensai da to omo-ttei-ta.
Yamada-TOP he-NOM genius is that think-PROG -PAST
'Yamada$_i$ thought that he$_i$ is a genius.' (Kuno 1976: 29)

b. *Yamada$_i$-wa kare$_i$-wo tensai da to omo-ttei-ta.
Yamada-TOP he-ACC genius is that think-PROG -PAST
'Yamada$_i$ thought him$_i$ to be a genius.' (Kuno 1976: 29)

In (12), both the nominative case marker and accusative case marker are possible with *zibun*, which is coreferential with the matrix subject. In (13), on the other hand, *kare* is possible only with the nominative case marker. This paradigm is expected if the noun phrase marked with the accusative case marker in (13b) is a matrix constituent and treated in the same way as (11b).

Lasnik and Saito (1991) provide further empirical data which strongly supports RTO analysis in English:

(14) a. Joan believes [$_S$ (that) he$_i$ is a genius] even more fervently than Bob$_i$'s mother does.

b.?*Joan believes him$_i$ even more fervently than Bob$_i$'s mother does.

c. ?*Joan believes him$_i$ [$_S$ t_i to be a genius] even more fervently than Bob$_i$'s mother does. (Lasnik and Saito (1991): 327-328)

(15) a. ?*The DA proved [$_S$ that the defendants$_i$ were guiltily] during each other$_i$'s trial.

b. ?The DA accused the defendants$_i$ during each other$_i$'s trial.

c. ?The DA proved the defendants$_i$ [$_S$ t_i to be guilty] during each other$_i$'s trial. (Lasnik and Saito (1991): 328)

These examples show that the subject of the infinitival in (14c) behaves like the object of the transitive verb in (14b). According to their analysis, the ungrammaticality of both (15b) and (15c) is due to the violation of Binding Condition C.[4] This is straight forwardly explained by RTO analysis, since *him* in both examples c-command the NPs in their adjunct parts. Their proposal is confirmed by the case for Binding Condition A in (15) where *defendants* in both (15b) and (15c) can c-command the reciprocals in adjunct parts.

Let us now turn to Japanese. Counterparts of (14) and (15) which are given in (16) and (17), respectively:

(16) a. Naomi-wa [$_S$ kare$_i$-ga tensai da to] Ken$_i$-no hahaoya yori
Naomi-TOP he genius is that Ken's mother than
tuyoku sinzi-tei-ru.
fervently believe-PROG -PRES
'Naomi believes that he is a genius even more fervently than Keni's mother does.'

b.?*Naomi-wa kare$_i$-o Ken$_i$-no hahaoya yori tuyoku
Naomi-TOP him Ken's mother than fervently
sinzi-tei-ru.
believe-PROG -PRES
'Naomi believes him even more fervently than Keni's mother does.'

c.?*Naomi-wa kare$_i$-o [$_S$ t_i tensai da to] Ken$_i$-no hahaoya yori
Naomi-TOP he genius is that Ken's mother than
tuyoku sinzi-tei-ru.
fervently believe-PROG -PRES
'Naomi believes him to be a genius even more fervently than Keni's mother does.'

(17) a.?*Naomi-wa [$_S$ karera$_i$-ga kyoohan da to] otagai$_i$-no
Naomi-TOP they complicity is that each other-GEN

[4]See Lasnik and Saito (1991) for the definition of Binding and its related conditions.

syoogen-ni motozuite utaga-tta.
testimony-DAT based on suspect-PAST
'Naomi suspected that they are complicity based on each other's testimony.'

b. Naomi-wa karera$_i$-o otagai$_i$-no syoogen-ni motozuiteutaga-tta.
Naomi-TOP them each other-GEN testimony-DAT based on suspected
'Naomi suspected him based on each others testimony.'

c. Naomi-wa karera$_i$-o [$_S$ t_i kyoohan da to] otagai$_i$-no
Naomi-TOP them complicity is that each other-GEN
syoogen-ni motozuite utagatta.
testimony-DAT based on suspect-PAST
'Naomi suspected him to be complicity based on each other's testimony.'

The prediction is borne out, though the Japanese data seem rather better than the English data.[5]

7.3.2 Exceptional Case Marking Approaches

Japanese CP-ECM Process

Kaneko (1988) and Ueda (1988) argue that the sentences like (2b) also involve the ECM process for its derivation, though Chomsky's (1981) motivation for not accepting RTO analysis is mainly theory internal.[6]

(2) a. Ken-wa [Naomi-ga kasikoi to] omo-ttei-ta.
Ken-TOP Naomi-NOM intelligent that think-PROG -PAST
'Ken thought that Naomi was intelligent.'

b. Ken-wa Naomi-wo [kasikoi to] omo-ttei-ta.
Ken-TOP Naomi-ACC intelligent that think-PROG -PAST
'Ken thought Naomi to be intelligent.'

Kaneko (1988) accepts Kuno's (1976) proposal that Japanese has a raising construction which is distinguishable from the control construction. However, he rejects the RTO analysis and discusses how his CP-ECM analysis accounts for Kuno's evidences of RTO phenomena of embedded subjects in the ECM sentences, without assuming RTO movement.

Kaneko assumes, along lines suggested by Saito (1982, 1983, 1985), the accusative case is assigned to an NP under government by a transitive verb, while the

[5]See Sakai (1996) for detailed discussion.

[6]The Projection Principle and θ-criterion conspire to rule out movements to complement position. However, if it turns out that either of these two principles is incorrect, or at least weaker than originally hypothesized, RTO analysis can be maintained. We are not concerned with such a problem in this thesis.

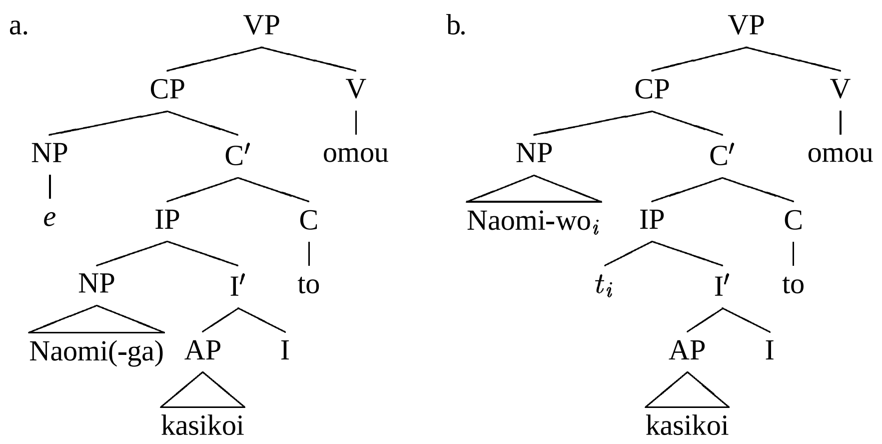


Figure 7.2: CP-ECM (a) Before and (b) After Movement: Tree Diagram

nominative case marker *-ga* is attached to a phrase, where the *ga*-marked phrases are subject to the condition in (18) at S-structure:

(18) **Definition 35 (The Condition for *Ga*-Marking:)**
A ga-marked phrase must appear in $[_{\text{IP}}\ \ I^n\ ]$

Given these assumptions, Kaneko proposes the structures in Figures 7.2a and 7.2b for (2a) and (2b), respectively. Kaneko claims that the Japanese CP-ECM process is involved in the case where an embedded subject NP, *Naomi(-ga)* in Figure 7.2a, is not assigned the nominative case. The subject NP, as it stands, cannot pass the Case filter; therefore it is forced to move to the SPEC(CP) where matrix verb can govern and assign Case, as in Figure 7.2b.[7]

Word Order Problem for RTO Analyses

Kaneko (1988) points out that while Kuno's (1976) evidence certainly supports the RTO analysis, it does not play any role for assuming only RTO analysis if a problem arises due to word order. Kaneko demonstrates that those pieces of evidence can also be explained under his CP-ECM analysis, as follows.

Kuno (1976) points out that while an *wo*-marked embedded subject can be scrambled, a *ga*-marked embedded subject cannot:

(19) a. Yamada-wa Tanaka-ga tensai da to omo-ttei-ta.
Yamada-TOP Tanaka-NOM genius is -COMP think-PROG -PAST
'Yamada thought that Tanaka was a genius.' (Kuno 1976: 26)

[7]One of Kuno's pieces of evidence for RTO analysis is the fact that *Naomi-wo* in Figure 7.2b is marked with the accusative Case. Kaneko claims that it does not occupy the subject position of the embedded clause. In this respect, CP-ECM analysis assumes that CP is not a barrier for its specifi er, and thus accusative Case is assigned to a NP in SPEC(CP) under government by matrix verb. See Kaneko (1988) for a detailed discussion.

b. *Tanaka-ga Yamada-wa tensai da to omo-ttei-ta.
Naomi-NOM Yamada-TOP genius is -COMP think-PROG -PAST
(Kuno 1976: 26)

(20) a. Yamada-wa Tanaka-wo tensai da to omo-ttei-ta.
Yamada-TOP Tanaka-ACC genius is -COMP think-PROG -PAST
'Ken thought Naomi to be a genius.' (Kuno 1976: 26)

b. Tanaka-wo Yamada-wa tensai da to omo-ttei-ta.
Tanaka-ACC Yamada-TOP genius is -COMP think-PROG -PAST
(Kuno 1976: 26)

Under Kuno's analysis the contrast between (19b) and (20b) indicates that *Naomi-wo* in (20a) behaves as a constituent of the matrix clause; therefore it can be preposed freely to the pre-subject position by scrambling. *Naomi-ga* in (19a), on the other hand, is a constituent of the embedded clause and cannot overpass the matrix subject.

Kuno also points out that while the subject-oriented adverb *orokanimo* 'stupidly' can be placed after an *wo*-marked embedded subject, it cannot be placed after a *ga*-marked embedded subject.

(21) a. Yamada-wa orokanimo Tanaka-ga baka da to omo-ttei-ta.
Yamada-TOP stupidly Tanaka-NOM fool is that think-PROG -PAST
'Yamada stupidly thought that Tanaka was a fool.' (Kuno 1976: 25)

b. *Yamada-wa [Tanaka-ga orokanimo baka da] to
Yamada-TOP Tanaka-NOM stupidly fool is that
omo-ttei-ta. (Kuno 1976: 25)
think-PROG -PAST

(22) a. Yamada-wa orokanimo Tanaka-wo baka da to omo-ttei-ta.
Yamada-TOP stupidly Tanaka-ACC fool is that think-PROG -PAST
'Yamada stupidly thought Tanaka to be a fool.' (Kuno 1976: 25)

b. Yamada-wa Tanaka-wo orokanimo baka da to omo-ttei-ta.
Yamada-TOP Tanaka-ACC stupidly fool is that think-PROG -PAST
(Kuno 1976: 25)

This is also accounted for if *Naomi-wo* in (22) behaves as a constituent of the matrix clause, as mentioned in the previous section.

However, these contrasts do not fully support Kuno's argument. Kaneko (1988) notes that Saito (1985) demonstrates that *ga*-marked phrases generally cannot be scrambled but *wo*-marked phrases can be scrambled out of an embedded clause:

(23) Sono hon$_i$-wo John-ga [Mary-ga t_i katta to]
the book-ACC John-NOM Mary-NOM bought -COMP
omo-ttei-ru.
think-PROG -PRES
'The book, John thinks that Mary bought.' Saito (1985: 156)

Kaneko argues that the contrast between (19b) and (20b) comes from the unscramblability of *ga-marked* phrase, as shown below:

(24) a. *Tanaka-ga$_i$ Yamada-wa [t_i baka da to] omo-ttei-ta.
b. Tanaka-wo$_i$ Yamada-wa [t_i baka da to] omo-ttei-ta.

Kaneko further claims that the contrast between (21b) and (22b) is also the result of the application of scrambling to (21a) and (22a), respectively:

(25) a. *Yamada-wa Tanaka-ga$_i$ orokanimo [t_i baka da to] omo-ttei-ta.
b. Yamada-wa Tanaka-wo$_i$ orokanimo [t_i baka da to] omo-ttei-ta.

Referring to the general unscramblability of *ga*-marked phrase, Kaneko concludes that these phenomena do not support Kuno's argument, either.

Word Order Problem for ECM Analyses

There are, however, some problems in the ECM analysis both empirically and theoretically.[8] Putting aside the theoretical problems, we point out here that the ECM analysis fails to capture details of pseudo-clefting. Compare (26) with (27) below:

(26) a. Ken-wa Naomi-ga kawaii to omo-ttei-ru.
Ken-TOP Naomi-NOM pretty that think-PROG -PRES
'Ken thinks Naomi is pretty.'

b. Ken-ga omo-ttei-ru nowa [$_{XP}$ Naomi-ga kawaii]
Ken-NOM think-PROG -PRES is Naomi-NOM pretty
toiukoto da.
that is
'What Ken thinks is that Naomi is pretty.'

(27) a. Ken-wa Naomi-wo kawaii to omo-ttei-ru.
Ken-TOP Naomi-ACC pretty that think-PROG -PRES
'Ken thought Naomi to be pretty.'

b. *Ken-ga omo-ttei-ru nowa [$_{XP}$ Naomi-wo kawaii]
Ken-NOM think-PROG -PRES is Naomi-ACC pretty
toiukoto da.
that is

When *Naomi* is marked with *ga* as in (26a), the complement clause containing it can be clefted as shown in (26b). On the other hand, such a clefting is not possible when *Naomi* is marked with *wo* as (27b), although *wo*-marked NP is also expected to be occupied within the complement clause. This test suggests *wo*-marked NP be not a constituent of CP as in Figure 7.2b.

[8] See Tanaka (1992) for the theoretical problems of Kaneko's CP-ECM analysis.

7.4 Control Verbs and Restriction of Complements

7.4.1 NP-*no koto* Sentence with Control Verb

Scramblability of Complement Clause

Kuno (1976) extensively argues that control (or equi) constructions like (28) and (29) below have a number of properties which are not found in raising (perceptual verb) constructions. One of his tests comes from the scramblability of the complement clause. In the case of control, the controlled complement can be moved around the matrix dative NP (= controller) as shown below:

(28) a. Yamada-wa Tanaka-ni sore-wo site kureru koto-wo
Yamada-TOP Tanaka-DAT it-ACC do thing-ACC
kitaisi-te-iru.
expect-PROG -PRES
'Yamada expects of Tanaka that he will do it.' (Kuno 1976: 33)

b. Yamada-wa sore-wo site kureru koto-wo Tanaka-ni
Yamada-TOP it-ACC do thing-ACC Tanaka-DAT
kitaisi-te-iru. (Kuno 1976: 35)
expect-PROG -PRES

(29) a. Yamada-wa Tanaka-ni sore-wo suru koto-wo meizi-ta.
Yamada-TOP Tanaka-DAT it-ACC do that-ACC order-PAST
'Yamada ordered Tanaka to do it.' (Kuno 1976: 34)

b. Yamada-wa sore-wo suru koto-wo Tanaka-ni meizi-ta.
Yamada-TOP it-ACC do that-ACC Tanaka-DAT order-PAST
(Kuno 1976: 35)

Now, compare (28) and (29) with (3) and (4):

(3) a. Yamada-wa Tanaka-wo baka da to omo-ttei-ta.
Yamada-TOP Tanaka-ACC fool is that think-PROG -PAST
'Yamada thought Tanaka to be a fool.'

b. *Yamada-wa kasikoi to Tanaka-wo omo-ttei-ta.
Yamada-TOP intelligent that Tanaka-ACC think-PROG -PAST

(4) a. Yamada-wa Tanaka-no koto-wo baka da to omo-ttei-ta.
Yamada-TOP Tanaka-GEN matter-ACC fool is that think-PROG -PAST
'Yamada thought Tanaka to be a fool.'

b. Yamada-wa baka da to Tanaka-no koto-wo omo-ttei-ta.
Yamada-TOP fool is that Tanaka-GEN thing-ACC think-PROG -PAST

Tanaka-ni in (28a) and (29a), and *Tanaka-no koto-wo* in (4a) can be located to the right of the complement clause, as (28b), (29b) and (4b), respectively. However, *Tanaka-wo* in (3a) cannot be located in such a position, as shown in (3b). It is noteworthy that the dative-marked NP and the NP-*no koto-wo* behave in the same manner.

Equi-NP Deletion

Equi-NP deletion also shows the similarity between dative-marked NP and the NP-*no koto-wo*. Kuno argues that equi-NP deletion is not an obligatory process, although (30a) and (30b) below are less natural than (28a) and (29a). See below:

(30) a. ?Yamada-wa Tanaka$_i$-ni kare$_i$-ga sore-wo site kureru koto-wo
Yamada-TOP Tanaka-DAT he-NOM it-ACC do thing-ACC
kitaisi-te-iru
expect-PROG -PRES
'(Lit.) Yamada expects of Tanaka$_i$ that he$_i$ will do it.'
(Kuno 1976: 35)

b. ?Yamada-wa Tanaka$_i$-ni kare$_i$-ga sore-wo suru koto-wo
Yamada-TOP Tanaka-DAT he-NOM it-ACC do that-ACC
meizi-ta.
order-PAST
'(Lit.) Yamada ordered Tanaka$_i$ that he$_i$ do it.' (Kuno 1976: 35)

Now consider the following constructions with a resumptive pronoun *kare-ga*:

(31) a. *Naomi-wa Ken-wo kare$_i$-ga kasikoi to omo-ttei-ta.
Naomi-TOP Ken-ACC he$_i$-NOM intelligent that think-PROG -PAST
(Judgment is mine.)

b. ?/?? Naomi-wa Ken-no koto-wo kare$_i$-ga kasikoi to
Naomi-TOP Ken-GEN matter-ACC he$_i$-NOM intelligent that
omo-ttei-ta.
think-PROG -PAST
'(Lit.) Naomi thought Ken$_i$ that he$_i$ is intelligent.'
(Judgment is mine.)

It is interesting that *kare-ga* co-occurs with NP-*no koto-wo* as shown in (31b). Though we will not be concerned with the problem of how resumptive pronouns are licensed, the crucial point here is that *Tanaka-ni* in (30) and *Naomi-no koto-wo* in (31b) share certain characteristics.

7.4.2 Semantic Restriction of Complement Predicates

Regulation by Verb Form

Another argument comes from the facts concerning 'selectional restriction'. In control cases, the matrix predicate poses some selectional restriction on the dative controller:

(32) *Yamada-wa sono hon-ni yoku ureru koto-wo kitaisi-te-iru.
Yamada-TOP that book-DAT well sell thing-ACC expect-PROG -PRES
'Yamada expects the book to sell well.' (Kuno 1976: 34)

In (32), *sono hon(-ni)* is not an appropriate 'expectee', which makes the sentence unacceptable. Compare (32) with the following sentences:

(33) a. Yamada-wa sono hon-wo tumaranai to omo-tta.
Yamada-TOP that book-ACC unintellesting that think-PAST
'Yamada thought the book to be uninteresting.' (Kuno 1976: 34)

b. *Yamada-wa sono hon-no koto-wo tumaranai to omo-tta.
Yamada-TOP that book-GEN thing-ACC uninteresting that think-PAST
'Yamada thought the book to be uninteresting.'

It is interesting that *sono hon-wo* in (33a) and *sono hon-no koto-wo* in (33b) exhibit the same contrast mentioned above. Kuno argues that when the object of raising verbs is human, *no koto* appears optionally after NP for the human (Kuno 1976 p.41). However, the contrast discussed above shows that the sentences with *no koto* share the properties with equi constructions and that there are at least two types of *omow*.

Kuno (1976) discusses that the complement predicates of RTO construction are limited to either adjectives or 'nominal + copula *da*'. This generalization predicts the unacceptability of the *wo*-marked NP in (34b) below, because the complement is a verb:

(34) a. Ken-wa Naomi-ga kuru to omo-tta.
Ken-TOP Naomi-NOM come that think-PAST
'Ken thought Naomi came.'

b. *Ken-wa Naomi-wo kuru to omo-tta.
Ken-TOP Naomi-ACC come that think-PAST

Kuno (1976) and Oshima (1979) point out that when the past tense form of a predicate appears, RTO construction is ungrammatical or (highly) marginal. However, some of the speakers we polled judged *baka-da-tta* not so bad:

(35) a. Ken-wa Naomi-wo baka da to omo-tta.
Ken-TOP Naomi-ACC fool is that think-PAST
'Ken thought that Naomi was a fool.' (Judgment is mine.)

b. ?/?? Ken-wa Naomi-wo baka da-tta to omo-tta.
Ken-TOP Naomi-ACC fool is-PAST that think-PAST
'Ken thought Naomi to be a fool.' (Judgment is mine.)

Oshima (1979) and Ueda (1988) discuss that the complement clause of RTO construction in Japanese is infinitive. If their arguments are correct, it gives an account of their judgment, but there are no implications for Kuno's and my accounts.

Regulation by Verb Meaning

This problem is not so simple. Sakai (1996) points out that the complement predicate is not regulated by its form. Consider (36) and (37) below:

(36) a. | Takasi-wa | ooame-ga | huri soo | da | to | omo-tta. |
|---|---|---|---|---|---|
| Takasi-TOP | heavy rain-NOM | rain is going to | is | that | think-PAST |

‘Takasi thought that it was going to rain heavily any minute now.’

b. | *Takasi-wa | ooame-wo | huri soo | da | to | omo-tta. |
|---|---|---|---|---|---|
| Takasi-TOP | heavy rain-ACC | rain is going to | is | that | think-PAST |

(Sakai 1996: 7, English is mine.)

(37) a. | Takasi-wa | kono | okasi-ga | oisi | soo | da | to | omo-tta. |
|---|---|---|---|---|---|---|---|
| Takasi-TOP | this | cake-NOM | delicious | looks like | is | that | think-PAST |

‘Takasi thought this cake was appetizing.’

b. | Takasi-wa | kono | okasi-wo | oisi | soo | da | to | omo-tta. |
|---|---|---|---|---|---|---|---|
| Takasi-TOP | this | cake-ACC | delicious | looks like | is | that | think-PAST |

‘Takasi thought this cake to be appetizing.’

(Sakai 1996: 7, English is mine.)

The grammaticality of the accusative case in (37b) is clearly problematic for Kuno and Oshima’s analyses, because they do not involve the form of either adjectives or nominal + copula *da*. Moreover, the following sentence, involving gerundive form *teiru* ‘being’ also seems good:

(38) a. | Ken-wa | Naomi-ga | huto-ttei-ru | to | omo-tta. |
|---|---|---|---|---|
| Ken-TOP | Naomi-NOM | stout-PROG -PRES | that | think-PAST |

‘Ken thought that Naomi was stout.’

b. | Ken-wa | Naomi-wo | huto-ttei-ru | to | omo-tta. |
|---|---|---|---|---|
| Ken-TOP | Naomi-ACC | stout-PROG -PRES | that | think-PAST |

‘Ken thought that Naomi to be stout.’ (p.c. Takao Gunji)

The data of (37b) and (38) show RTO is not regulated by form and/or tensedness of the predicate, and it is unexpected on the case-motivated account of RTO.

To explain the difference between (36b) and (37b), Sakai (1996) proposes that the essential nature of the complement predicate of RTO construction is the type of predication for the predicate, which is originally discussed in Borkin (1984):

(39) **Citation 1 (Borkin’s Generalization for the Complement Predicate of RTO)**
The predication in complements is a characteristics or an attribute of the entity represented by the raised NP. (Cited from Sakai 1996: 6)

Though we reject Sakai’s analysis without going into any detail about it here, we accept his intuition that the complement predicate and its subject must reflect the relation ‘*has a property X*,’ and that there is a stage- and individual-level predicate asymmetry for licensing RTO.[9] Now, consider the complement predicate of (34)–(37), which are repeated as (40a)–(40d) below:

(40) a. Naomi-ga kuru.
'Naomi comes.'

b. Naomi-wa baka-da.
'Naomi is a fool.'

c. Ooame-ga huri-soo-da.
'It is going to rain heavily.'

d. Kono okasi-wa oisi-soo-da.
'This cake is appetizing.'

Only (40b) and (40d), which are the complements of grammatical sentences, mean that the subject has a property described by its predicate, as predicted. We point out here for later discussion that this distinction is also reflected on the marker of the subject, i.e., *ga*/*wa*.[10]

Next, consider (41) and (42) below. If our assumption is correct then the subject's marker alternation reflects the interpretation of the adverbial complements:

(41) a. Ken-wa Naomi-ga saikin huto-tte-ki-ta to
Ken-TOP Naomi-NOM recently stout-PROG -become-PAST that
omo-tta.
think-PAST
'Ken thought that Naomi had gained weight recently.'

b.??Ken-wa Naomi-wo saikin huto-tte-ki-ta to
Ken-TOP Naomi-ACC recently stout-PROG -become-PAST that
omo-tta.
think-PAST
'Ken thought Naomi to have gained weight recently.'

(42) a.??Ken-wa Naomi-ga umaretuki huto-ttei-ru to omo-tta.
Ken-TOP Naomi-NOM by nature stout-be-PRES that think-PAST
'Ken thought that Naomi was stout by nature.'

b. Ken-wa Naomi-wo umaretuki huto-ttei-ru to omo-tta.
Ken-TOP Naomi-ACC by nature stout-be-PRES that think-PAST
'Ken thought Naomi to be stout by nature.'

By inserting some modifiers forcing a stage- and individual-level interpretation, nominative/accusative marker alternation is observed. If this account is correct and a stage-level predicate has some lexical property to license nominative marker as in (41a), it is also predicted that a small clause with such a predicate also allows a *ga*-marked argument. Consider the following:

[9] See Diesing (1992) for the discussion about the syntactic/semantic nature of stage- and individual-level predicate.

[10] See also Chapter 10.

(43) a. *Ken-wa Naomi-ga kawaiku omo-u.
Ken-TOP Naomi-NOM pretty think-PRES

b. Ken-wa Naomi-wo kawaiku omo-u.
Ken-TOP Naomi-ACC pretty think-PRES
'Ken thinks Naomi pretty.'

It is sometimes assumed that the realization of a nominative marker is associated with tense (Takezawa 1987). In (43a) the small clause predicate lacks an overt tense morpheme and the logical subject of the predicate cannot be marked as nominative. Next, consider (44):

(44) Boku-wa konogoro en-(ga/??wo) takaku omo-u.
I-TOP recently yen-NOM/ACC up think-PRES
'(Lit.) I think that the yen has recently strengthened on the exchange market.'

When inserting a modifier, a nominative marker is more suitable than an accusative marker, as shown in (44). This also suggests that a stage-level predicate licenses a nominative marker as discussed above.

In this section, we have discussed that the stage- and individual-level distinction of the complement predicates plays a crucial role for licensing RTO. This explanation also accounts for various judgments in (35b), because such a distinction greatly depends on speakers (Carlson 1977). We also mention the relation between the distinction and the marker.

7.5 The Linearization Approach to Word Order Variation

7.5.1 Scrambling Revisited

NAIST JPSG does not postulate individual phrase structure rules for constructing well-formed sentences, while most traditional syntactic theories assume that even linear ordering is defined by the phrase structure. In JPSG, the lexical information of subcategorization and some schemata replace the role played by PS-rules posited in such theories.

This section provides a characterization of word order variation in terms of a linearization approach (Calcagno 1993, Pollard et al. 1994, Dowty 1996, Gunji 1996a, Reape 1996), which allows the treatment of discontinuous constituency and relatively free word order without appealing to non-configurationality or some transformation for changing a phrase structure itself.

Phenogrammar and Tectogrammar

In Chapter 4, we have briefly mentioned that Japanese syntax can be characterized in terms of two interrelated, yet distinct, levels of representation. The linearization model assumes that natural language has at least two information.

The first is *tectogrammatical information*, which is a set of constraints on the phrase structure projected from valence properties of lexical items. The second is *phenogrammatical information* which is a separate set of constraints on word order or language as (phonological) strings, and may or may not depend on tectogrammatical relations such as sisterhood and so forth (Curry 1963, Pollard et al. 1994, Dowty 1996).

The NODE and the DAUGHTER Feature

In HPSG/JPSG, the linguistic object is taken to be a *sign*, modeled by a typed feature structure, where different types of feature structures permit different sets of appropriate features whose values in turn must be feature structures of an appropriate type. Thus, as in Figure 7.3, *signs* are taken to have the features MORPHON and SYNSEM whose values are a bundle of phonological information, and a bundle of syntactic and semantic information, respectively.

$$\begin{bmatrix} \textit{sign} & \\ \textsc{morphon} & \text{(morphophonological information)} \\ \textsc{synsem} & \begin{pmatrix}\text{morphosyntactic, valence,}\\ \text{and semantic content information}\end{pmatrix}\end{bmatrix}$$

Figure 7.3: Feature Structure of *sign*

Following Pollard et al. (1994), we will gather MORPHON and SYNSEM information into the object of type *node*, encoded by the feature NODE.

Phrasal *signs* also have a DTRS feature whose value is a bundle of structural information on the immediate constituents *signs* of the sign. As shown in Figure 7.4, NODE and DTRS information are included in the feature structure in Figure 7.3.

$$\begin{bmatrix} \textit{phrase} & \\ \textsc{node} & \begin{bmatrix}\textsc{morphon} & \text{(phonological information)} \\ \textsc{synsem} & \begin{pmatrix}\text{morphosyntactic, valence,}\\ \text{and semantic content information}\end{pmatrix}\end{bmatrix} \\ \textsc{dtr} & \text{(information about phrase structure)}\end{bmatrix}$$

Figure 7.4: Feature Structure of *phrase* with the NODE and the DTR Features

Note that DTR is not directly represented in the feature structure for the current implementation of NAIST JPSG. This is because both the analytic record maintained by CKY table in GraDEUS and the DTR feature substantially include the same information on phrase strucure, and moreover our grammar constraints are defined without referring to the feature. So, in the following discussion, DTR is assumed to be a theoretical device, but it can be readily introduced.

The DOMAIN Feature and Sequence Unifon

We also assume the DTRS attribute to be the locus for the type of information associated with tectogrammatical structure.

Phenogrammatial information, on the other hand, will be encoded in the feature DOM(AIN), certain points about which are summarized in (45).

(45) **Definition 36 (Reape's (1996) Linearization)**

- a. *Word order is determined within the word order domain.*
- b. *The word order domain is encoded by the feature* DOM.
- c. *The word order domain of a daughter may be the same as a subpart of the domain of its mother.*
- d. *The value of* DOM *is a list of elements of type* NODE*, which consists of the features* PHON *and* SYNSEM. *(d is from Pollard et al. (1994).)*

Assuming (45), the phrasal sign in Figure 7.4 is further extended as in Figure 7.5.

$$\begin{bmatrix} \textit{phrase} & \\ \text{NODE} & \boxed{1} \begin{bmatrix} \text{MORPHON} & \text{(phonological information)} \\ \text{SYNSEM} & \begin{pmatrix} \text{morphosyntactic, valence,} \\ \text{and semantic content information} \end{pmatrix} \end{bmatrix} \\ \text{DOM} & \langle \boxed{1} \rangle \\ \text{DTR} & \text{(information about phrase structure)} \end{bmatrix}$$

Figure 7.5: Feature Structure of *phrase* with the DOM Feature

We also assume the list concatenating operation *sequence union*. (45c) above is described by the *sequence union* in (46):

(46) **Definition 37 (Sequence Unifon)**

- a. *union*($\langle\rangle$, $\langle\rangle$, $\langle\rangle$)
- b. *union*($\langle A|X\rangle$, $\langle Y\rangle$, $\langle A|Z\rangle$) *if union(X, Y, Z)*
- c. *union*($\langle X\rangle$, $\langle A|Y\rangle$, $\langle A|Z\rangle$) *if union(X, Y, Z)*

That is, Z is a list obtained by merging X and Y with the condition that the relative order of elements in X and Y is preserved in Z. For example, let A $= \langle a, b\rangle$ and B $= \langle c, d\rangle$, then union(A, B, C) iff C is one of the sequences in (47):

(47) $\langle a, b, c, d\rangle$, $\langle a, c, b, d\rangle$, $\langle a, c, d, b\rangle$, $\langle c, d, a, b\rangle$, $\langle c, a, d, b\rangle$, $\langle c, a, b, d\rangle$

Based on the assumptions and definitions here, we will account for relatively free word order phenomena in the next section.

7.5.2 Word Order Variation as Domain Union

Let us now consider the word order phenomena using the example in (48).

(48) Ken-ga Naomi-ni keeki-wo age-ta.
Ken-NOM Naomi-DAT cake-ACC give-PAST
'Ken gave cakes to Naomi.'

Since Japanese is a head final language, *age-ta* 'gave,' the head in (48), must be located at the end of the given sentence, but the order of nonhead elements, three NPs *Ken-ga*, *Naomi-ni*, *Keeki-wo*, are (relatively) free.[11] See the possible word order variations of (48) below. [12]

(49) a. Ken ga Naomi ni keeki wo age ta.
b. Ken ga keeki wo Naomi ni age ta.
c. Naomi ni Ken ga keeki wo age ta.
d. Naomi ni keeki wo Ken ga age ta.
e. Keeki wo Ken ga Naomi ni age ta.
f. Keeki wo Naomi ni Ken ga age ta.

Here we assume an HPSG-based variant of the linearization model based on the work of Pollard et al. (1994), Reape (1996) etc., discussed in the previous section.

Let us examine the feature structure in Figure 7.6 for (48) and how the word order variation in (49) may be explained.

In Figure 7.6, each tectogrammatical combination will have associated with it the formation of a new, more inclusive phenogrammatical (word order) domain, such that elements in a daughter's order domain may become elements in the mother's order domain.

This allows tectogrammatically nonadjacent elements to be ordered adjacently in the phenogrammar, and it crucially allows even tectogrammatical non-sisters to be ordered with respect to each other phenogrammatically. The following are possible sequences of NODE in Figure 7.6.

(50)
$\langle \boxed{1}, \boxed{2}, \boxed{3}, \boxed{4} \rangle, \langle \boxed{2}, \boxed{1}, \boxed{3}, \boxed{4} \rangle, \langle \boxed{3}, \boxed{1}, \boxed{2}, \boxed{4} \rangle, \langle \boxed{4}, \boxed{1}, \boxed{2}, \boxed{3} \rangle,$
$\langle \boxed{1}, \boxed{2}, \boxed{4}, \boxed{3} \rangle, \langle \boxed{2}, \boxed{1}, \boxed{4}, \boxed{3} \rangle, \langle \boxed{3}, \boxed{1}, \boxed{4}, \boxed{2} \rangle, \langle \boxed{4}, \boxed{1}, \boxed{3}, \boxed{2} \rangle,$
$\langle \boxed{1}, \boxed{3}, \boxed{2}, \boxed{4} \rangle, \langle \boxed{2}, \boxed{3}, \boxed{1}, \boxed{4} \rangle, \langle \boxed{3}, \boxed{2}, \boxed{1}, \boxed{4} \rangle, \langle \boxed{4}, \boxed{2}, \boxed{1}, \boxed{3} \rangle,$
$\langle \boxed{1}, \boxed{3}, \boxed{4}, \boxed{2} \rangle, \langle \boxed{2}, \boxed{3}, \boxed{4}, \boxed{1} \rangle, \langle \boxed{3}, \boxed{2}, \boxed{4}, \boxed{1} \rangle, \langle \boxed{4}, \boxed{2}, \boxed{3}, \boxed{1} \rangle,$
$\langle \boxed{1}, \boxed{4}, \boxed{2}, \boxed{3} \rangle, \langle \boxed{2}, \boxed{4}, \boxed{1}, \boxed{3} \rangle, \langle \boxed{3}, \boxed{4}, \boxed{1}, \boxed{2} \rangle, \langle \boxed{4}, \boxed{3}, \boxed{1}, \boxed{2} \rangle,$
$\langle \boxed{1}, \boxed{4}, \boxed{3}, \boxed{2} \rangle, \langle \boxed{2}, \boxed{4}, \boxed{3}, \boxed{1} \rangle, \langle \boxed{3}, \boxed{4}, \boxed{2}, \boxed{1} \rangle, \langle \boxed{4}, \boxed{3}, \boxed{2}, \boxed{1} \rangle$

[11] Once a domain NODE corresponding to the NP, e.g., *Ken-ga* is in existence, there is no way that other NODE could be interleaved between the noun *Ken* and the postposition/marker *ga*.

[12] The difference in meaninig among sentences presented in (49), if any, is highly pragmatic. That is, older information tends to appear earlier in the sentence, but beyond that differences are minimal (see also Kuno (1973)). We will assume that sentences in (49) mean the same thing, pragmatic differences aside.

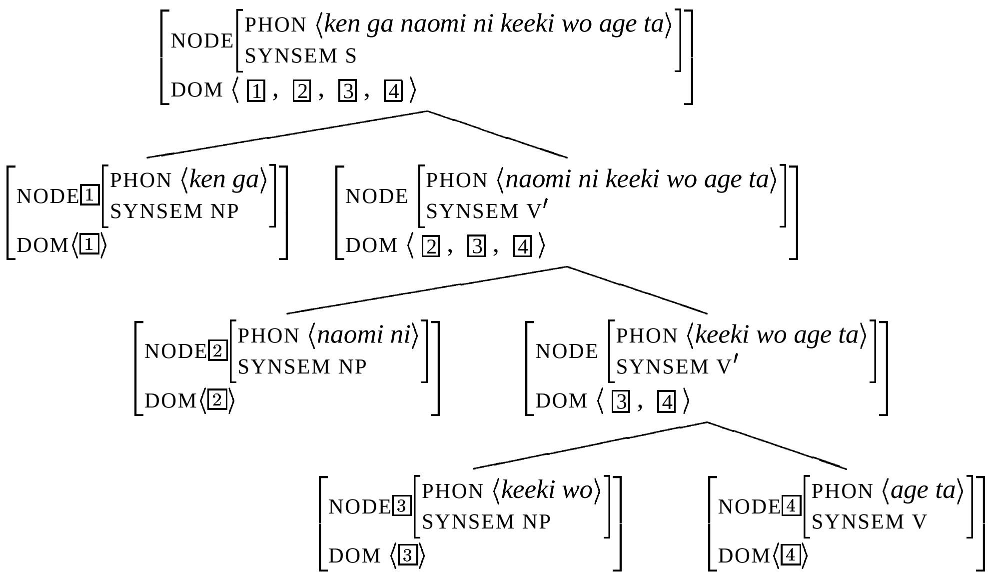


Figure 7.6: '*ken ga naomi ni keeki wo age ta*': Tree Diagram

Though the NODE features of the non-head daughter and the head daughter, i.e., ' $\boxed{1}$, $\boxed{2}$, $\boxed{3}$ ' and ' $\boxed{4}$,' are permutable in principle, we assume the linear precedence (LP) rule in Figure 7.7, which is needed to explain the head-final property of Japanese.

$$X < \text{head}$$

Figure 7.7: Linear Precedence Rule for Head in Japanese

Since four elements in the DOM are permutable with each other so long as LP rule in Figure 7.7 is preserved, a total of six DOM is derived as (51).

(51)
a. Ken ga Naomi ni keeki wo age ta $\langle \boxed{1}, \boxed{2}, \boxed{3}, \boxed{4} \rangle$
b. Ken ga keeki wo Naomi ni age ta $\langle \boxed{1}, \boxed{3}, \boxed{2}, \boxed{4} \rangle$
c. Naomi ni Ken ga keeki wo age ta $\langle \boxed{2}, \boxed{1}, \boxed{3}, \boxed{4} \rangle$
d. Naomi ni keeki wo Ken ga age ta $\langle \boxed{2}, \boxed{3}, \boxed{1}, \boxed{4} \rangle$
e. keeki wo Ken ga Naomi ni age ta $\langle \boxed{3}, \boxed{1}, \boxed{2}, \boxed{4} \rangle$
f. keeki wo Naomi ni Ken ga age ta $\langle \boxed{3}, \boxed{2}, \boxed{1}, \boxed{4} \rangle$

Notice that the word order of (48) shown in (49) above is derived as (51). Thus, the linearization approach properly predicts the (relatively) free word order in Japanese.

7.6 Raising and Control Verbs and Word Order

7.6.1 Lexical Description of Raising and Control *Omow*

Let us now turn to the difference between (3) and (4) below:

(3) a. Yamada-wa Tanaka-wo baka da to omo-ttei-ta.
Yamada-TOP Tanaka-ACC fool is that think-PROG -PAST
'Yamada thought Tanaka to be a fool.'

b. ?/?? Yamada-wa baka da to Tanaka-wo omo-ttei-ta.
Yamada-TOP fool is that Tanaka-ACC think-PROG -PAST

(4) a. Yamada-wa Tanaka-no koto-wo baka da to
Yamada-TOP Tanaka-GEN matter-ACC fool is that
omo-ttei-ta.
think-PROG -PAST
'Yamada thought Tanaka to be intelligent.'

b. Yamada-wa baka da to Tanaka-no koto-wo omo-ttei-ta.

In Section 7.4.1, we argued that (3) and (4) show a number of the properties of raising and control constructions, respectively.

Thus, we assume the lexical entries for *omow* in Figure 7.8 and Figure 7.9.

$$\begin{bmatrix} \text{SUBCAT} & \left\langle \boxed{1}\text{PP}\left[\textit{ga}\right]_i, \boxed{2}\text{PP}\left[\textit{wo}\right], \text{VP}\left[\text{SUBJ}\left\langle \boxed{2}\right\rangle\right]\text{:}\boxed{3}\right\rangle \\ \text{ARG-ST} & \boxed{1} \oplus \boxed{3} \\ \text{SEM} & \begin{bmatrix} \textit{think-rel} & \\ \text{THINKER} & i \\ \text{SOA-ARG} & \boxed{3} \end{bmatrix} \end{bmatrix}$$

Figure 7.8: '*omow*': Feature Structure of the Raising Verb

$$\begin{bmatrix} \text{SUBCAT} & \left\langle \boxed{1}\text{PP}\left[\textit{ga}\right]_i, \boxed{2}\text{PP}\left[\textit{wo}\right]_j, \text{VP}\left[\text{SUBJ}\left\langle \text{PP}_j\right\rangle\right]\text{:}\boxed{3}\right\rangle \\ \text{ARG-ST} & \boxed{1} \oplus \boxed{2} \oplus \boxed{3} \\ \text{SEM} & \begin{bmatrix} \textit{think-rel} & \\ \text{THINKER} & i \\ \text{TOPIC} & j \\ \text{SOA-ARG} & \boxed{3} \end{bmatrix} \end{bmatrix}$$

Figure 7.9: '*omow*': Feature Structure of the Control Verb

The important difference between Figures 7.8 and 7.9 is that for the control verb in Figure 7.9, the unexpressed subject or the VP complement is coindexed with an NP complement, not structure-shared with it, like the raising verb in Figure 7.8 (Pollard & Sag 1994).

7.6.2 Word Order Domain of *Omow*

Control Verb

Returning to the word order of (4), the structure in Figure 7.10 can be given.

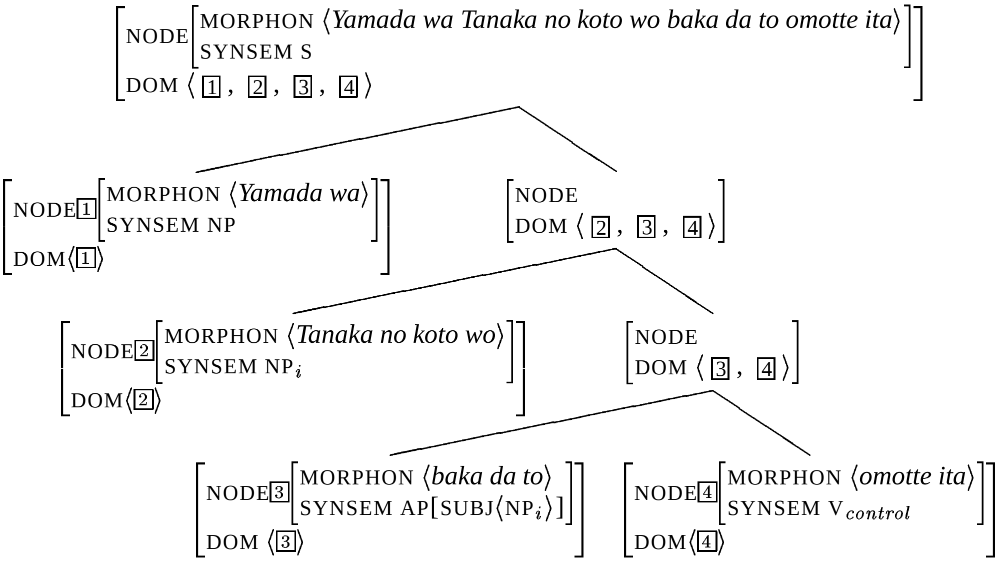


Figure 7.10: '*yamada wa tanaka no koto wo baka da to omo ttei ta*': Tree Diagram

Since the four elements in the DOM are permutable with each other so long as the LP rule in Figure 7.7 is preserved, a total of six values of DOM are derived as in Figure 7.11.

a. DOM⟨ $\boxed{1}$, $\boxed{2}$, $\boxed{3}$, $\boxed{4}$ ⟩
b. DOM⟨ $\boxed{1}$, $\boxed{3}$, $\boxed{2}$, $\boxed{4}$ ⟩
c. DOM⟨ $\boxed{2}$, $\boxed{1}$, $\boxed{3}$, $\boxed{4}$ ⟩
d. DOM⟨ $\boxed{2}$, $\boxed{3}$, $\boxed{1}$, $\boxed{4}$ ⟩
e. DOM⟨ $\boxed{3}$, $\boxed{1}$, $\boxed{2}$, $\boxed{4}$ ⟩
f. DOM⟨ $\boxed{3}$, $\boxed{2}$, $\boxed{1}$, $\boxed{4}$ ⟩

Figure 7.11: Six Values of the DOM Feature

Since the LP rule regulates the word order between three complements and its head, there are at most six possible word order variations.

Raising Verb

Notice that the word order of (3b) is also derived as in Figure 7.11b.

With this in mind, we observe Figure 7.12 carefully.

a.	Yamada-wa Tanaka-wo baka da to omotta.	$\langle \boxed{1}, \boxed{2}, \boxed{3}, \boxed{4} \rangle$
b. ?/??	Yamada-wa baka da to Tanaka-wo omotta.	$\langle \boxed{1}, \boxed{3}, \boxed{2}, \boxed{4} \rangle$
c.	Tanaka-wo Yamada-wa baka da to omotta.	$\langle \boxed{2}, \boxed{1}, \boxed{3}, \boxed{4} \rangle$
d.	Tanaka-wo baka da to Yamada-wa omotta.	$\langle \boxed{2}, \boxed{3}, \boxed{1}, \boxed{4} \rangle$
e. ?/??	baka da to Yamada-wa Tanaka-wo omotta.	$\langle \boxed{3}, \boxed{1}, \boxed{2}, \boxed{4} \rangle$
f. ?/??	baka da to Tanaka-wo Yamada-wa omotta.	$\langle \boxed{3}, \boxed{2}, \boxed{1}, \boxed{4} \rangle$

Figure 7.12: Six Values of the DOM Feature for Raising Verb

Not only Figure 7.12b originally pointed out by Kuno (1976) but also Figures 7.12e and 7.12f are (highly) marginal. Moreover, notice that all of these DOM include the linear precedence $\boxed{3} < \boxed{2}$, which may be straightforwardly rejected by the rule in Figure 7.13.

$$\boxed{2} < \boxed{3}$$

Figure 7.13: Linear Precedence Rule for Raising: Preliminary

However, we cannot assume the rule in Figure 7.13 as a linear precedence rule for a raising verb, because it fails to limit the freedom of order between the NP and AP complement daughters of a control verb shown in Figure 7.11. The question arising here is how we can derive the effect of the application of this rule in Figure 7.13 only to the structure in Figure 7.14.

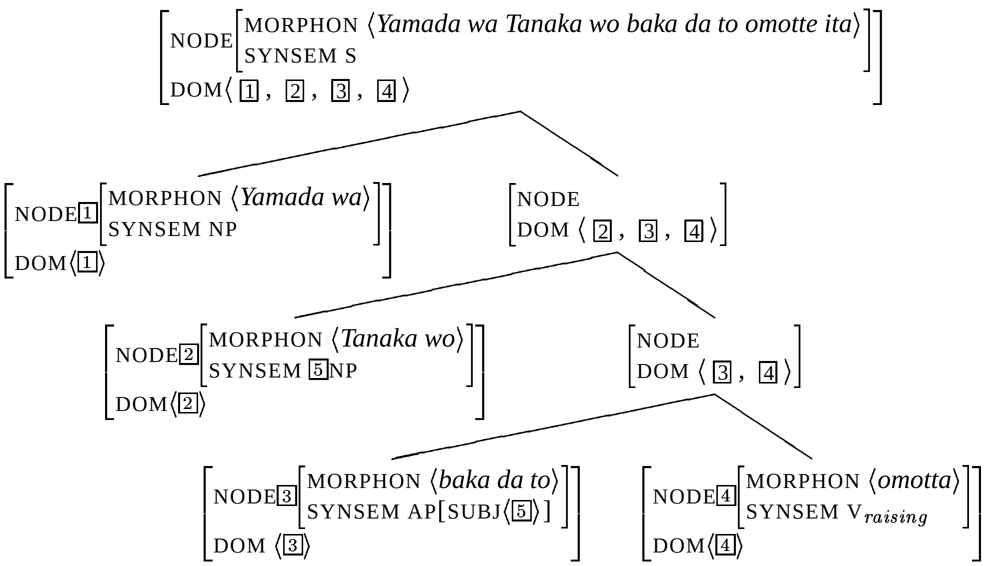


Figure 7.14: '*yamada wa tanaka wo baka da to omo ttei ta*': Tree Diagram

To solve this problem, we assume the LP rule in Figure 7.15.

$$\boxed{\text{N}}\ \text{NP} < [\text{SUBJ}\ \langle\ \boxed{\text{N}}\ \rangle]$$

Figure 7.15: Another Kind of Linear Precedence Rule in Japanese

Though we assume the rule in Figure 7.15 without going into any detail, it properly eliminates the illegitimate word order in Korean (Yoo 1993), the Japanese small clause and other constructions which include raising.

Let us turn back to the rule in Figure 7.13. There is a structure-sharing relation between the NP in NODE $\boxed{2}$ and that in NODE $\boxed{3}$ as shown in Figure 7.14. Now, applying the rule in Figure 7.15 to these NPs, $\boxed{2}$ and $\boxed{3}$ are not permutable. This constraint is shown in Figure 7.16 below:

$$\left[\text{NODE}\ \boxed{2}\ \begin{bmatrix}\text{MORPHON} & \langle \textit{Yamada-wo} \rangle \\ \text{SYNSEM} & \underline{\boxed{5}\ \text{NP}}\end{bmatrix}\right] < \left[\text{NODE}\ \boxed{3}\ \begin{bmatrix}\text{MORPHON} & \langle \textit{baka da to} \rangle \\ \text{SYNSEM} & [\text{SUBJ}\ \langle\ \underline{\boxed{5}}\ \rangle]\end{bmatrix}\right]$$

Figure 7.16: Linear Precedence Rule with Feature Structure

This is why the freedom of word order is limited to some degree. Remember that a control construction is irrelevant to the rule in Figure 7.15 since the subject of the VP complement is only coindexed with an NP complement, not structure-shared. Therefore, the difference between *Tanaka-wo* with a raising verb and *Tanaka-no koto-wo* with an equi verb concerning their scramblability arises.

7.6.3 Other Word Order Variations as Linearization

Unscramblability of *Ga*-marked Phrase

Kuno (1976) points out that while an *wo*-marked embedded subject can be scrambled, a *ga*-marked embedded subject cannot:

(19) a. Yamada-wa Tanaka-ga tensai da to omo-ttei-ta.
Yamada-TOP Tanaka-NOM genius is -COMP think-PROG -PAST
'Yamada thought that Tanaka was a genius.'

b. *Tanaka-ga Yamada-wa tensai da to omo-ttei-ta.
Naomi-NOM Yamada-TOP genius is -COMP think-PROG -PAST

(20) a. Yamada-wa Tanaka-wo tensai da to omo-ttei-ta.
Yamada-TOP Tanaka-ACC genius is -COMP think-PROG -PAST
'Ken thought Naomi to be a genius.'

b. Tanaka-wo Yamada-wa tensai da to omo-ttei-ta.
Tanaka-ACC Yamada-TOP genius is -COMP think-PROG -PAST

He discusses that the contrast between (19) and (20) indicates that *Tanaka-wo* in (20b) behaves as a constituent of the matrix clause and can be preposed freely to the pre-subject position by scrambling. *Tanaka-ga* in (19b), on the other hand, is a constituent of the embedded clause and cannot be overpassing the matrix subject.

We have already explained the word order restriction of (20) from the view of linearization-based approach. Here we show only the case of unscramblability of *Tanaka-ga*. The following is the word order domain for (19):

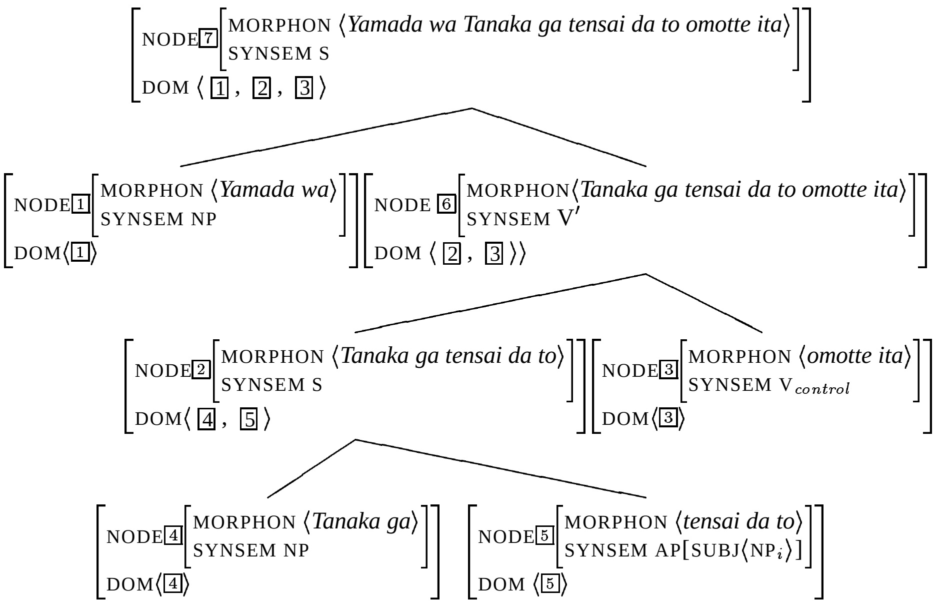


Figure 7.17: '*yamada wa tanaka ga tensai da to omo ttei ta*': Tree: Diagram

Though $\boxed{4}$ and $\boxed{5}$ are permutable in principle, the LP rule for head in Figure 7.7 licenses only the order $\boxed{4} < \boxed{5}$. Thus, the three elements in the DOM of matrix verb are permutable with each other so long as LP rule is preserved, giving a total of two DOM as in Figure 7.18.

a. DOM$\langle \boxed{1}, \boxed{2}, \boxed{3} \rangle$ (DOM$\langle \boxed{1}, \langle \boxed{4}, \boxed{5} \rangle, \boxed{3} \rangle$)

b. DOM$\langle \boxed{2}, \boxed{1}, \boxed{3} \rangle$ (DOM$\langle\langle \boxed{4}, \boxed{5} \rangle, \boxed{1}, \boxed{3} \rangle$)

Figure 7.18: The DOM Feature for Embedded Sentence

Notice that the word order of (19b) shown in Figure 7.19 is not included in the pattern in Figure 7.18.

$$\left\langle \boxed{5}\begin{bmatrix}\text{MORPHON}\langle \textit{Tanaka go}\rangle \\ \text{SYNSEM NP}\end{bmatrix}, \boxed{1}\begin{bmatrix}\text{MORPHON}\langle \textit{Yamada wa}\rangle \\ \text{SYNSEM NP}\end{bmatrix}, \boxed{4}\begin{bmatrix}\text{MORPHON}\langle \textit{baka da to}\rangle \\ \text{SYNSEM AP}\end{bmatrix}, \boxed{3}\begin{bmatrix}\text{MORPHON}\langle \textit{omotte ita}\rangle \\ \text{SYNSEM V}\end{bmatrix} \right\rangle$$

Figure 7.19: The DOM Feature for Embedded Sentence

Adverb Placement

Adverb placement, shown below, is accounted for under the linearization approach. Because of the relatively free word order, Japanese adverbs can be positioned in various places in the sentence, but the matrix clause modifiers cannot be placed inside the embedded clause:

(52) *Yamada-wa [Tanaka-ga orokanimo tensai de aru] koto-o
Yamada-TOP Tanaka-NOM stupidly genius is that-ACC
sira-nakat-ta.
know-NOT-PAST
'Stupidly, Yamada did not know that Tanaka was a genius.'
(Kuno 1976: 24)

Kuno points out that *orokanimo* 'stupidly' can be placed after the embedded subject when it is assigned the accusative case:

(53) a. Yamada-wa orokanimo, Tanaka-ga hannin da to danteisita.
Yamada-TOP stupidly Tanaka-NOM culprit is that determined
'Stupidly, Yamada thought that Tanaka was the culprit.'

b. *Yamada-wa Tanaka$_i$-ga orokanimo, hannin da to danteisita.
(Kuno 1976: 25)

(54) a. Yamada-wa orokanimo, Tanaka$_i$-wo hannin da to danteisita.
Yamada-TOP stupidly Tanaka-ACC culprit is that determined
'Stupidly, Yamada thought that Tanaka to be the culprit.'

b. Yamada-wa Tanaka$_i$-wo orokanimo hannin da to danteisita.
(Kuno 1976: 25)

He argues that the contrast between (53b) and (54b) also indicates that *Tanaka-wo* in (54a) is a constituent of the matrix clause. We agree with Kuno's treatment of the empirical data as for this point and explain the case for the sentence with nominative-marked embedded subject. See below.

(55) a. *Orokanimo*, Yamada-wa Tanaka-ga tensai de aru to sira-nakat-ta.

b. Yamada-wa *orokanimo* Tanaka-ga tensai de aru to sira-nakat-ta.

c. *Yamada-wa Tanaka-ga *orokanimo* tensai de aru to sira-nakat-ta.

d. Yamada-wa Tanaka-ga tensai de aru to *orokanimo* sira-nakat-ta.

e. *Yamada-wa Tanaka-ga tensai de aru to sira-nakat-ta *orokanimo*

In (55c), *orokanimo* cannot intervene between the embedded subject and predicate, since the constituents cannot be permutable with the constituent in a different word order domain. (55e) is rejected if we assume the general LP rule in Figure 7.7.

Thus, linearization-based analysis, which integrates both preposing and adverb placement into a general theory of Japanese word order, predicts the correct word order relation.

7.6.4 RTO and Semantic Restriction of Complement Predicate

The next question is: (i) how can we define the nature of the predicates allowing RTO/ECM, (ii) how accusative case-marking is allowed to take place in individual-level predicates and why it is disallowed in stage-level predicates?

Inner and Outer Subject Positions in Japanese

Diesing (1992) argues that there are two positions for the subject of stative predicates in English, and that they have different semantic correlates, i.e., stage- and individual-level interpretations.

As we will discuss in Chapter 10, Japanese counterparts exhibit this difference by the markers of the subject. As is well-known, both *wa* and *ga*-marked NPs show subjecthood, but they are different, concerning not only the semantic aspects but also the syntactic respects. Even within *ga*-marked NPs, there are various semantic and pragmatic statuses which should be classfied. Here we will only propose that there are potentially multiple subject positions, as shown in Figure 7.20.

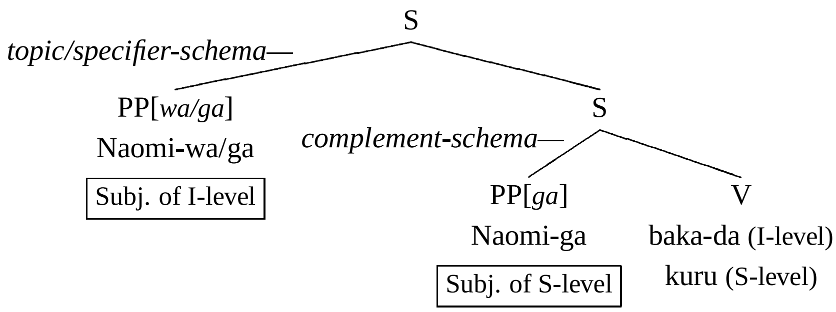


Figure 7.20: Subject Positions in Japanese

The detailed feature structures, schemata, and some relevant constraints will be introduced in Chapter 10. Figure 7.20 is abbreviated form and the tree diagram conventionally represented in the following discussion.

In Section 7.4.2, we discussed the relation between the semantic property of the predicate and the marker of its subject. This is summarized as follows:

(56) The subject of stage-level predicate is marked with the marker *ga*.
The subject of individual-level predicate is marked with the marker *wa*.

Based on the proposal in Figure 7.20, the complement predicates (40a) and (40b) have the different subject positions, respectively.

(40) a. Naomi-ga kuru.
'Naomi comes.'

b. Naomi-wa baka-da.
'Naomi is a fool.'

Although both *wa* and *ga*-marked NPs in (40a) and (40b) are equal syntactic subjects, they respectively reflect the different semantic and pragmatic interpretations, concerning generic, existential, topical, and so on.[13] Remember that only the subject of individual-level predicate in (40b) allows RTO.

It is noteworthy that the subject of a stage-level predicate can also have the topic marker *wa*, receiving a topic reading.

(57) Naomi-wa kuru.
Naomi-TOP come
'Naomi comes.'

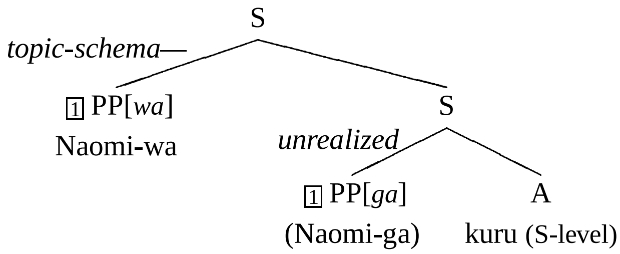


Figure 7.21: '*naomi wa kuru*': Tree Diagram

As we shall see in Chapter 10, the topic reflects contextual information rather than mere syntactic information such as Case. Thus, topic *wa* and nominative case*ga* are not treated as the same sort and hence the structure-sharing of [1] above is possible.

Next, the subjects positions in Figure 7.20 predicts that two or more subjects can exist in Japanese, and the so-called 'multiple-subject construction' corresponds to this (Kuno 1973). Consider (58).

(58) Tokyo-(wa/ga) bukka-ga takai.
Tokyo-TOP /NOM price-NOM high
'As for Tokyo, prices are high. / It is Tokyo where prices are high.'

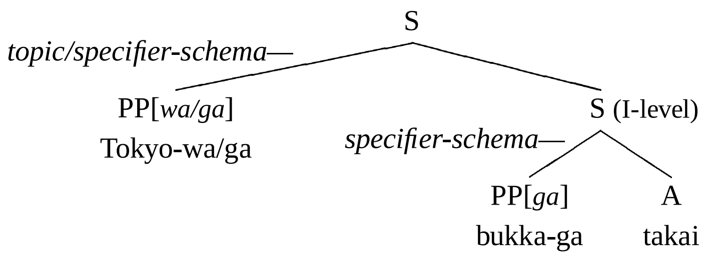


Figure 7.22: '*tokyo wa bukka ga takai*': Tree Diagram

[13]See Chapter 10, Kubo (1992) and Endo (1994).

Note (58) licenses the RTO as below:

(59) Ken-wa Tokyo-wo bukka-ga takai to omo-tta.
Ken-TOP Tokyo-ACC price-NOM high that think-PAST
'(Lit.) As for Tokyo, Ken thought prices were high.'

Notice that a stage- and individual distinction, pointed out in Section 7.4.2, predicts this state of affairs, because the predicate (part) of the multiple subject construction attributes an essential property to a person or an entity (Kuno 1973) like an individual-level predicate which allows RTO.

Raising-to-Object as Structure Sharing

We are now ready to consider the formal mechanism of RTO. What we want to propose here is that RTO's asymmetry discussed in Section 7.4.2 arises from the interaction between the subject positions dependent on the predicate introduced in Figure 7.20 and the possibility of structure-sharing.

Let us examine why stage-level predicates do not license RTO. See Figure 7.23.

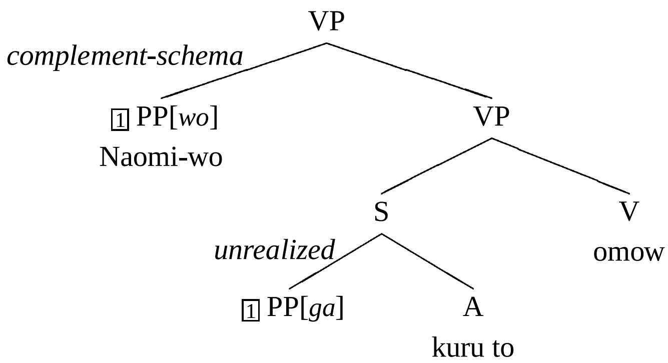


Figure 7.23: Stage-level Predicate and RTO: Tree Diagram

In Figure 7.23 the matrix object is specified as PP[*wo*]. On the other hand, the embedded object is specified as PP[*ga*] because it is specified by some lexical property of the stage-level predicate discussed in Section 7.4.2. Thus, structure-sharing between them is not possible, and then RTO is not licensed.

Next, let us consider how RTO is licensed in the case of individual-level predicates. In Figure 7.24 the matrix object is specified as PP[*wo*] and at this point there is no difference between Figure 7.23 and Figure 7.24.

However, the embedded subject is specified only as PP[*wap*] since it is located in the subject position where the Case may not be specified. Thus, structure-sharing is possible. This is why the RTO is limited to the individual-level predicate.

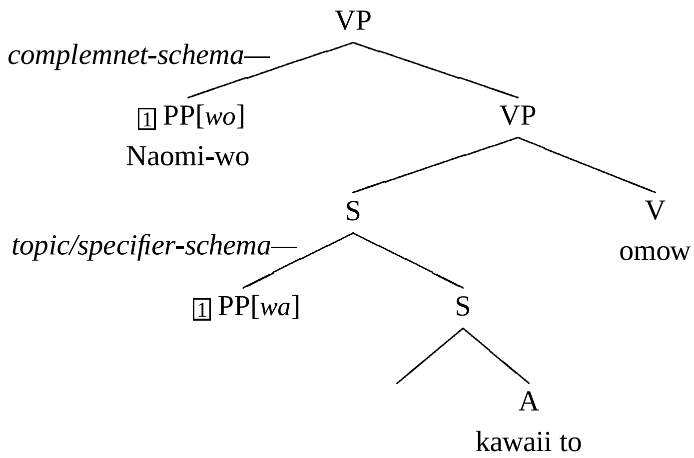


Figure 7.24: Individual-level Predicate and RTO: Tree Diagram

7.7 Summary

This chapter began by examining the so-called raising-to-object construction, where interesting problems arise with respect to the syntactic/semantic status of *wo*-marked NPs in the construction.

We argued that two types of *omow*, control and raising verb, must be recognized. Moreover, we suggested that the stage- and individual-level distinction of the complement predicates plays a crucial role for licensing raising-to-object.

The conclusions outlined here are shown to account for the problems illustrated by the possibility of word order variation and the restriction of the complement predicate, which were not fully explained in the previous analyses.

Conclusion

We have demonstrated in Part II that systematic tuning of a grammar-based parser overcome the parsing problem which is caused by processing some fundamental grammatical constructions. These constructions innately contain mutually constraining relationships between linguistic modules, syntax and semantics may, for example, simultaneously constrain one another. HPSG's multi-dimensional constraint-based architecture is well-suited to representing such relationships among modules which interact each other in principled ways.

The NAIST JPSG analyses presented in this section are able to account for the following characteristics of some Japanese fundamental constructions:

1. Japanese causatives are divided into three types, control causatives, adversity causatives and lexical causative.
    (a) Both control causatives and adversity causatives have a syntactic embedding structure but only the former involves syntactic control structure.
    (b) Avoiding the structural ambiguities of the complex predicate with a syntactic embedding structure, pseudo-lexical rule schema is introduced.
2. Minami's Japanese hierarchical clause formation is a unit of complex linguistic information that mainly has reflexes in syntax and semantics.
    (a) Combinatory relations between matrix clause and subordinate clause is regulated by adjacent feature, modification feature and their constraint.
    (b) Syntactic and semantic dependency of subordinate clause modification is formalized by only the lexical description of conjunctive particle.
3. Two types of *omow* 'think', control and raising verb, must be recognized.
    (a) The linearization approach can capture the possibility of word order variation, especially, the distribution of *wo*-marked NPs in the epistemic construction.
    (b) The stage and individual-level distinction of the complement predicates of *omow* raising verb plays a crucial role for licensing raising-to-object.

Grammatical descriptions within JPSG generally take the form of statements about constraints among feature values, and about sharing of partial information represented by these features. The current grammar however has concentrated on the issues of syntax and semantics and has not treated phonology and pragmatics. In these respects, JPSG does not fully integrated different aspects of sentence information factored out into separate levels or representations for linguistic modules into HPSG's sign. The linguisic information on the latter will be discussed in Part III.

Part II has also explored some fundamentals of grammar-based parsing. If the aim of NLP is to have one type of procedure dealing with every type of information rather than having several procedures dedicated to particular types then JPSG is on the right track since the entire task of the sentence processing can be divided into modules of constraints rather than modules of procedures.

Part III

Extensions of the Proposed Grammar System with Semantic and Pragmatic Constraints

Introduction

One serious difficulty in artificial intelligence in general and, in particular, natural language processing (NLP) is that it is practically impossible to stipulate which type of information to process and in what order, given the innumerable, unpredictable pieces of information coming into play. It does not appear at all useful to describe a procedure to deal with only some types of information.

NLP involves a very complex flow of information which cannot be stipulated procedurally or programmatically. Thus, a parser to handle just syntactic information does not contribute to the total design of NLP system.

A prospective approach to NLP is, we think, not to have several procedures each dealing with one particular type of linguistic information, but to have just one procedure, unification, to deal with every type of information. This means that the entire task of NLP should be divided into modules of constraints rather than modules of procedures as has been done traditionally.

Hence, in Part III, we will make a possible extension of JPSG with semantic and pragmatic constraints. We propose a new analysis of semantic uniformity which can capture the semantic commonalities among various constructions, and a theory of information structure which has not been applied to Japanese.

This part is organized as follows:

Chapter 8 proposes a new approach to Japanese passives, which has been a focus of attention in many linguistic studies in English and many other languages.

Chapter 9 discusses the benefactives at which relatively few attempts have so far been made, compared with the passives. The idea of thematic underspecification adopted in these chapters reconciles the apparent syntactic commonality and semantic differences between passives and benefactives.

Chapter 10 is concerned with how topic and focus articulation should be optimally integrated into Japanese grammar. The information structure introduced here is an integral part of the grammar and interacts in principled ways with both syntax and morpho-phonology.

Chapter 8

Passive Constructions and Semantic Uniformity

8.1 Introduction

Cross-linguistically, it has been observed that a passive sentence usually has a corresponding active sentence with the same truth value and the subject of a passive sentence corresponds to an object of an active sentence. The subject argument of an active sentence is expressed as an agentive (instrumental, locative, etc.) prepositional and postpositional phrase in the corresponding passive sentence in some languages, while some languages do not allow the argument in question to appear on the surface. These properties constitute a core part of the received universal characterization of passives in theory-neutral terms (Spencer 1991).

Japanese passives are composed of a stem verb followed by a bound morpheme *(r)are*. These have also provoked a great deal of controversy in studies of not only the characterization of passives but also of Japanese grammar.

8.2 Japanese Passive Constructions

8.2.1 Indirect Passive

The existence of the indirect passive has, in particular, called for different approaches from those proposed for the English passive, since it has no active counterpart and has one more argument than is subcategorized for by the stem verb:

(1) a. Ken-ga Naomi-ni nikki-wo yom-are-ta.
Ken-NOM Naomi-DAT diary-ACC read-PASS-PAST
'Ken was adversely affected by Naomi's reading his diary.'

b. Naomi-ga nikki-wo yon-da.
Naomi-NOM diary-ACC read-PRES
'Naomi read the diary.'

Further, indirect passives can be based not only on transitive verbs but also on intransitive verbs:

(2) a. Ken-ga ame-ni hur-are-ta.
Ken-NOM rain-DAT fall-PASS-PAST
'Ken was affected by rain's falling on him.'

b. Ame-ga hut-ta.
rain-NOM fall-PAST
'It rained.'

This runs counter to most of the universal characterizations of passives and therefore has provided a long-standing problem in characterizing the Japanese passive.

8.2.2 Direct Passive

Japanese Direct Passive

Direct passives in Japanese can easily find correspondents in cross-linguistic studies of passives. They typically have a corresponding active sentence. (3a) is an example of direct passives shown with their active counterpart (3b):

(3) a. Naomi-ga Ken-niyotte home-rare-ta.
Naomi-NOM Ken-by praise-PASS-PAST
'Naomi was praised by Ken.'

b. Ken-ga Naomi-wo home-ta.
Ken-NOM Naomi-ACC praise-PAST
'Ken praised Naomi.'

Observationally, the object of the active sentence corresponds to the subject of the passive sentence. The truth value of the active sentence in (3a) is maintained in the passive sentence in (3b).

As can be seen in (5) below, either the direct or the indirect object can be passivized in Japanese.

(4) Ken-ga Naomi-ni tegami-wo watasi-ta.
Ken-NOM Naomi-DAT letter-ACC hand-PAST
'Ken handed the latter to Naomi.'

(5) a. Naomi-ga Ken-ni tegami-wo watas-are-ta.
Naomi-NOM Ken-DAT letter-ACC hand-PASS-PAST
'Naomi was handed the latter by Ken.'

b. Tegami-ga Ken-niyotte Naomi-ni watas-are-ta.
letter-NOM Ken-by Naomi-DAT hand-PASS-PAST
'The latter was handed to Naomi by Ken.'

The unpassivized object, which does not become the subject, maintains its original case, whether accusative or dative.

No direct passive can be made from an intransitive verb.

Two Types of Direct Passive

Japanese direct passives have also been considered to be peculiar, especially due to the existence of two apparently similar types, *ni*-direct passives and *ni-yotte* direct passives (Inoue 1976, Kuroda 1979).[1] Thus for the active sentence (3b), there are two types of passive sentences, (6a) and (6b):

(6) a. *ni*-direct passive
Naomi-ga Ken-ni home-rare-ta.
Naomi-NOM Ken-DAT praise-PASS-PAST
'Naomi was affected by the Ken's praising her.'

b. *niyotte*-direct passive
Naomi-ga Ken-niyotte home-rare-ta.
Naomi-NOM Ken-by praise-PASS-PAST
'Naomi was praised by Ken.'

At first glance, it looks as if there is no difference between *ni*-direct and *ni-yotte* direct passives except for the postposition. Terada (1990) and Kubo (1990) argue that the dative case *ni* alternate with an agentive postposition *ni-yotte* or a source postposition *kara* in some cases, and that the possibility of alteration correlates with the distinction between the direct and indirect passives. See below:

(7) a. Naomi-ga Ken-{ni/niyotte} home-rare-ta.
Naomi-NOM Ken-DAT /by praise-PASS-PAST
'Naomi was affected by the Ken's praising her. / Naomi was praised by Ken.'

b. Sensee-ga seeto-{ni/niyotte/kara} hihans-are-ta.
teacher-NOM Ken-DAT /by/from criticize-PASS-PAST
'The teacher was affected by his/her student's criticizing him/her. / The teacher was criticized by his/her students.'

(8) a. Ken-ga ame-{ni/*niyotte/*kara} hur-are-ta.
Ken-NOM rain-DAT /by/from fall-PASS-PAST
'Ken was affected by rain's falling on him.'

b. Ken-ga musuko-{ni/*niyotte/*kara} sin-are-ta.
Ken-NOM son-DAT /by/from fall-PASS-PAST

[1]Hoshi (1994a, 1994b) argues that the existence of these two types of passives is not peculiar to Japanese. He refers to Lasnik and Fiengo's (1974) proposal that there are two types of passives in English, *get* passives and *be* passives, and show that (6a) is an instance of the *get* passive, whereas (6b) is an instance of the *be* passive.

(i) a. *get*-passive:
Naomi got praised by Ken.

b. *be*-passive:
Naomi was praised by Ken.

‘Ken was affected by his son’s death.’

According to Terada and Kubo, this alteration is possible only with direct passives. The data given above seem to support their argument. Moreover, the number of the arguments is the only aspect in which the direct passives and indirect passives contrast. However, we will present the distinctive characteristics of passives, in what follows.

8.2.3 Syntactic and Semantic Properties

Several syntactic or semantic differences are recognized in the literature.

Firstly, as the English glosses in the above examples suggest, only *ni*-direct and indirect passives are accompanied by an implication that the matrix subject is adversely affected by the event denoted by the rest of the sentence.[2]

Secondly, the matrix subject of *ni*-direct and indirect passives is restricted to animate NPs. An inanimate subject would be interpreted as metaphor, metonymy, or personification. No such restriction is imposed on *niyotte*-direct passives.

(9) a. Sono seeto-wa sensee-ni betuno seeto-wo
that student-TOP teacher-DAT different student-ACC
home-rare-ta.
publish-PASS-PAST
‘The student was adversely affected by his/her teacher’s praising a different student.’

b. *Sono hon-wa syuppansya-ni betuno hon-wo
that book-TOP publisher-DAT different book-ACC
syuppans-are-ta.
publish-PASS-PAST
‘The book was adversely affected by the publisher’s publishing a different book.’

The contrast between *ni*-direct and *niyotte*-direct passives is confirmed by the following sentences, which includes verb phrase idiom *tyuui-wo haraw* ‘pay heed (Hoshi 1991):

(10) Ken-ga tyuui-wo harat-ta.
Ken-NOM heed-ACC pay-PAST
‘Ken paid heed.’

(11) a. *Tyuui-ga Ken-ni haraw-are-ta.
heed-NOM Ken-DAT pay-PASS-PAST
‘Heed$_i$ was affected by Ken’s paying it$_i$.’

b. Tyuui-ga Ken-niyotte haraw-are-ta.
heed-NOM Ken-by pay-PASS-PAST
‘Heed was paid by Ken.’

[2]For this reason, this class of passive has been referred to as adversity passives since Kuno (1973).

Since an NP such as *hon* ‘book’ and *tyuui* ‘heed’ are not animate, (9b) and (11a) are ruled out due to the violation of the selectional restriction.

Finally, as well as in the passives of English and many other languages, the Agent phrase is not an obligatory argument in Japanese. Consider below:

(12) a. Tyuui-ga haraw-are-ta.
heed-ACC pay-PASS-PAST
‘Heed was paid (by someone).’

b. *Ken-ga hur-are-ta.
Ken-NOM fall-PASS-PAST
‘Ken was affected (by rain’s) falling on him.’

It has been observed that the agent phrase can be omitted only in direct passives (Miyagawa 1989, Kubo 1990, Terada 1990). However, the sentences above show that only (12a), which is obligatory interpreted as the example of *niyotte*-direct passives allow such omission.

Given these data, it seems unquestionable that *ni*-direct, *niyotte*-direct and indirect passives have different syntactic or semantic properties. The next section shows how Japanese passives have been analyzed in the literature.

8.3 Previous Analyses of Japanese Passives

Passives have been analyzed from a number of points of view. In this section, we will survey previous studies of Japanese passives to give an idea of how problems concerning passives have been dealt with.

8.3.1 The Trend of Transformational Grammar

Passive construction has been a focus of attention in many linguistic studies in English and many other languages.

In the main trend of Transformational Grammar of the 1960’s and early 1970’s, English passive sentences were derived from their active counterparts through a series of transformations collectively called passivization (Chomsky 1957, 1965).

From approximately 1980 a trend toward a lexical analysis of the passive rather than a syntactic one started. Early studies in Government-Binding Theory assume a lexical operation that changes the verb form from base to the passive participle, absorbing the case-assigning property of the original verb. The rest of the derivation is taken care of by NP-movement stimulated by three major principles: the θ-criterion, Case Theory, and Binding Theory (Chomsky 1981).

Later works of GB argue that the passive morpheme *-en* is a nominal receiving the accusative case, thus making the accusative case unavailable to any other argument. This idea eliminates the lexical operation which changes the case marking property of a verb (e.g. Borer (1984), Jaeggli (1986), Roberts (1987)).

Baker (1988) proposes that the passive morpheme is actually an external argument bearing the subject θ-role, which can be transmitted to the agent phrase (*by*-phrase in English) via coindexing (cf. also Baker, Johnson, and Roberts (1989)). This passive morpheme, however, appears in the Infl node, a position to which the verb moves. This verb movement is considered to be the essential part of the passivization; NP movement is only a peripheral side-effect. NP movement takes place when it is allowed or forced by general principles. The often-assumed case absorption is also inessential. Case absorption depends on the property of the passive morpheme: whether it requires the accusative case or not.

8.3.2 Transformational Approaches

The Non-uniform Approach

Transformational analyses attempted to derive the passive sentence from a Deep Structure by transformations (Kuroda (1965b), Kuno (1973), Inoue (1976), among others). They are further divided into two approaches, uniform and non-uniform approaches. In either case, transformational approaches share the strategy of deriving passive sentences by syntactic transformation.

Non-uniform approaches start out with the assumption that the discrepancies between direct and indirect passives are only a surface matter.

For example, such an approach represented by Kuno (1973) postulates separate structures for the direct passive and the indirect passive. The direct passive in (13) is derived from a simple active sentence through scrambling, as shown in Figure 8.1.

(13) Naomi-ga Ken-ni home-rare-ta.
Naomi-NOM Ken-DAT praise-PASS-PAST
'Naomi was praised by Ken.'

The indirect passive in (14) is, on the other hand, derived from a embedded structure through Predicate Raising and S-Pruning, as shown in Figure 8.2.

(14) Ken-ga ame-ni hur-are-ta.
Ken-NOM rain-DAT fall-PASS-PAST
'Ken was affected by rain's falling on him.'

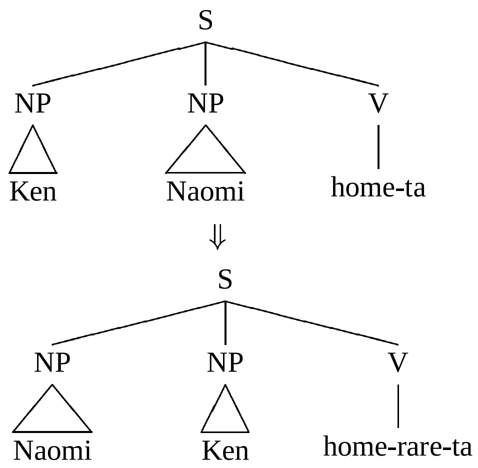


Figure 8.1: Direct Passive: The Non-uniform Approach

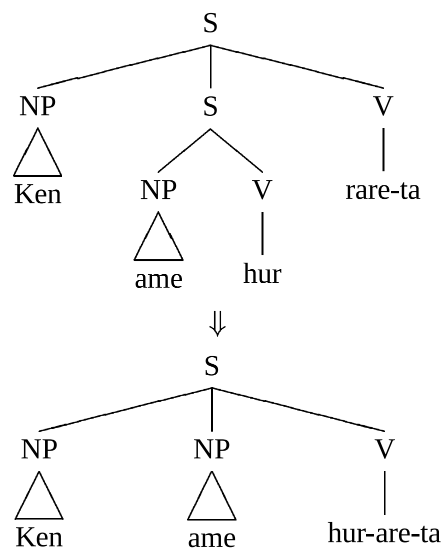


Figure 8.2: Indirect Passive: The Non-uniform Approach

The Uniform Approach

The uniform approach assumes a biclausal underlying structure for both the direct and indirect passives. The following shows the structure assumed by Howard and Niyekawa-Howard (1976). Figure 8.3 is a direct passive, and Figure 8.4 an indirect passive:

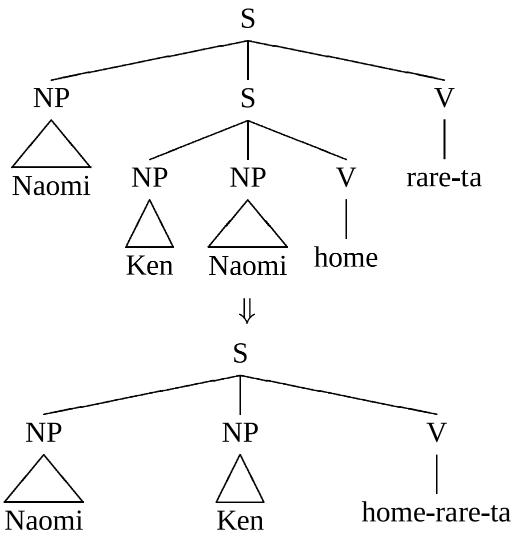


Figure 8.3: Direct Passive: The Uniform Approach

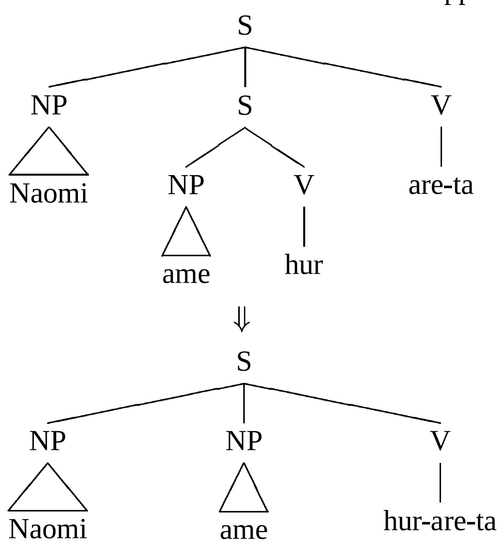


Figure 8.4: Indirect Passive: The Uniform Approach

Under this approach both direct and indirect passives undergo S-pruning. Notice that the Agent phrase is a subject in both direct and indirect passives in this approach.

These analyses have largely been considered outdated since such construction-specific transformations are incompatible with the later model of Government and Binding Theory (Chomsky 1981, 1982, 1986a). Besides theory-internal reasons, these transformational analyses suffer from other problems as well.

They are not able to explain the existence and case distribution of three types of passives. Moreover, both uniform and non-uniform approaches cannot give any insight on the reason for the animacy requirement of the indirect passive subject and the optionality of the Agent phrase, pointed out in the previous section.

Thus, transformational approaches do not seem to fare very well in accounting for all of the essential properties of Japanese passives.

8.3.3 The Lexical Approach

Lexical approaches assume that the passive morpheme *(r)are* is attached by a morphological process in the lexicon. Instead of a structural change, they are mostly concerned with the assignment of grammatical case, thematic role, or grammatical function as a result of the morphological change. Hasegawa (1981b, 1981a), Farmer (1980, 1984) and Miyagawa (1980b, 1989) have a special appeal in Japanese because the passive morpheme is a bound morpheme in the language.

Hasegawa (1981b) proposes the Japanese passive lexical rule for direct passives in Figure 8.5.

Change in Functional Frame	OBJ	$\rightarrow$	ϕ
	θ_1	$\rightarrow$	ϕ
Morphological Change	V_{stem}	$\rightarrow$	$[V_{stem} + (r)are]V_{stem}$

Condition: OBJ must be semantically related to the V_{stem}
θ_1 is the external argument of the predicate.

Figure 8.5: Direct Passive: The Lexical Approach

Figure 8.6 is basically equivalent to the English passive lexical rule of Hasegawa's proposal and the lexical redundancy rule cancels both a grammatical function OBJ and an external thematic role, accompanying the morphological change. This rule applies to the verb stem *home* 'praise' to change the lexical entry as shown in Figure 8.6.

As OBJ and Agent (= θ_1) are cancelled according to the rule in Figure 8.6, the Theme and SUBJ are linked together by convention. Consequently, the passive participle has the Theme argument as the subject.

Hasegawa (1981b, 1981a) treats indirect passives as being derived by a very different lexical composition rule as shown in Figure 8.7.

Hasegawa assumes that the object argument of the passive morpheme has no thematic role and the thematic role of the subject argument of the embedded predicate is percolated by convention in such cases. Thus, Hasegawa attempts to con-

home:	V_{stem}	: [Agent,	Theme]
		|	|
		SUBJ	OBJ
home-rare	$[V_{stem} + \textit{rare}]V_{stem}$	: ~~[Agent~~,	Theme]
		|	|
		SUBJ	~~OBJ~~

Figure 8.6: Direct Passive ‘*homer are*’: The Lexical Approach

a.	*(r)are*:	V_{stem}: [−stative]	$[< \theta_1 >$	θ_0	$\theta_2]$	
			|	|	|	
			SUBJ	OBJ	PRED	
b.	*home*:	V_{stem}: [−stative]	$[< \theta_1 >$	θ_2		
			|	|		
			SUBJ	OBJ		
c.	*home-rare*:	V_{stem}: [−stative]	$[< \theta_1 >$	θ_0	*home* $[< \theta_1 >$	$\theta_2]$
			|	|	|	|
			SUBJ	OBJ	SUBJ	OBJ

Figure 8.7: Indirect Passive ‘*homer are*’: The Lexical Approach

struct a predicate argument structure which is intuitively close to an object control structure represented in a lexical level.

However, this approach also misses the existence of three types of passives. It is also incapable of giving any account of the impressionistic ‘passive’ sense common to both *ni*-direct and indirect passives, because of its non-uniformist nature. Furthermore, as Uda (1992) pointed out, positing a matrix object corresponding to the lower subject in indirect passives does not seem to be right. An object-control analysis seems to make wrong predictions regarding Object Honorification (henceforth OH). OH is possible with the usual control structures:

(15) a. Ken-ga sensee-ni soko-e iku-yoo o-negai-si-ta.
Ken-NOM teacher-DAT there-to go-MOD HON-ask-do-PAST
‘Ken asked the teacher to go there. (honorific)’

b. Ken-ga sensee-ni soko-e iku-to o-yakusoku-si-ta.
Ken-NOM teacher-DAT there-to go-COMP HON-promise-do-PAST
‘Ken promised the teacher to go there. (honorific)’

However, it is impossible to make an OH sentence based on any type of passive sentence, where the respect is directed toward the Agent phrase, or controller. The following examples demonstrate this point:

(16) a. *Ken-ga sensee-ni o-home-rare-si-ta.
Ken-NOM teacher-DAT HON-praise-PASS-do-PAST

'Ken was praised by the teacher. (honorific)'

b. *Ken-ga sensee-ni nikki-wo o-yom-are-si-ta.
Ken-NOM teacher-DAT diary-ACC HON-read-PASS-do-PAST
'Ken was adversely affected by the teacher's reading his diary. (honorific)'

The unavailability of OH for passives strongly suggests that the Agent phrase is not an object of the passive predicate in either the direct-type or indirect-type.[3] The facts of OH, therefore, indicate that the Agent phrase is not an object argument of a passive predicate, and that do not have an object-control structure.[4]

Miyagawa (1989) proposes a uniform movement approach based on Government and Binding Theory (Chomsky 1981, 1982, 1986a). Following Borer (1984), Jaeggli (1986), and Roberts (1987), Miyagawa assumes the characterization of the passive morpheme *(r)are* as follows:

(17) **Definition 38 (Characterization of the Passive Morpheme)**

a. The passive morpheme (r)are must absorb case, either accusative or dative, if the case-assigning feature exists.

b. If (r)are absorbs the case from the verb that it attaches to, it can optionally assign this absorbed case.

The direct passive is generated in almost exactly the same way as the English passive. Since the passive morpheme absorbs the case assigning property of a

[3]Uda (1992) also argue that this gives a strong argument against the VP-complement analysis of the passives advocated by Gunji (1987) and Fukushima (1990) and any analysis positing the Agent phrase as an object argument of the passive morpheme (cf. Terada (1990)).

[4]Uda (1992) gives another evidence regarding to passivization. The Agent phrase cannot undergo direct passivization, though the object phrase of a control structure can usually be passivized:

(i) a. Naomi-ga Ken-ni nige-rare-ta.
Naomi-NOM Ken-DAT flee-PASS-PAST
'Naomi was adversely affected by Ken's running away on her.'

b. *Naomi-ga Ken-ni nige-rare-rare-ta.
Naomi-NOM Ken-DAT flee-PASS-PASS-PAST
'(lit.) Naomi had it that Ken was adversely affected by her running away on him.'

(ii) a. Ken-ga sensee-ni soko-e iku-yoo o-negai-si-ta.
Ken-NOM teacher-DAT there-to go-MOD HON-ask-do-PAST
'Ken asked the teacher to go there. (honorific)'

b. Sensee-ga soko-e iku-yoo o-negai-s-are-ta.
teacher-NOM there-to go-MOD HON-ask-do-PASS-PAST
'The teacher was asked to go there.'

(ia) shows that the direct passivization of the Agent phrase of indirect passives is impossible. Uda argues that this fact suggest that it is not merely due to processing difficulties, though double passivization poses extra processing difficulty. We don't know whether this really confirms her claim.

transitive verb, the object NP must move to subject position to receive nominative case. The attachment of the passive morpheme also suppresses the external θ-role to be assigned to the subject due to Burzio's generalization (Burzio 1981, 1986) given in (18):

(18) **Definition 39 (Burzio's generalization)**
A verb assigns an external θ-role iff it assigns case.

The indirect passive, on the other hand, does not seem to absorb case. In order to maintain uniformity, Miyagawa stipulates that the passive predicate can optionally undo case absorption. The indirect passive takes this option, and it regains the capacity to assign object case. Thus the object can remain in its original position. Furthermore, as the passive morpheme assigns internal case, it follows that it must also assign an external θ-role according to Burzio's generalization. To receive this external θ-role Experiencer, a new NP is introduced in the subject position and is realized as the matrix subject NP. Concomitantly the original external θ-role, i.e., Agent is internalized and surfaces as a dative NP.

The problems with Miyagawa approach concern the derivation of indirect passives based on intransitive verbs. According to Miyagawa (1989), indirect passives based on intransitive verbs and those based on transitive verbs are derived in the different way as follows. When the stem verb is a transitive verb, it has case to assign; hence, its derivation is as mentioned above. When the stem verb is an intransitive verb, it does not have case to assign; hence, it is exempt from case absorption. It follows that the stem verb does not regain the case assigning property, either. Burzio's generalization has nothing to say about the derivation in this case. It rather seems to be a violation of the generalization because it introduces a new external argument without getting the ability to assign case. Miyagawa admits that the generalization does not help derive this structure, and also states that the external argument of the stem verb is somehow suppressed and internalized to receive dative case, a new external argument must, then, be introduced by the Extended Projection Principle (Chomsky 1982):

(19) **Definition 40 (Extended Projection Principle)**
A clause must have a subject (non-expletive in Japanese).

Note that the suppression and internalization of the Agent phrase of intransitive-based indirect passives lacks any independent motivation. If the same analysis were to hold with transitive-based indirect passives, transitive-based indirect passives could be derived by the Extended Projection Principle without Burzio's generalization. Miyagawa's approach separates intransitive-based indirect passives from transitive-based indirect passives and transitive-based direct passives for achieving uniformity. However the semantic and syntactic facts indicate that intransitive-based indirect passives group together with transitive-based indirect passives.

8.3.4 Movement Approaches

The Gapped and Gapless Approach

Kubo (1990) argues against the proposals made in the literature of GB framework. She argues, for instance, that the Japanese passive morpheme is not an argument (against Travis (1984), Jaeggli (1986), Roberts (1987)), and does not absorb case (against Miyagawa (1989), Terada (1990); but with Hasegawa (1988)). As Kubo does not assume case absorption, Case Theory can no longer provide the motivation for NP movement in Kubo's framework. This movement is ultimately forced by the Extended Projection Principle, coupled with the fact that Japanese lacks expletives.

Kubo (1990) also posits the following lexical entries for the two types of passive morpheme *(r)are*:

$$\textit{(r)are},\ \mathrm{V}, \left\{ \begin{array}{lll} +\mathrm{V}^{0} & \underline{\quad\quad} & \\ +\mathrm{VP} & \underline{\quad\quad} & \text{[malefactive]} \end{array} \right\}$$

Figure 8.8: Passive Morpheme '*(r)are*': The Gapped and Gapless Approach

The lexical entry in (8.8) conveys the following information. The passive morpheme *(r)are* is a verbal category which subcategorizes for either V^0 or VP. When it subcategorizes for a V^0, it has no external θ-role. When it subcategorizes for a VP, it also has an external θ-role [malefactive] to assign. The former will constitute direct passives and the latter indirect passives, which are defined 'gapped' passives and 'gapless' passives in Kubo's terms.[5]

Kubo draws the syntactic differences among the two types of passives only from the information in the lexical entry in (8.8) and independent general principles of grammar. Let us first take a look at gapped direct passives in (13):

As shown in Figure 8.9, the stem verb and the passive morpheme *(r)are* form a verbal constituent of bar-level 0, which projects only one VP as an amalgam. The head of the stem-passive constituent V^0 is the passive morpheme rather than the stem verb. As the passive morpheme does not have an external θ-role to assign, the Spec of VP position headed by the passive morpheme is left empty. The Agent phrase is an external argument not of the head i.e., passive morpheme but of the stem verb. Thus, it is not allowed to be realized at S-structure as the matrix subject. Consequently one of the object arguments is forced to move to the subject position to satisfy the Extended Projection Principle in (19). Kubo stipulates that the Agent phrase is realized as an adjunct as a last resort. Under this approach, the optionality of the Agent phrase in the direct passive is a direct consequence of the fact that the phrase in question is an adjunct.

The structure in Figure 8.10 represents indirect passives exemplified in (20).

[5]Kubo (1990) presents an interesting movement analysis of passives, which very convincingly argues for the class of possessive passives. The possessive passive is a type of gapped passive, in which the subject argument in fact has been moved out of the Spec of NP position of a lower argument.

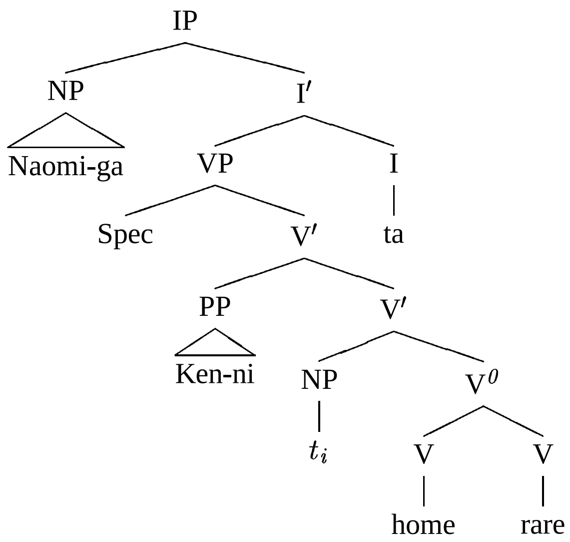


Figure 8.9: Direct Passive: The Gapped and Gapless Approach

(20) Ken-ga Naomi-ni nikki-wo yom-are-ta.
Ken-NOM Naomi-DAT diary-ACC read-PASS-PAST
'Ken was adversely affected by Naomi's reading his diary.'

In the case of indirect passives, on the other hand, the stem verb and the passive morpheme *(r)are* independently head verbal projections. Thus, there are two VPs. Further, each of the two head verbs has an external argument, so the VP-Spec positions are occupied by the matrix subject and the Agent phrase. The matrix subject is then moved to the IP-Spec position to receive nominative case, and the Agent subject receives dative case in the VP-Spec position. No further movement is required.

My analyses will take some of the insights given in Kubo's approach, in spite of the difference in theoretical approaches. However, there are two points that we disagree with in Kubo's analysis. The first is concerned with an adversity interpretation. This is available only with indirect passives, since only the passive morpheme of an indirect passive has an external θ-role which is specified as [malefactive] already in the lexicon. This is wrong, since we will point out that a *ni*-direct passive also has such an interpretation. The second is concerned with the animacy requirement. Kubo's approach simply states that only animate creatures can experience malefunction. This is right, but it also misses the point that *ni*-direct passive also requires such restriction.[6]

[6]According to Kubo (1990), the subject of the indirect passive cannot be the target of Subject Honorification (henceforth, SH). This, however, seems to be a wrong judgment. As Uda (1992) points out that both the matrix subject and Agent phrase can trigger SH:

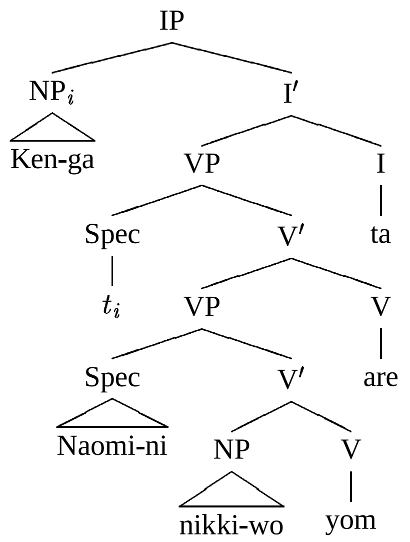


Figure 8.10: Indirect Passive: The Gapped and Gapless Approach

The Incorporation Approach

Terada (1990) presents an analysis of passives based on the Incorporation approach of Baker (1988). With Kubo (1990), Terada holds that direct passives contrast with indirect passives in that the former involves NP movement, while the latter does not. Terada posits two kinds of passive morpheme *(r)are* for the two types of passives, though both morphemes are considered to be V^0.[7]

The morpheme associated with the direct passive is an unaccusative verb with only one internal θ-role, Theme, which is syntactically realized as a CP. Thus it subcategorizes for a CP, and absorbs both case and the external θ-role of the stem

---

(i) a. Sensee-ga Naomi-ni hon-wo o-kak-are-ninat-ta.
teacher-NOM Naomi-DAT book-ACC HON-write-PASS-HON-PAST
'The teacher had Naomi write the book 'The teacher was adversely affected by Naomi's writing the book.'

b. ??Naomi-ga Sensee-ni hon-wo o-kaki-ninar-are-ta.
Naomi-NOM teacher-DAT book-ACC HON-write-HON-PASS-PAST
'Naomi was adversely affected by her teacher's writing the book.'

Kubo draws much on the analysis of SH by Suzuki (1989), which is partly problematic itself. Anyway, the contrast in (i) cannot be account for in Kubo's approach.

[7] As far as classification and very basic assumptions are concerned, Terada (1990) has much in common with Kubo (1990), though the actual analyses are quite different. Terada also recognizes possessive passives as an independent subtype of the class of direct passives. The following schematically shows the D-structures assumed for the direct, possessive, and indirect passives:

(i)
a. direct ____ [$_{CP}$ NP-ni NP* V] rare
b. possessive ____ [$_{CP}$ NP-ni [$_{NP}$ NP* N] V] rare
c. indirect NP NP$_i$ -ni [PRO VP] rare

The NP* in (ia) and (ib) is subsequently moved to the subject position indicated by ____.

verb. Figure 8.11 represents the S-structures of direct passive.

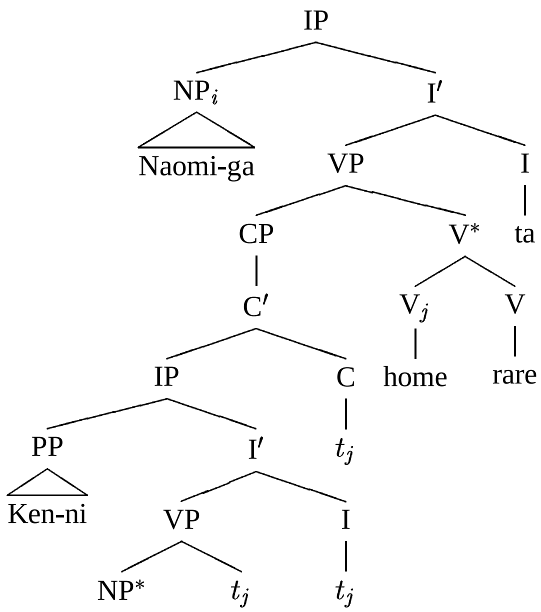


Figure 8.11: Direct Passive: The Incorporation Approach

Incorporation of the stem verb into the passive morpheme takes place between D- and S-structures, as Terada assumes that V affixation takes place as soon as possible. NP movement is motivated by Case Theory on the assumption that the passive morpheme of this type absorbs case.

The other morpheme associated with the indirect passive is a transitive verb with the θ-grid (Experiencer, Source, Theme). It also subcategorizes for a CP with a θ-role Theme, but does not absorb either case or a θ-role. The structure for indirect passives is a control structure as shown in Figure 8.12; the Source argument of *(r)are* controls the subject of the CP. Figure 8.12 represents the PF-structures of indirect passive.

V affixation has to wait untill PF because, otherwise, PRO would be governed due to the Government Transparency Corollary (Baker 1988). If the incorporation were to take place from D- to S-structures, the ECP would have to be observed. So the stem verb would have to move successive cyclically, passing through the head of IP and the head of CP positions. Then, by the Government Transparency Corollary, the amalgam of the stem verb and the passive morpheme would govern PRO; cyclic movement renders maximal projections, i.e., IP and CP, non-barriers. On the other hand, Terada assumes that ECP does not apply at PF, so that the trace of the stem verb need not be properly governed; hence no intermediate trace is necessary, and the incorporation does not have to proceed successive cyclically. Moreover, Terada takes the view that a PRO is invisible at PF; therefore, it does not matter whether it is governed or not.

Terada's (1990) accounts of the optionality of the Agent phrase in direct pas-

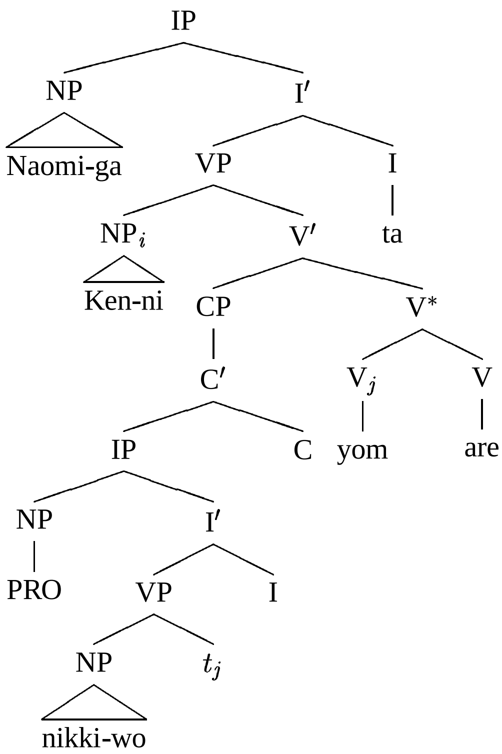


Figure 8.12: Indirect Passive: The Incorporation Approach

sives, and the animacy requirement and adversity interpretation of indirect passives are also similar to Kubo's (1990). The Agent phrase of direct passives is an adjunctive PP, whereas that of indirect passives is an object argument subcategorized for by *(r)are*. An animacy requirement is obtained by indirect passives because the passive predicate for indirect passives has an external θ-role Experiencer. Direct passives can take non-animate subjects because they lack this external θ-role.

Thus Terada's (1990) approach is very powerful in providing a desirable explanation for the characteristics of passives discussed in the previous section. However, we disagree with the idea that the Agent phrase of indirect passives is an object argument of the passive morpheme *(r)are*, as mentioned in Hasegawa (1981b, 1981a).[8]

8.3.5 The Phrase Structure Approach

Gunji (1987) offers a phrase structure analysis of passivization in the framework of Japanese Phrase Structure Grammar (JPSG) that he has proposed. This approach assumes that passivization is a syntactic process rather than a lexical process. The

[8]Uda (1992) argues that the most serious problem with Terada's (1990) approach resides in the level distinction of verb incorporation, which is a crucial mechanism in her system. See Uda (1992) for detailed discussion.

difference between the direct passive and the indirect passive is captured in terms of the syntactic category of the verbal phrase that the head (passive) verbs of each type subcategorize for. The head verb *(r)are* is shown in Figure 8.13.

Direct Passive:
(r)are: {POS V: SUBCAT {PP[SUBJ], PP[OBJ;ni], TVP[+PAS]}, PAS−}
Indirect Passive:
(r)are: {POS V: SUBCAT {PP[SUBJ], PP[OBJ;ni], VP}, PAS−}

Figure 8.13: Passive Verbs '*(r)are*': The Phrase Structure Approach

Being a descendant of Categorial Grammar, JPSG an available distinction between TVP and VP, and makes crucial use of this distinction in the analysis of passives.

Figure 8.14 represents the structure of a direct passives.

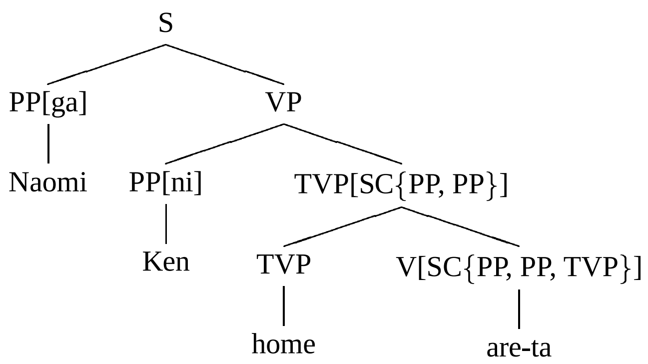


Figure 8.14: Direct Passive: The Phrase Structure Approach

Figure 8.15 represents the structure of an indirect passive.

The direct passive morpheme subcategorizes for two PPs and a TVP while the indirect passive morpheme subcategorizes for two PPs and a VP. Therefore, Gunji's (1987) approach is uniform in the sense that the same structure is assumed for both, and is non-uniform in the sense that two different passive morphemes are postulated.

Gunji's (1987) system, however, has at least two problems. First, the Agent phrase is treated simply as a controller in both direct and indirect passives, and there seems to be no easy way to account for the differences between the Agent phrases of these two types of passive. The second is that the analysis of indirect passives, in addition to those of Hasegawa (1981b, 1981a) and Terada (1990), assumes the object-control structure. We disagree with the idea that the Agent phrase of indirect passives is an object argument of the passive morpheme as mentioned in Hasegawa (1981b, 1981a) and Terada (1990)

Some of these approaches have offered insights in the account of data, and we will incorporate them in the following discussion. For instance, we are in rough

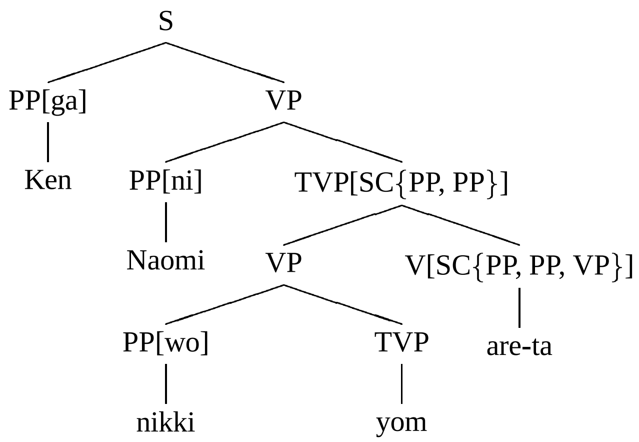


Figure 8.15: Indirect Passive: The Phrase Structure Approach

agreement with Hasegawa (1981b, 1981a), Kubo (1990) and Terada (1990) in considering the Agent phrase of (*niyotte*) direct passives as adjunct so that it can be marked with a postposition. This is crucial in accounting for the optionality of Agent phrases. In the question of the adversity interpretation and animacy requirement of the subject phrase, we agree with Kubo (1990) and Terada (1990) that it is because the external argument of indirect passives is an Experiencer. Keeping these points in mind, in Section 8.5, let us now turn to our formal approach and examine how HPSG can accommodate Japanese passives.

8.4 Adversity and Animacy

8.4.1 Adversity

Obligatory Adversity Interpretation

One of the properties distinguishing the direct and indirect passives is that the obligatory adversity interpretation associated with the indirect passive and the neutral interpretation of the direct passive.

Indirect passives are characterized by a special obligatory connotation. They are always accompanied by an implication that the matrix subject is adversely affected by the event denoted by the rest of the sentence, and for this reason, this class of passive has been referred to as adversity passives since Kuno (1973).

(21) a. Ken-ga ame-ni hur-are-ta.
Ken-NOM rain-DAT fall-PASS-PAST
'Ken was affected by rain's falling on him.'

b. Ken-ga Naomi-ni nikki-wo yom-are-ta.
Ken-NOM Naomi-DAT diary-ACC read-PASS-PAST
'Ken was adversely affected by the Naomi's reading his diary.'

It has been suggested that direct passives also tend to carry the adversity implication, but the implication is often cancellable. The examples below (22) demonstrate clear cases of neutral interpretation:

(22) a. Naomi-ga Ken-ni home-rare-ta.
Naomi-NOM Ken-DAT praise-PASS-PAST
'Naomi was praised by Ken. / Naomi was affected by Ken's praising her.'

b. Naomi-ga Ken-ni tasuke-rare-ta.
Naomi-NOM Ken-DAT help-PASS-PAST
'Naomi was helped by Ken. / Naomi was affected by Ken's helping her.'

Such neutral interpretation is unavailable with indirect passives.

Involvement of the Subject

Oehrle and Nishio (1981) investigate the source of adversity interpretation of passives by examining Japanese direct and indirect passives and various English constructions which carry adversity meanings. They particularly draw on the observation by Wierzbicka (1979) which correlates the adversity interpretation with the involvement of the (matrix) subject of passives in the expressed event. They suggest that the adversity interpretation is obtained when the subject is not directly involved in the event denoted by the stem verb. The indirect passive situation induces adversity because, according to them, the passive subject is not directly involved in the event denoted by the stem verb. The direct passive allows a neutral interpretation because the passive subject is a participant of the expressed event.

We basically agree with this view and will elaborate further in Sections 8.5.2 and 8.5.3.[9]

8.4.2 Animacy

Animacy Requirement of the Subject

In the previous section, we assumed that the adversity interpretation is not something inherent in the lexical entry of the passives of any type, but is something obtained from the semantic relation between the matrix subject and the event denoted by the verb stem. Based on this view, we will account for another semantic property which distinguishes the direct passives and the indirect passives, a semantic restriction of the matrix subject.

The matrix subject of *ni*-direct and indirect passives is restricted to animate NPs. *niyotte*-direct passives, on the other hand, does not show such a restriction.

[9] This semantic solution has been shared with Kuno (1983) and Shibatani (1990).

The following show such a restriction on the matrix subject of *niyotte*-direct and *ni*-direct passives:

(23) a. *Tyuui-ga Ken-ni haraw-are-ta.
heed-NOM Ken-DAT pay-PASS-PAST
'Heed$_i$ was affected by Ken's paying it$_i$.'

b. Tyuui-ga Ken-niyotte haraw-are-ta.
heed-NOM Ken-by pay-PASS-PAST
'Heed was paid by Ken.'

(24) a. *Sono hon-wa syuppansya-ni betuno hon-wo
that book-TOP publisher-DAT different book-ACC
syuppans-are-ta.
publish-PASS-PAST
'The book was adversely affected by the publisher's publishing a different book.'

b. Sono seeto-wa sensee-ni betuno seeto-wo
that student-TOP teacher-DAT different student-ACC
home-rare-ta.
praise-PASS-PAST
'The student was adversely affected by his/her teacher's praising a different student.'

Since an NP such as *tyuui* 'heed' and *hon* 'book' are not animate, (23a) and (24a) are ruled out due to the violation of the selectional restriction.

One way to guarantee the animacy requirement and the adversity interpretation is proposed by Kubo (1990). This proposition is that the external θ-role of the indirect passive morpheme *(r)are* is specified as [malefactive] in the lexical entry. However, this approach cannot explain the neutral interpretation of the *ni*-direct passive.

Thematic Underspecification

Here we adopt the idea of thematic underspecification by Ritter and Rosen (1993). Ritter and Rosen suggests that in predicate formation, when an extra argument is introduced as the matrix subject, there are roughly two ways to relate it to the embedded (core) event: either as the one who causes the event, or as the one who is influenced by the event. Namely, the Causer role and the Experiencer role are the two choices in such cases. As the event participant cannot be the Causer in the case of adversity interpretation, it is left with an Experiencer role.

Under this assumption, the problem of the animacy requirement of the matrix subject mentioned above is simply explained in the same way as Kubo (1990) and Terada (1990) suggest. That is, an argument must be animate to experience something, except in metaphor or in fantasy. This idea finds support in the fact that virtually all of the recent major works on the Japanese passives have defined the thematic role of the subject of at least indirect passives as Experiencer (Miyagawa 1989, Terada 1990, Kubo 1990).

8.4.3 Uniformity in Semantics

The approach newly presented must provide satisfactory answers to most of the questions regarding not only the syntactic different behavior which is the controversy of the previous studies but semantic commonality of direct and indirect passives. The problem is how to seek the uniformity in sentences with the same morphological shapes.

Recent uniformists have attempted to capture uniformity while, at the same time, deriving distinct syntactic surface structures. For instance, Miyagawa (1989) attributes the difference only to the optional 're-assignment' of the once-absorbed accusative case. In the case where this option is taken, indirect passives result. In other cases, direct passives result. Kubo (1990) seeks uniformity in the lexical entry of the passive morpheme *(r)are*. Kubo claims that the bar-level of the verbal category for which it subcategorizes has two options. When the bar-level is maximal, indirect passives result. When it is zero, direct passives result.

Criticisms of each approach have already been made in the previous section. Here we adopt the HPSG approach which easily provides another domain in which to seek uniformity while maintaining syntactic distinctiveness. We have proposed three types of passives, *niyotte*-direct passives, *ni*-direct passives, and indirect passives. SUBCAT and ARG-ST features occurring in each of them will be different depending on the type of passive. The (main part of) SEM features, on the other hand, will be shared between *ni*-direct passives and indirect passive since they have same semantic properties, i.e., adversity interpretation and animacy requirement. The mechanism of feature-sharing and the Semantic Principle ensure that essentially the same SEM feature structure will appear as the SEM of the whole sentence. Therefore, in my analysis, uniformity is guaranteed in the SEM carried by both types of the passive sentences. The detailed feature structures are discussed in the next section.

8.5 Semantic Uniformity and Underspecification

In Section 8.3, we surveyed some of the studies of Japanese passives presented in the literature. In Section 8.4, we argued for semantic properties for passives. Although some of the previous studies are better able to account for the data than others, they all seem to seek the answer to the same question: how reconcile the apparent syntactic differences and semantic commonality between the direct passives and the indirect passives under the morphological uniformity? In this section, we will discuss an approach that can simultaneously accommodate both syntactic differences and semantic commonalities among different types of Japanese passive.

8.5.1 *Niyotte*-Direct Passives

We claim that *niyotte*-direct passives are derived by a lexical rule much in line with Pollard and Sag (1987) where the crucial operation is the change of grammatical relations among arguments.

If an operation triggers a change of the member of the SUBCAT list of a predicate, i.e., subject and complements, then it has to take place at the lexical level, due to the monotonicity of the unification operation in syntax. The following is the lexical rule that we propose for *niyotte*-direct passives:

$$\begin{bmatrix} \text{MORPHON} & \langle \boxed{1} \rangle \\ \text{SUBCAT} & \langle \boxed{2}\ \text{NP}[\textit{nom}]_i \oplus \boxed{3} \oplus \boxed{4}\ \text{NP} \oplus \boxed{5} \rangle \\ \text{ARG-S} & \langle \boxed{2} \oplus \boxed{3} \oplus \boxed{4} \oplus \boxed{5} \rangle \\ \text{SEM} & \boxed{6} \end{bmatrix}$$

$$\rightarrow \begin{bmatrix} \text{MORPHON} & \langle \boxed{1}\ \textit{rare} \rangle \\ \text{SUBCAT} & \langle \boxed{4}\ \text{NP}[\textit{nom}] \oplus \boxed{3} \oplus \boxed{5} \oplus \boxed{7}(\text{PP}[\textit{niyotte}]_i) \rangle \\ \text{ARG-S} & \langle \boxed{4} \oplus \boxed{3} \oplus \boxed{5} \oplus \boxed{7} \rangle \\ \text{SEM} & \boxed{6} \end{bmatrix}$$

Figure 8.16: Lexical Rule: *Niyotte*-Direct Passive

Figure 8.16 follows the spirit underlying the passive lexical rule of English proposed by Pollard and Sag (1987) as far as the SUBCAT feature is concerned; one of the arguments in ARG-ST list becomes the least oblique argument, and the original subject loses its argument status in SUBCAT list.

See Figure 8.17, where the input verb is *haraw* 'pay' :

$$\begin{bmatrix} \text{MORPHON} & \langle \textit{haraw} \rangle \\ \text{SUBCAT} & \langle \boxed{1}\ \text{NP}[\textit{nom}]_i \oplus \boxed{2}\ \text{NP}[\textit{acc}]_j \rangle \\ \text{ARG-ST} & \langle \boxed{1} \oplus \boxed{2} \rangle \\ \text{SEM} & \boxed{3} \begin{bmatrix} \textit{pay-rel} & \\ \text{PAYER} & i \\ \text{PAID} & j \end{bmatrix} \end{bmatrix}$$

$$\rightarrow \begin{bmatrix} \text{MORPHON} & \langle \textit{haraware} \rangle \\ \text{SUBCAT} & \langle \boxed{2}\ \text{NP}[\textit{nom}]_j \oplus \boxed{4}(\text{PP}[\textit{niyotte}]_i) \rangle \\ \text{ARG-ST} & \langle \boxed{2} \oplus \boxed{4} \rangle \\ \text{SEM} & \boxed{3} \begin{bmatrix} \textit{pay-rel} & \\ \text{PAYER} & i \\ \text{PAID} & j \end{bmatrix} \end{bmatrix}$$

Figure 8.17: '*haraw are*': *Niyotte*-Direct Passive

As mentioned above, the present approach accepts the idea of subject demotion in passivization. That is, the original subject can be left out of the syntactic SUBCAT list. This is why it can be omitted in many languages. The crucial data are given below:

(25) a. Tyuui-ga (Ken-niyotte) haraw-are-ta.
heed-NOM Ken-by pay-PASS-PAST
'Heed was paid (by Ken).'

b. Ken-ga *(ame-ni) hur-are-ta.
Ken-NOM rain-DAT fall-PASS-PAST
'Ken was affected (by rain's) falling on him.'

In some languages, the Agent phrase of a passive is obligatorily absent (Baker 1988, Spencer 1991). Recall also that in recent studies of Japanese passives, the Agent phrase of direct passives is treated as an adjunct, while the Agent phrase of indirect passives is considered an argument (Miyagawa 1989, Kubo 1990, Terada 1990). We basically agree with these treatments. As with the passives of many other languages including English, the Agent phrase is not an obligatory argument in Japanese. It has been claimed that the Agent phrase can be omitted only in direct passives. However, the output of the lexical rule guarantees that only (25a), which is obligatory interpreted as the example of *niyotte*-direct passives, allows such omission.

8.5.2 Indirect Passives

Syntactic Compounds

In contrast with the *niyotte*-direct passives, the indirect passives involve syntactic embedding. Namely, the passive morpheme *(r)are* of the indirect passive functions as a word with its own SUBCAT attribute. The following is the relevant part of the feature structure of the indirect passive morpheme *(r)are*:

$$\begin{bmatrix} \text{MORPHON} & \langle \textit{(r)are} \rangle \\ \text{SUBCAT} & \langle \boxed{1}\ \text{NP}[\textit{nom}]_i \oplus \boxed{2}\ \text{NP}[\textit{dat}] \oplus \boxed{3} \rangle \\ \text{ADJCNT} & \boxed{4} \left\langle \text{V} \begin{bmatrix} \text{SUBCAT} & \langle \boxed{2}\ \text{NP} \oplus \boxed{3}\rangle \\ \text{ARG-ST} & \langle \boxed{2} \oplus \boxed{3} \rangle \\ \text{SEM} & \boxed{5} \end{bmatrix} \right\rangle \\ \text{ARG-ST} & \boxed{1} \oplus \boxed{4} \\ \text{SEM} & \begin{bmatrix} \textit{affect-rel} & \\ \text{AFFECTEE} & i \\ \text{EVENT} & \boxed{5} \end{bmatrix} \end{bmatrix}$$

Figure 8.18: '*(r)are*': Indirect Passive Morpheme

Notice that among the arguments of *(r)are*, $\boxed{2}$ NP and $\boxed{3}$ NP in SUBCAT list are structure shared by the subject and object of the stem verb respectively. These arguments are raising controllers, playing no semantic role with respect to the passive predicate *(r)are*.

Therefore they appears only in the SUBCAT list, and not in the ARG-ST list of *(r)are* since the argument attraction is not supposed to affect the ARG-ST feature.

As a consequence, the ARG-ST of *(r)are* contains only the subject [1] NP and the S-complement [4]. The lack of the raising controller [2] in the ARG-ST of *(r)are* accounts for the unavailability of the Object Honorification. The appearance of [3] in SUBCAT of *rare* explains why it is possible to construct a resultative sentence out of the indirect passives (Uda 1996).

See the example in Figure 8.19, where the input verb is *hur* 'fall'.

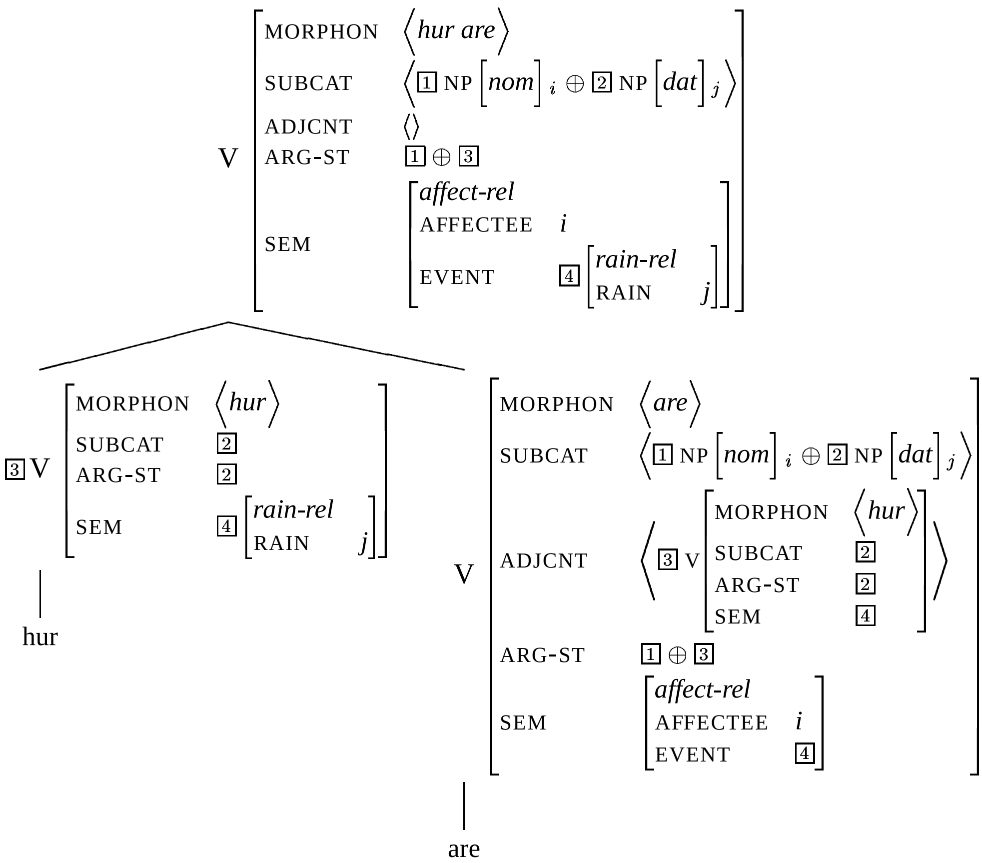


Figure 8.19: '*hur are*': Feature Structure with Tree Diagram

As shown in Figure 8.19, the arguments in matrix SUBCAT list are not PPs, unlike *niyotte*-direct passive, and structure-shared with the embedded arguments. This is why the second NP and the third NP are marked with dative and accusative respectively, and cannot be omitted. The crucial data is shown in below:

(26) a. Ken-ga ame-{ni/*niyotte/*kara} hur-are-ta.
Ken-NOM rain-DAT /by/from fall-PASS-PAST
'Ken was affected by rain's falling on him.'

b. Ken-ga *(ame-ni) hur-are-ta.
Ken-NOM rain-DAT fall-PASS-PAST
'Ken was affected by (rain's) falling on him.'

(27) a. Ken-ga Naomi-{ni/*niyotte/*kara} nikki-wo yom-are-ta.
Ken-NOM Naomi-DAT /by/from diary-ACC read-PASS-PAST
'Ken was adversely affected by the Naomi's reading his diary.'

b. Ken-ga ??(Naomi-ni) *(nikki-wo) yom-are-ta.
Ken-NOM Naomi-DAT diary-ACC read-PASS-PAST
'Ken was adversely affected by the Naomi's reading his diary.'

Semantic Underspecification

The indirect passive output also differs from that of *niyotte*-direct passive in terms of the SEM feature. Recall that the matrix subject of the indirect passive is restricted to the animate NP. The crucial data are shown in below:

(28) a. *Sono hon-wa syuppansya-ni betuno hon-wo
that book-TOP publisher-DAT different book-ACC
syuppans-are-ta.
publish-PASS-PAST
'The book was adversely affected by the publisher's publishing a different book.'

b. Sono seeto-wa sensee-ni betuno seeto-wo
that student-TOP teacher-DAT different student-ACC
home-rare-ta.
praise-PASS-PAST
'The student was adversely affected by his/her teacher's praising a different student.'

Since the NP *hon* 'book' is not animate, (28a) is ruled out due to the violation of the selectional restriction of the subject. As discussed in Section 8.4.2, Ritter and Rosen (1993) suggests that in predicate formation, when an extra argument is introduced as the matrix subject, Experiencer role and Causer role are the two choices in such cases. Since the event participant must be Experiencer in adversity interpretation, an argument bearing such a thematic role has to be animate to experience something.

Now, let us precisely consider the SEM feature structure of indirect passives to fully incorporate Ritter and Rosen's (1993) approach discussed in Section 8.4.2. We have proposed that the lexical rule above indicates that indirect passives specify a semantic relation tentatively referred to as *affect-rel* with two arguments, AFFECTEE and EVENT. The relevant part of feature structure of (28b) is shown in Figure 8.20.

The extra argument, i.e., matrix subject in indirect passives, has an underspecified role referred to as AFFECTEE, which is the label for some set of relations and roles with relevant entailments much in the same way as the proto-role in Dowty (1991). The value of EVENT feature is the SEM of the stem verb.

$$
\left[\begin{array}{ll}
\text{SEM} & \left[\begin{array}{ll}
\textit{affect-rel} & \\
\text{AFFECTEE} & i \\
\text{EVENT} & \left[\begin{array}{ll}
\textit{praise-rel} & \\
\text{PRAISER} & j \\
\text{PRAISEE} & k
\end{array}\right]
\end{array}\right]
\end{array}\right]
$$

Figure 8.20: '*hur are*': The SEM Feature

The only crucial specification that we propose here is that *affect-rel* is also an underspecified relation. The only condition is that *affect-rel* is defined by its primary participant, i.e., AFFECTEE, whose role is sufficiently removed from the Proto-Agent role (Dowty 1991). Crucially, among the entailments for the Proto-Agent role, AFFECTEE must be neither volitional nor causative. We further claim that *affect-rel* and AFFECTEE require more specification in order for the matrix subject to establish a specific semantic link to the semantics of stem verb i.e., EVENT. This is crucial for introducing Oehrle and Nishio's (1981) approach discussed in Section 8.4.1. This point will be elaborated further in the discussion of *ni*-direct passives in the next section.

8.5.3 *Ni*-Direct Passives

Another Type of Lexical Rule

Ni-direct passives are also derived by a lexical rule but they differ from *niyotte*-direct passives. Consider the following:

$$
\left[\begin{array}{ll}
\text{MORPHON} & \boxed{1} \\
\text{SUBCAT} & \left\langle \boxed{2}\ \text{NP}\left[\textit{nom}\right]_i \oplus \boxed{3}\ \text{NP}\left[\textit{acc}\right]_j \right\rangle \\
\text{ARG-ST} & \left\langle \boxed{2} \oplus \boxed{3} \right\rangle \\
\text{SEM} & \boxed{4} \left[\begin{array}{ll}
\textit{act-und-rel} & \\
\text{ACT} & i \\
\text{UND} & j
\end{array}\right]
\end{array}\right]
\rightarrow
\left[\begin{array}{ll}
\text{MORPHON} & \left\langle \boxed{1}\ \textit{rare} \right\rangle \\
\text{SUBCAT} & \left\langle \boxed{3}\ \text{NP}\left[\textit{nom}\right]_j \oplus \boxed{2}\ \text{NP}\left[\textit{dat}\right]_i \right\rangle \\
\text{ARG-ST} & \left\langle \boxed{3} \oplus \boxed{2} \right\rangle \\
\text{SEM} & \left[\begin{array}{ll}
\textit{affect-rel} & \\
\text{AFFECTEE} & j \\
\text{EVENT} & \boxed{4}
\end{array}\right]
\end{array}\right]
$$

Figure 8.21: Lexical Rule: *Ni*-Direct Passive

The crucial operation in the formation of *ni*-direct passives is also the change of grammatical relations, as *niyotte*-direct passives. However, this lexical rule differs from the passive lexical rule of not only English, as proposed by Pollard and Sag

(1987), but also *niyotte*-direct passives discussed above in terms of SEM feature. See the example below, where the input verb is *home* 'praise':

$$
\begin{bmatrix}
\text{MORPHON} & \langle \textit{home} \rangle \\
\text{SUBCAT} & \langle \boxed{1}\ \text{NP}[\textit{nom}]_i \oplus \boxed{2}\ \text{NP}[\textit{acc}]_j \rangle \\
\text{ARG-ST} & \langle \boxed{1} \oplus \boxed{2} \rangle \\
\text{SEM} & \boxed{3} \begin{bmatrix} \textit{praise-rel} & \\ \text{PRAISER} & i \\ \text{PRAISED} & j \end{bmatrix}
\end{bmatrix}
$$

$$
\rightarrow
\begin{bmatrix}
\text{MORPHON} & \langle \textit{homerare} \rangle \\
\text{SUBCAT} & \langle \boxed{2}\ \text{NP}[\textit{nom}]_j \oplus \boxed{1}\ \text{NP}[\textit{dat}]_i \rangle \\
\text{ARG-ST} & \langle \boxed{2} \oplus \boxed{1} \rangle \\
\text{SEM} & \begin{bmatrix} \textit{affect-rel} & \\ \text{AFFECTEE} & j \\ \text{EVENT} & \boxed{3} \begin{bmatrix} \textit{praise-rel} & \\ \text{PRAISER} & i \\ \text{PRAISEE} & j \end{bmatrix} \end{bmatrix}
\end{bmatrix}
$$

Figure 8.22: '*homer-are*': *Ni*-Direct Passive

One of the non-subject arguments in SUBCAT list is promoted to the subject but the original subject is demoted to the SUBCAT list, without losing its argument status. This is why the NP which bears Agent θ-role is marked with dative in *ni*-direct passives. The crucial data is shown in below:

(29) Naomi-ga Ken-ni home-rare-ta.
Naomi-NOM Ken-DAT praise-PASS-PAST
'Naomi was affected by the Ken's praising her.'

Note that the matrix subject of the *ni*-direct passive is restricted to the animate NP. The crucial data is shown in below:

(30) a. *Tyuui-ga Ken-ni haraw-are-ta.
heed-NOM Ken-DAT pay-PASS-PAST
'Heed$_i$ was affected by Ken's paying it$_i$.'

b. Tyuui-ga Ken-niyotte haraw-are-ta.
heed-NOM Ken-by pay-PASS-PAST
'Heed was paid by Ken.'

Since an NP *tyuui* 'heed' is not animate, (30a) is ruled out due to the violation of the selectional restriction of the AFFECTEE. (30b) is, on the other hand, derived by the *niyotte*-direct passive lexical rule which has no semantic restriction; therefore inanimate NP can become subject.

Semantic Uniformity

As for this point, we assume the SEM feature of *ni*-direct passives is not identical to that of not only the active counterparts but also that of the *niyotte*-direct passives, as is standardly assumed. We propose that the lexical rule above indicates that *ni*-direct passives specify a semantic relation referred to as *affect-rel*. The relevant part of feature structure is shown in Figure 8.23.

$$\begin{bmatrix} \text{SEM} & \begin{bmatrix} \textit{affect-rel} & \\ \text{AFFECTEE} & j \\ \text{EVENT} & \begin{bmatrix} \textit{praise-rel} & \\ \text{PRAISER} & i \\ \text{PRAISEE} & j \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Figure 8.23: The SEM Feature: *Ni*-Direct Passive

Notice that the feature structure in Figure 8.23 is not identical to that of the indirect passives given in Figure 8.20, repeated as Figure 8.24.

$$\begin{bmatrix} \text{SEM} & \begin{bmatrix} \textit{affect-rel} & \\ \text{AFFECTEE} & i \\ \text{EVENT} & \begin{bmatrix} \textit{praise-rel} & \\ \text{PRAISER} & j \\ \text{PRAISEE} & k \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Figure 8.24: The SEM Feature: Indirect Passive

Compare Figure 8.23 and 8.24. The same SEM structure guarantees that *ni*-direct and indirect passives are accompanied by an implication that the matrix subject is adversely affected by the event denoted by the rest of the sentence. The only difference between 8.23 and 8.24 is the presence or absence of coindexing relation between AFFECTEE and the participant of EVENT.

When the argument with the AFFECTEE is coindexed with the participant of EVENT, there are two ways for substantiating the unspecified AFFECTEE. If the entailments of the Patient-like participant of EVENT are completely compatible with the entailments of the AFFECTEE, AFFECTEE is substantiated by the semantic role it bears with respect to EVENT. This means the matrix subject is directly connected to the EVENT denoted by the stem verb. Thus adversity interpretation is cancelled.

In the case of indirect passives, no coindexing relation is involved. The AFFECTEE is not connected to EVENT in any way. This is why indirect passive obligatory has adversity interpretation.

Uniformity in the analysis of passives is achieved at the level of SEM structure. The information-based nature of HPSG makes it possible for types of Japanese passive to share essentially the same SEM feature.

8.5.4 Adversity Causatives

Oehrle and Nishio (1981), Ritter and Rosen (1993), Washio (1993, 1995) have argued that there are some instances of causatives which allow the addition of the matrix subject that is not responsible for the event denoted by the stem verb, but rather is adversely affected by it. Some examples of this appear in (31):

(31) a. Naomi-wa kodomo-wo sin-ase-ta.
Naomi-TOP child-ACC die-CAUSE-PAST
'Naomi had her child die on her.'

b. Ken-wa kaisya-wo toosans-ase-ta.
Ken-TOP company-ACC break-CAUSE-PAST
'Ken had his company go broke on him.'

In each case, *(s)ase* is interpreted as experience rather than causation. The generalization seems to be that when *(s)ase* is combined with an unaccusative verb, it cannot be used as a causative verb. The relevant characteristic of unaccusatives is that they have no external argument, and therefore the control relation relate two events as control causative.

Thus, we will call this type of causatives adversity causative and claim that these have the feature structure in Figure 8.25.

$$\begin{bmatrix} \text{MORPHON} & \langle \textit{(s)ase} \rangle \\ \text{SUBCAT} & \langle \boxed{1}\ \text{NP}[\textit{nom}]_i \oplus \boxed{2}\ \text{NP}[\textit{acc}] \rangle \\ \text{ADJCNT} & \boxed{3} \left\langle \text{V} \begin{bmatrix} \text{SUBCAT} & \boxed{2}\langle \text{NP}_j \rangle \\ \text{ARG-ST} & \boxed{2} \\ \text{SEM} & \boxed{4} \begin{bmatrix} \textit{und-rel} & \\ \text{UND} & \text{J} \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{ARG-ST} & \boxed{1} \oplus \boxed{3} \\ \text{SEM} & \begin{bmatrix} \textit{affect-rel} & \\ \text{AFFECTEE} & i \\ \text{EVENT} & \boxed{4} \end{bmatrix} \end{bmatrix}$$

Figure 8.25: '*(s)ase*': Adversity Causative Morpheme

The causative morpheme *(s)ase* is a bound form, but functions syntactically as a verb. Notice that among the arguments of *(s)ase*, $\boxed{2}$ NP in the SUBCAT list is structure-shared with the subject of the stem verb. This is a raising controller, playing no semantic role with respect to the causative predicate *(s)ase*. See the example in Figure 8.26, where the input verb is *sin(u)* 'die'.

Now, let us carefully consider the SEM feature structure of the adversity causative to fully incorporate Ritter and Rosen's (1993) approach introduced for adversity passive. We have proposed that the semantic relation tentatively referred to as *affect-rel* with two features, AFFECTEE and EVENT. Since adversity causative also has the same semantic entailment, we assume the SEM of such a causative as in

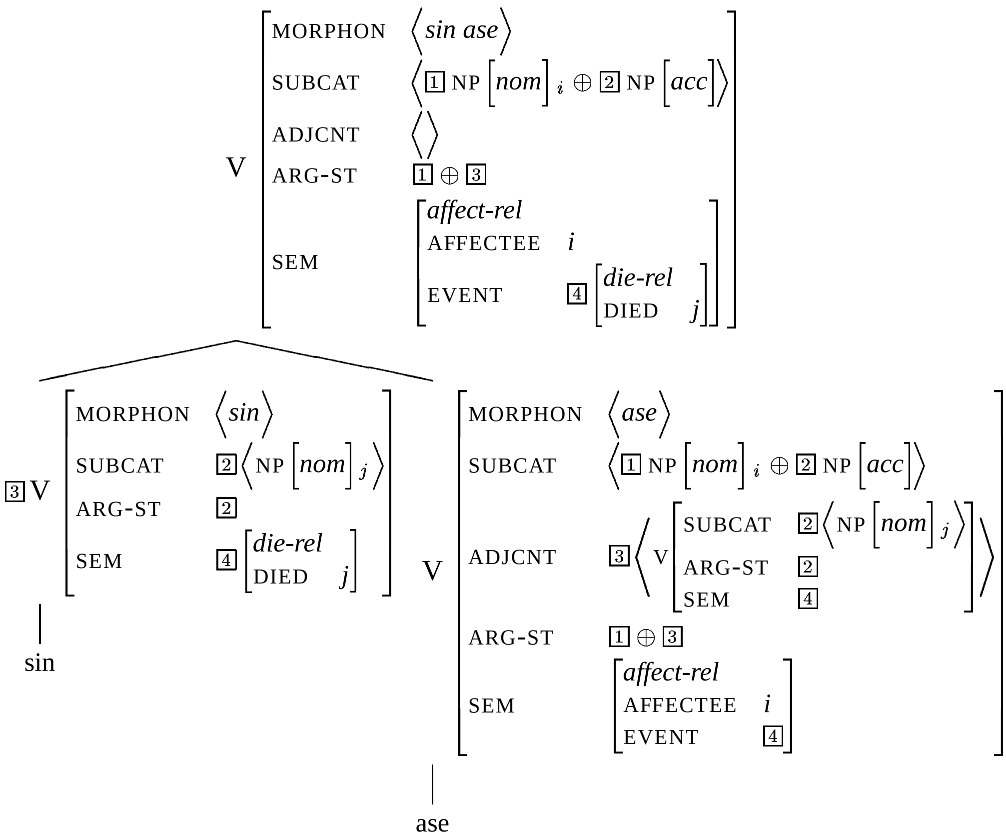


Figure 8.26: ‘*sin ase*’: Adversity Causative with Tree Diagram

Figure 8.25. The relevant part of the feature structure in Figure 8.26 is shown in Figure 8.27.

$$\left[\text{SEM} \quad \begin{bmatrix} \textit{affect-rel} & \\ \text{AFFECTEE} & i \\ \text{EVENT} & \begin{bmatrix} \textit{die-rel} & \\ \text{DIED} & j \end{bmatrix} \end{bmatrix}\right]$$

Figure 8.27: The SEM Feature: Adversity Causative

The extra argument, i.e., the matrix subject in adversity causatives, also has an underspecified role referred to as AFFECTEE, which is the label for some set of relations and roles with relevant entailments much in the same way as the proto-Patient role in Dowty (1991). The value of the EVENT feature is the SEM of the stem verb.

Notice that the feature structure in Figure 8.27 is identical to that of the indirect passives. Since no coindexing relation is involved between the two relations, the AFFECTEE is not connected to the EVENT and therefore adversity interpretation occurs.

One might object to positing a common SEM for both indirect passive and adversity causative by pointing out the semantic difference between cause and affect, which is their original meaning. On this point, we simply assume that the real semantic difference between the two constructions is maintained as each semantic entailment of the AFFECTEE is unspecified, allowing a different set of entailment. However, the concept of adversity is derived from their uniform SEM along the line of Oehrle and Nishio (1981), Ritter and Rosen (1993), Washio (1993, 1995).

8.6 Summary

In this chapter, we have presented a fragment of JPSG, and an analysis of Japanese passives. Based on the basic assumptions and mechanism of HPSG and NAIST JPSG introduced in Chapter 2 and 4, we discussed the important aspects of the framework for inquiring various properties of Japanese Passive.

We have proposed that Japanese passives can be classified into three subclasses: *niyotte*-direct passives, *ni*-direct passives, and indirect passives. *Niyotte* and *ni*-direct passives are derived through lexical rules. The indirect passive involve syntactic embedding structure.

We also claim that the properties separating direct and indirect passives, which have been recurrent problems in analyses of Japanese passives, are best accounted for in terms of not only the structural differences but semantic requirements of each types of passives. This semantics also explains the interpretation of adversity causative.

Chapter 9

Benefactive Constructions and Parallelism among Constructions

9.1 Introduction

Only a few attempts have so far been made at the *te-moraw* benefactive constructions compared with the causative and the passive constructions in Japanese linguistics (Kuroda 1965a, 1965b, Inoue 1976, Nakau 1973, McCawley & Momoi 1985, Gunji 1987, Terada 1990). Among them, Gunji (1987), Terada (1990) and Uda (1992) point out the interesting syntactic similarities between benefactives and passives.

This chapter discusses the benefactive constructions, with the main focus on *te-moraw* benefactives, which will be examine to support our approach.

9.2 Japanese Benefactive Constructions

9.2.1 Parallelism with Passives

Compare the two types of benefactives which have been recognized as corresponding to passive sentences shown in the following:

(1) a. Naomi-ga Ken-ni(yotte) home-te-morat-ta.
Naomi-NOM Ken-by praise-INFL-BEN-PAST
'Naomi was praised by Ken for her benefit.'

b. Naomi-ga Ken-ni(yotte) homer-are-ta.
Naomi-NOM Ken-by praise-PASS-PAST
'Naomi was praised by Ken.'

(2) a. Naomi-ga Ken-ni deteit-te-morat-ta.
Naomi-NOM Ken-DAT get.out-INFL-BEN-PAST
'Naomi had Ken get out for her benefit.'

b. Naomi-ga Ken-ni deteik-are-ta.
Naomi-NOM Ken-DAT leave-PASS-PAST
'Naomi had Ken leave to her disadvantage.'

Intutively speaking, (1a) and (1b) share the same meaning with their active counterpart as (3), except for the benefactive implication:

(3) Ken-ga Naomi-wo home-ta.
Ken-NOM Naomi-ACC praise-PAST
'Ken praised Naomi.'

(2a) and (2b) show that the valency of the stem or gerundive verb is increased by one both in the passive and in the benefactive.

As shown in the glosses, passives in Japanese sometimes carry the implication of disadvantageous affectedness, i.e., adversity, on the part of the matrix subject, whereas the *te-moraw* benefactives always carry the opposite implication, i.e., the subject receives benefit. Otherwise, they are almost identical in terms of the thematic relations among the arguments. In particular, the benefactives seem to fit into the two types posited for the passive, i.e., direct and indirect. Therefore, we will call (1a) and (2a) the direct benefactive and the indirect benefactive, respectively.[1]

The parallelism between the passives and the benefactives is found not only in terms of the surface arrangement of their arguments. It is further confirmed by their behavior with respect to *zibun* binding in (4)–(5) and the behavior of the dative-marked phrases in (6)–(7). First, consider the examples of *zibun* binding:

(4) a. Naomi$_i$-ga Ken$_j$-ni zibun$_{i/?*j}$-no ie-de
Naomi-NOM Ken-DAT self-GEN house-LOC
home-te-morat-ta.
praise-INFL-BEN-PAST
'Naomi was praised by Ken in her/?*his house for her benefit.'

b. Naomi$_i$-ga Ken$_j$-ni zibun$_{i/?*j}$-no ie-de
Naomi-NOM Ken-DAT self-GEN house-LOC
homer-are-ta.
praise-PASS-PAST
'Naomi was praised by Ken in her/?*his house.'

[1] There is another type of benefactive which corresponds to possesive passive.

(i) a. Naomi-ga Ken-ni kodomo-wo home-te-morat-ta.
Naomi-NOM Ken-DAT child-ACC praise-INFL-BEN-PAST
'Naomi had Ken praise her child for her benefit.'

b. Naomi-ga Ken-ni kodomo-wo homer-are-ta.
Naomi-NOM Ken-DAT child-ACC praise-PASS-PAST
'Naomi had Ken praise her child.'

How to treat this type of benefactives/passives is a question which we want to keep beyond the scope of this present discussion. See Terada (1990) and Uda (1992) for detailed discussion.

(5) a. Naomi$_i$-ga Ken$_j$-ni zibun$_{i/j}$-no heya-kara
Naomi-NOM Ken-DAT self-GEN room-from
deteit-te-morat-ta.
get.out-INFL-BEN-PAST
'Naomi had Ken get out of her/his own room for her benefit.'

b. Naomi$_i$-ga Ken$_j$-ni zibun$_{i/j}$-no heya-kara deteik-are-ta.
Naomi-NOM Ken-DAT self-GEN room-from get.out-PASS-PAST
'Naomi had Ken get out of her/his own room to her disadvantage.'

It has been observed that the matrix subject of a passive is always able to bind a *zibun* phrase as in both (4b) and (5b), whereas the dative marked phrase can bind it only in the indirect passive as in (5b). Exactly the same behavior is observed with benefactives in (4a) and (5a), respectively (Gunji 1987, Terada 1990). Next, let us see the examples of optionality of the dative-marked phrase:

(6) a. Naomi-ga Ken-{ni/niyotte/ϕ} home-te-morat-ta.
Naomi-NOM Ken-DAT -by praise-INFL-BEN-PAST
'Naomi was praised (by Ken) for her benefit.'

b. Naomi-ga Ken-{ni/niyotte/ϕ} homer-are-ta.
Naomi-NOM Ken-DAT -by praise-PASS-PAST
'Naomi was praised (by Ken).'

(7) a. Naomi-ga Ken-{ni/*niyotte/*ϕ} deteit-te-morat-ta.
Naomi-NOM Ken-DAT -by get.out-INFL-BEN-PAST
'Naomi had Ken get out for Naomi's her benefit.'

b. Naomi-ga Ken-{ni/*niyotte/*ϕ} deteik-are-ta.
Naomi-NOM Ken-DAT -by get.out-PASS-PAST
'Naomi had Ken get out to her disadvantage.'

The *te-moraw* benefactives also show exactly the same property as passives. The alternation of *ni* and *niyotte*, and the potential for deletion of the Agent phrase exist with the direct benefactive (6a), but are not possible with the indirect benefactive (7a).[2] Thus these data clearly show that the benefactive constructions syntactically parallel the passive constructions.

9.2.2 Differences with Passives

There are some differences in syntactic and morphological behavior between benefactives and passives. The relevant data are Subject Honorification and Do-support.

[2] We have claimed that the direct passive is further divided into two types, i.e., the *ni*-direct passive and the *niyotte*-direct passive. Here we assume that the direct benefactive has a two counterparts, but we will ignore that the alternation fact suggests there are at least two types of direct benefactives and that the optionality is only caused by the *niyotte*-types.

Morphological Order in Honorification

Let us first observe the crucial data of Subject Honorification. In the following examples, respect is supposed to be directed toward *sensee* 'teacher.'

(8) Sensee-ga Ken-ni o-tasuke-rare-ninat-ta.
teacher-NOM Ken-DAT HON-help-PASS-HON-PAST
'The teacher was helped by Ken. (honorific)'

(9) a. *Sensee-ga Ken-ni o-tasuke-te-morai-ninat-ta.
teacher-NOM Ken-DAT HON-help-INFL-BEN-HON-PAST

b. Sensee-ga Ken-ni tasuke-te-o-morai-ninat-ta.
teacher-NOM Ken-DAT help-INFL-HON-BEN-HON-PAST
'The teacher was helped by Ken for the teacher's benefit. (honorific)'

Subject Honorification (henceforth, SH) is syntactically derived by putting an verb which subcategorizes for the target of the honor between *(g)o* and *ninar*. It is noteworthy that passives and benefactives show different morpheme order in the case of the SH of the matrix subject. To be more precise, V-INFL*o*-BEN-HON is the order for the benefactives, and *o*-V-PAS-HON is the order for passives. This is confirmed by observing the case of indirect type of the passives and benefactives. See below: [3]

(10) Sensee-ga Ken-ni hon-wo o-kak-are-ninat-ta.
teacher-NOM Ken-DAT book-ACC HON-write-HON-PAST
'The teacher had Ken write the book to the teacher's disadvantage. (honorific)'

(11) a. *Sensee-ga Ken-ni hon-wo o-kai-te-morai-ninat-ta.
teacher-NOM Ken-DAT book-ACC HON-write-INFL-BEN-HON-PAST

b. Sensee-ga Ken-ni hon-wo kai-te-o-morai-ninat-ta.
teacher-NOM Ken-DAT book-ACC help-INFL-HON-BEN-HON-PAST
'The teacher had Ken write the book for the teacher's benefit. (honorific)'

[3] The same holds true with the indirect type constructions. When passive sentences undergo SH, not only the matrix subject but also the dative-marked phrase qualifi es as the trigger honorifi cation in the indirect passives. Compare (i) and (ii) below:

(i) Ken-ga sensee-ni hon-wo o-kaki-ninar-are-ta.
Ken-NOM teacher-DAT book-ACC HON-write-HON-PASS-PAST
'Ken had the teacher write the book to Ken's disadvantage. (honorifi c)'

(ii) Ken-ga sensee-ni hon-wo o-kaki-ninat-te-morat-ta.
Ken-NOM teacher-DAT book-ACC HON-write-HON-INFL-BEN-PAST
'Ken was helped by the teacher for the Ken's benefi t. (honorifi c)'

As shown in the above, the stem and the gerundive verb occurs between the honorifi c particle *o* and *ninar* in (i) and (ii), respectively. Thus, passives and benefactives parallel each other in terms of morpheme order, when the honorifi cation is triggered by the dative-marked phrase.

Word Boundary and Do-support

Another difference between passives and benefactives is found regarding Do-support. Emphatic particles, *wa/sae/mo* ‘only/even/also’, and the supportive verb *s(u)* ‘do’ can intervene between the stem verb and the passive morpheme *(r)are* only in the indirect passives. See below:

(12) a. *Naomi-ga Ken-ni(yotte) home-sae s-are-ta.
Naomi-NOM Ken-by praise-even do-PASS-PAST
‘Naomi was even praised by Ken.’

b. Naomi-ga Ken-ni deteiki-sae s-are-ta.
Naomi-NOM Ken-DAT leave-even do-PASS-PAST
‘Naomi had Ken even leave to her disadvantage.’

Those items can be inserted only at a syntactic word boundary. In the case of direct passives, there is no syntactic boundary between the stem verb and the passive morpheme. In the case of indirect passives, on the other hand, the stem verb and the passive morpheme are both syntactic words, so the emphatic particle and the supportive *s(u)* ‘do’ can occur between them. Now, return to the case of benefactives.

(13) a. Naomi-ga Ken-ni(yotte) home-sae si-te-morat-ta.
Naomi-NOM Ken-by praise-even do-INFL-BEN-PAST
‘Naomi was even praised by Ken for her benefit.’

b. Naomi-ga Ken-ni deteiki-sae si-te-morat-ta.
Naomi-NOM Ken-DAT get.out-even do-INFL-BEN-PAST
‘Naomi had Ken even get out for her benefit.’

(13a) and (13b) show that the insertion of the emphatic particle and the light verb *s(u)* is possible between the gerundive verb and the benefactive morpheme in not only indirect but direct benefactives.[4]

The data illustrated here suggest that passives and benefactives are not in fact exact parallels, since differences are found in syntactic/morphological aspects. However, morphological issues aside, syntactic similarities between these constructions should be explained. The present approach that each linguistic sign consists of several independent aspects of information is expected to capture the uniformities among the constructions. So, in this chapter, we will discuss how we can describe the feature structure of benefactives referring to syntactic, semantic and morphological similarities and differences.

[4]Uda (1992) judges that (13a) is not grammatical sentence and discusses that the insertion of the emphatic particle and the supportive verb is possible only in the case of indirect benefactives. She analyses that all tests presented here show the complete parallelism.

9.3 Previous Analyses of Japanese Benefactives

This section presents two previous analyses of *te-moraw* benefactives, Gunji (1987) and Terada (1990) where syntactic similarities between the passives and the benefactives have been recognized.

9.3.1 The Incorporation Approach

Terada (1990) presents a verb incorporation analysis of the *te-moraw* benefactives. Terada has recognized the parallelism between passives and benefactives, but does not provide parallel structures for them. The direct *te-moraw* benefactive, as in (14) below, does not have the same structure as the direct passive.[5]

(14) Naomi-ga Ken-ni home-te-morat-ta.
Naomi-NOM Ken-DAT praise-INFL-BEN-PAST
'Naomi was praised by Ken for her benefit.'

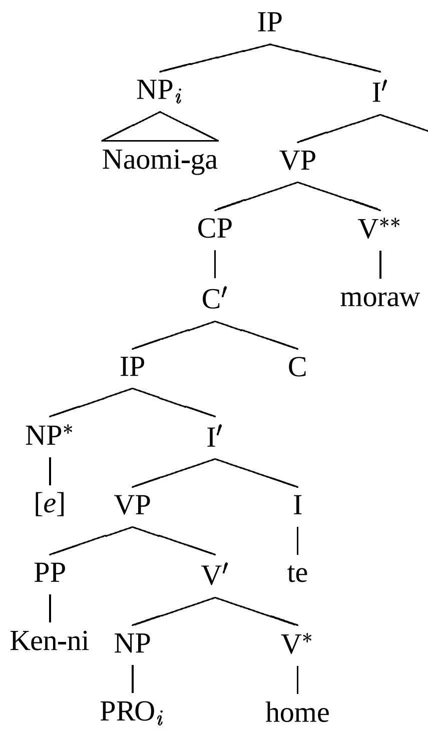


Figure 9.1: Direct Benefactive: The Incorporation Approach

The predicate subcategorizes for a Beneficiary and a Theme. The latter is realized as a sentential complement which has an empty subject position, adjunct PP, and the direct object position occupied by PRO at D-structure, as in Figure 9.1.

[5]See Section 8.3.4 for Terada's analysis of passives.

The subject position of the complement, NP*, is empty because the Infl *te* is assumed to select a non-thematic subject. The adjunctive PP corresponds to the Agent phrase. The PRO in the direct object position is controlled by the matrix subject. *Te* absorbs the Case of the stem verb under V affixation. Case absorption is optional, but is necessary in the direct type of *te-moraw* benefactives, because, otherwise, Case would be assigned to the object position. The PRO in the object position must move to the NP* position so as not to be governed by the V*. As the final step of the verb incorporation does not take place until PF, under Terada's assumption, PRO in the NP* position manages to avoid government by the V**.

The indirect *te-moraw* benefactive as in (15), on the other hand, has essentially the same structure as the indirect passive. The benefactive predicate of this type selects Beneficiary, Source and Theme. Theme is also realized as the sentential complement, but it selects PRO subject controlled by the matrix object NP. Figure 9.2 shows the D-structure for this type.

(15) Ken-ga Naomi-ni ringo-wo mui-te-morat-ta.
Ken-NOM Naomi-DAT apple-ACC peel-INFL-BEN-PAST
'Ken$_i$ had Naomi peel an apple.'

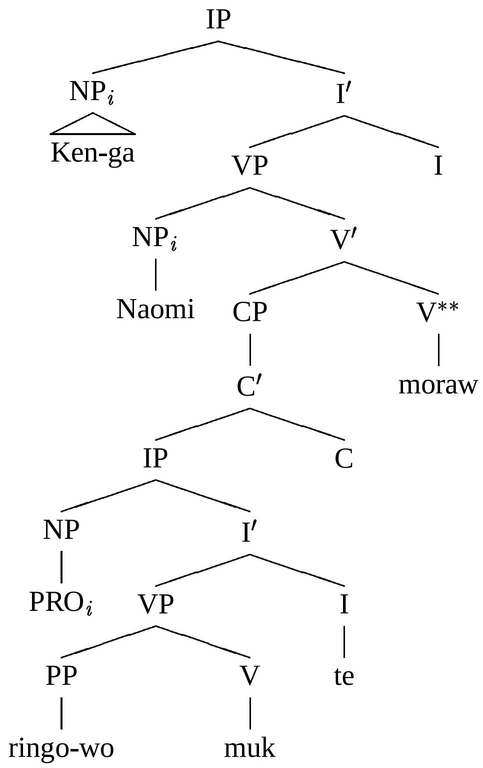


Figure 9.2: Indirect Benefactive: The Incorporation Approach

Note that the Infl *te* of this type selects a thematic subject, which is realized as PRO. It is also stipulated that *te* does not absorb Case, because, otherwise, the NP* would fail to receive any Case. The final step of the verb incorporation which does not take place until PF guarantees that the PRO is ungoverned at S-structure.

As shown above, Terada (1990) assumes that the matrix subject of the *te-moraw* benefactives always carries a Beneficiary θ-role, whether in the direct benefactives or in the indirect benefactives. This suggests that the subject of the *te-moraw* benefactives is a θ-position in either type, and contrasts with the passives, where the subject position of direct type is allegedly a θ'-position, in spite of the data showing syntactic parallelism between passives and *te-moraw* benefactives.

One of the problems in Terada's (1990) analysis is the postulation of Infl *te* as a θ-role assigner since we believe that *te* is an inflectional morpheme forming a gerund and nothing more.[6]

However, Terada's approach has offered good insights in the account of the relevant data, and we will incorporate it in the following discussion. We are in roughly the same position as Terada (1990) in considering the Beneficiary as an independent subject so that it can appear in both types of benefactives. This is crucial in accounting for the beneficiary interpretation and animacy requirement of the subject phrase. Keeping these points in mind, in Section 9.5, let us return to our formal approach to examine how HPSG can accommodate Japanese benefactives.

9.3.2 The Phrase Structure Approach

Gunji (1987) proposes a phrase structure analysis of the *te-moraw* benefactives. Gunji's analysis of the *te-moraw* benefactives exactly parallels that of the passives. Thus, he proposes two types of *te-moraw* morphemes shown in Figure 9.3:

temoraw: {POS V: SUBCAT {PP[SUBJ], PP[OBJ;ni], TVP}, PAS −}
temoraw: {POS V: SUBCAT {PP[SUBJ], PP[OBJ;ni], VP}, PAS −}

Figure 9.3: Benefactive Verb '*temoraw*': The Phrase Structure Approach

In Gunji's (1987) analysis, the *te-moraw* for the direct benefactives subcategorizes for a TVP, while the one for the indirect benefactives subcategorizes for a VP, parallel to the passive morphemes. In addition, both passives and benefactives have an object control structure.

The same criticism that we raised in relation to Gunji's (1987) analysis of passives seems to apply directly to his analysis of benefactives. In fact, the data of Object Honorification (henceforce OH) challenge the idea of positing an Agent phrase as an object argument of the matrix benefactive verb. Anyway, see the data in (16) and compare them with (17):

[6] Uda (1992) points out that the postulation of PRO in the direct object position of the lower verb is also a problem. To avoid government, the movement of the PRO and the movement of the verb require an intricate ordering relation, together with a specifi cation of the levels at which each principle applies. However, the intricate level ordering of Terada's (1990) analysis simply fails in the interaction with causatives. See Uda (1992) for detailed discussion.

(16) a. *Ken-ga sensee-ni homete o-morai-si-ta.
Ken-NOM teacher-DAT praise-INFL HON-BEN-do-PAST
'Ken$_i$ was praised by the teacher for his$_i$ benefit (honorific).'

b. *Ken-ga sensee-ni o-sake-wo non-de
Ken-NOM teacher-DAT HON-sake-ACC drink-INFL
o-morai-si-ta.
HON-BEN-do-PAST
'Ken$_i$ had the teacher drink sake for his$_i$ benefit (honorific).'

(17) a. *Ken-ga sensee-ni o-homer-are si-ta.
Ken-NOM teacher-DAT HON-praise-PASS do-PAST
'Ken was praised by the teacher (honorific).'

b. *Ken-ga sensee-ni o-sake-wo o-nom-are si-ta.
Ken-NOM teacher-DAT HON-sake-ACC HON-drink-PASS do-PAST
'Ken was adversely affected by the teacher's drinking sake (honorific).'

Uda (1992) argues that the situation is the same in *te-moraw* benefactives and in passives. Since the dative-marked phrase of *te-moraw* of either type of benefactives cannot trigger OH as shown in (16), Uda concludes that the dative-marked Agent phrase should not be assumed to be an argument of the matrix clause. At this point, we only state that we do not agree with Uda and that we shall return to this issue in Section 9.4.2.

Apart from OH, Gunji's analysis has no implication for the question of why the dative-marked phrase of direct passives and benefactives and that of indirect passives and benefactives show syntactic differences, as mentioned in Section 9.2.2.

9.4 Benefactive and Causative Interpretation

In Section 9.2.2, we observed that the benefactives and passives are not in fact exact parallels. Morphological issues aside, differences are found in the semantic properties of the matrix subject.

9.4.1 Obligatory Benefi ciary Interpretation

One of the properties distinguishing the benefactives from passives is that the obligatory beneficiary interpretation associated with both the direct and the indirect benefactives.

(18) a. Naomi-ga Ken-ni(yotte) home-te-morat-ta.
Naomi-NOM Ken-by praise-INFL-BEN-PAST
'Naomi was praised by Ken for her benefit.'

b. Naomi-ga Ken-ni deteit-te-morat-ta.
Naomi-NOM Ken-DAT get.out-INFL-BEN-PAST
'Naomi had Ken get out for her benefit.'

(19) a. Naomi-ga Ken-ni(yotte) homer-are-ta.
Naomi-NOM Ken-by praise-PASS-PAST
'Naomi was praised by Ken.'

b. Naomi-ga Ken-ni deteik-are-ta.
Naomi-NOM Ken-DAT get.out-PASS-PAST
'Naomi had Ken get out to her disadvantage.'

The matrix subjects of benefactives and passives share similar semantic properties, contrastive only in the benefactive vs. malefactive (positive vs. negative) implication. However, the benefactive interpretation is obligatory in all types of benefactive as in both (18a) and (18b), while the adversity interpretation in passives is obligatory only in indirect passives.

This has the further consequence that the matrix subject must be animate in all types of benefactives, but this requirement exists only in indirect passives.

(20) a. Ken-ga mondai-wo okosi-ta.
Ken-NOM trouble-ACC make-PAST
'Ken made trouble.'

b. *Mondai-ga Ken-ni okosi-te-morat-ta.
trouble-NOM Ken-DAT pay-INFL-BEN-PAST
'Trouble was made by Ken for their benefit.'

(21) a. Naomi-ga tyuui-wo harat-ta.
Naomi-NOM heed-ACC pay-PAST
'Naomi paid heed.'

b. *Tyuui-ga Naomi-ni harat-te-morat-ta.
heed-NOM Naomi-DAT pay-INFL-BEN-PAST
'Heed was paid by Naomi for Naomi's benefit.'

These points show that parallelism is not really complete.

9.4.2 Causative Implication behind Benefi t Implication

Optional Causative Interpretation

There are further points of contrast. That is, benefactives optionally take a causative interpretation, which is unavailable with passives. Consider the following:

(22) a. Ken-ga Naomi-ni yane-ni nobor-are-ta.
Ken-NOM Naomi-DAT roof-LOC climb-PASS-PAST
'Ken was adversely affected by Naomi's climbing on the roof.'

b. Ken-ga Naomi-ni yane-ni nobor-ase-ta.
Ken-NOM Naomi-DAT roof-LOC climb-CAUSE-PAST
'Ken made Naomi climb up on the roof.'

	c.	Ken-ga	Naomi-ni	yane-ni	nobot-te-morat-ta.
		Ken-NOM	Naomi-DAT	roof-LOC	climb-INFL-BEN-PAST

‘Ken received a benefit from Naomi’s climbing on the roof.’
‘Ken may have asked Naomi to climb up on the roof.’

(23)	a.	Ken-ga	Naomi-ni	yuusyoku-wo	tukur-are-ta.
		Ken-NOM	Naomi-DAT	dinner-ACC	cook-PASS-PAST

‘Ken was adversely affected by Naomi’s preparing dinner.’

	b.	Ken-ga	Naomi-ni	yuusyoku-wo	tukur-ase-ta.
		Ken-NOM	Naomi-DAT	dinner-ACC	cook-CAUSE-PAST

‘Ken made Naomi prepare dinner.’

	c.	Ken-ga	Naomi-ni	yuusyoku-wo	tukut-te-morat-ta.
		Ken-NOM	Naomi-DAT	dinner-ACC	cook-INFL-BEN-PAST

‘Ken received a benefit from Naomi’s preparing dinner.’
‘Ken may have asked Naomi to prepare dinner.’

(22) and (23) show the semantic contrast among passives, causatives and benefactives. The matrix subject of the indirect passives in (a)-sentences is always an Experiencer and never a Causer. The matrix subject of the causatives in (b)-sentences is always a Causer and never an Experiencer. Thus, the subject of the passive and the causative have exactly opposite implications from each other. By contrast, the matrix subject of the benefactives in (c)-sentences are always an Experiencer, and are sometimes a Causer under the proper context. In this sense, not only is the matrix subject of the benefactive the one who experiences the consequence of the event denoted by the original predicate, but it could also be the initiator of the event.

Note that causative interpretation is observed not only in the indirect benefactives but also in the direct benefactives:

(24)	a.	Ken-ga	Naomi-ni	tasuke-te-morat-ta.
		Ken-NOM	Naomi-DAT	help-INFL-BEN-PAST

‘Ken received a benefit from Naomi’s helping him.’
‘Ken may have asked Naomi to help him.’

	b.	Ken-ga	Naomi-ni	okosi-te-morat-ta.
		Ken-NOM	Naomi-DAT	wake.up-INFL-BEN-PAST

‘Ken received a benefit from Naomi’s waking him up.’
‘Ken may have asked Naomi to wake him up.’

As for the causative interpretation of these *te-moraw* sentences, Gunji (1987) gives a translation of the benefactives as ‘ask and receive the favor of.’ Nakau (1973) refers to the *te-moraw* benefactives as ‘polite causative.’ It is ‘polite’ in the sense that it implies that the causation is executed by request and not by force, as the translation by Gunji (1987) also suggests.

Self-Controllability and Causative Interpretation

Note that there are some examples which do not allow causative reading. Consider the following:

(25) a. Ken-ga Naomi-ni iwat-te-morat-ta.
Ken-NOM Naomi-DAT congratulate-INFL-BEN-PAST
'Ken received a benefit from Naomi's congratulating him.'
'? Ken may have asked Naomi to congratulate him.'

b. Naomi-ga raibaru-ni byooki-ni nat-te-morat-ta.
Naomi-NOM rival-DAT sick-DAT get-INFL-BEN-PAST
'Naomi received a benefit from her rival's getting ill.'
'* Naomi may have asked her rival to get cancer.'

c. Naomi-ga Ken-ni kizetusi-te-morat-ta.
Naomi-NOM Ken-DAT faint-INFL-BEN-PAST
'Naomi received a benefit from the Kent's fainting.'
'* Naomi may have asked Ken to faint.'

In the above examples, 'to get ill' and 'to faint' are usually not considered as self-controllable actions. In particular, causative reading of (25c) is licensed only when Ken can intentionally faint, i.e., pretending or acting in a play. Thus, (25b) and (25c) clearly demonstrate that only the self-controllable action can induce a causative interpretation. This is the same as for causatives which are an object-control construction.[7] This analysis is also confirmed by the following sentences:

(26) a. *Ken-wa ame-ni hut-te-morat-ta.
Ken-TOP rain-DAT fall-INFL-BEN-PAST
'Ken received a benefit from rains falling on me.'
'Ken may have asked of raining.'

b. *Ken-wa kuruma-ni koware-te-morat-ta.
Ken-TOP car-DAT break-INFL-BEN-PAST
'Ken received a benefit from the car's breaking.'
'Ken may have asked the car to break down.'

An inanimate subject would be interpreted only as a metaphor, metonymy, or personification. If self-controllability connects with the syntactic control structure discussed in Chapter 5, the discussion here suggests politely caused event denoted by the stem verb is controlled by the dative-marked phrase under the syntactic control structure.

[7] See Section 5.4 and 5.5.

9.5 Similarities and Differences among Constructions

So far, we have shown the similarities and differences between benefactive and passive constructions. This section proposes an HPSG analysis for Japanese benefactives which accommodates the above-mentioned properties. We claim that Japanese benefactives are divided into two types, direct benefactives and indirect benefactives, and also assert that their feature structures are roughly related to the direct passive and control causative, respectively.

9.5.1 Two Types of Benefactives

Indirect Benefactive

We assert that indirect benefactives have a syntactic control structure. In particular, they have an object control structure. The benefactive morpheme *moraw* is a free form, and it syntactically functions as a verb. See the following feature structure in Figure 9.4:

$$
\begin{bmatrix}
\text{MORPHON} & \langle \textit{moraw} \rangle \\
\text{SUBCAT} & \langle \boxed{1}\ \text{NP}[\textit{nom}]_i \oplus \boxed{2}\ \text{NP}[\textit{dat}]_j \oplus \boxed{3}\ \text{NP}[\textit{acc}] \rangle \\
\text{ADJCNT} & \boxed{4} \left\langle \text{V} \begin{bmatrix}
\text{HEAD} & \textit{verb}[\text{VFORM} \quad \textit{ger}] \\
\text{SUBCAT} & \langle \boxed{5}\ \text{NP}_j \oplus \boxed{3}\ \text{NP}_k \rangle \\
\text{ARG-ST} & \boxed{5} \oplus \boxed{3} \\
\text{SEM} & \boxed{6} \begin{bmatrix} \textit{act-und-ref} & \\ \text{ACT} & j \\ \text{UND} & k \end{bmatrix}
\end{bmatrix} \right\rangle \\
\text{ARG-ST} & \boxed{1} \oplus \boxed{2} \oplus \boxed{4} \\
\text{SEM} & \begin{bmatrix} \textit{benefi t-rel} & \\ \text{BENEFICIARY} & i \\ \text{BENEFACTOR} & j \\ \text{EVENT} & \boxed{6} \end{bmatrix}
\end{bmatrix}
$$

Figure 9.4: ‘*moraw*’: Direct Benefactive Morpheme

The benefactive morpheme *moraw* is essentially a control verb as *(s)ase* ‘cause’ subcategorizing for two NP arguments and a gerundive VP, which is controlled by the first object NP.

Control entails that the unexpressed subject of the VP is coreferential with the first object NP. The controller selection is based on the semantics of the benefactive morpheme. In line with Nakau (1973) and Gunji (1987), we assume that the BENEFICIARY, the role for the matrix subject, has not only the set of entailments for Beneficiary but also the set for the Causer. Since these entailments don’t constitute a proper subset relation, the matrix subject functions as both Beneficiary and Causer.

Control theory in HPSG refers to the semantic class of the object control predicate as the influence class.

(27) **Definition 41 (HPSG's Control Theory)**
Given an infinite VP or predicative complement C, whose semantic content C′ is the soa-arg of a soa s whose relation is R, the unexpressed subject of C is linked to:

i. the influenced participant of s, if R is of influence type,

ii. the committor participant of s, if R is of commitment type,

iii. the experiencer participant of s, if R is of orientation type.

Influence-type verbs specify a relation in which an Agent-like participant exerts influence on another participant so that a particular action will be brought about. The influenced participant is the performer of the action. Since such a participant, in Figure 9.4, is an ACTOR, the (polite) causative of the benefactive relation fits into this semantic class, qualifying for the object control structure. The coindexing relation with index *j* above, therefore, is guaranteed by the semantics of the polite causative relation.

Direct Benefactive

Direct benefactives are also derived by a lexical rule just like *ni*-direct passives. Consider Figure 9.5:

$$\begin{bmatrix} \text{MORPHON} & \boxed{1} \\ \text{SUBCAT} & \left\langle \boxed{2}\ \text{NP}\left[nom\right]_i \oplus \boxed{3}\ \text{NP}_j \right\rangle \\ \text{ARG-ST} & \boxed{2} \oplus \boxed{3} \\ \text{SEM} & \boxed{4} \begin{bmatrix} \textit{act-und-rel} & \\ \text{ACT} & i \\ \text{UND} & j \end{bmatrix} \end{bmatrix}$$
$$\rightarrow \begin{bmatrix} \text{MORPHON} & \left\langle \boxed{1}\ \textit{te moraw} \right\rangle \\ \text{SUBCAT} & \left\langle \boxed{3}\ \text{NP}_j \oplus \boxed{2}\ \text{NP}\left[dat\right]_i \right\rangle \\ \text{ARG-ST} & \boxed{3} \oplus \boxed{2} \\ \text{SEM} & \begin{bmatrix} \textit{benefit-rel} & \\ \text{BENEFICIARY} & j \\ \text{BENEFACTOR} & i \\ \text{EVENT} & \begin{bmatrix} \textit{act-und-rel} & \\ \text{ACT} & i \\ \text{UND} & j \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Figure 9.5: Lexical Rule: Direct Benefactive

The crucial operation in the formation of the direct benefactives is also the change of grammatical relations, as *ni*-direct passive. Naturally, this lexical rule differs from the passive lexical rule in terms of the change of MORPHON feature. This issue is discussed in Section 9.5.2. See the example in Figure 9.6, where the input verb is *tasuke* 'help':

$$\begin{bmatrix} \text{MORPHON} & \langle \textit{tasuker} \rangle \\ \text{SUBCAT} & \langle \boxed{2}\ \text{NP}[\textit{nom}]_i \oplus \boxed{3}\ \text{NP}[\textit{acc}]_j \rangle \\ \text{ARG-ST} & \boxed{2} \oplus \boxed{3} \\ \text{SEM} & \boxed{4} \begin{bmatrix} \textit{help-rel} & \\ \text{HELPER} & i \\ \text{HELPEE} & j \end{bmatrix} \end{bmatrix}$$

$$\rightarrow \begin{bmatrix} \text{MORPHON} & \langle \textit{tasuke-te moraw} \rangle \\ \text{SUBCAT} & \langle \boxed{3}\ \text{NP}[\textit{nom}]_j \oplus \boxed{2}\ \text{NP}[\textit{dat}]_i \rangle \\ \text{ARG-ST} & \boxed{3} \oplus \boxed{2} \\ \text{SEM} & \begin{bmatrix} \textit{benefit-rel} & \\ \text{BENEFICIARY} & j \\ \text{BENEFACTOR} & i \\ \text{EVENT} & \begin{bmatrix} \textit{help-rel} & \\ \text{HELPER} & i \\ \text{HELPEE} & j \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Figure 9.6: '*tasuke te moraw*': Direct Benefactive

The contrast between direct benefactives and indirect benefactives, which is observed in Section 9.2.2, is accounted for in exactly the same way as the corresponding contrast in the passives (and causatives). The case marker alternation and the omissibility of the Agent phrase of the direct benefactives reflect the syntactic suppression of the Agent phrase.[8] The subject honorification (SH) facts show directly that the indirect benefactives are biclausal, with two syntactic subjects. Direct benefactives do not allow the agentive phrase to trigger SH because the dative-marked NP is not a syntactic subject in these types. The contrast in reflexive binding also follows from the fact that the dative-marked NP in the direct benefactive is syntactically demoted, hence does not qualify as a *zibin* binder.

9.5.2 The Difference between Passives and Benefactives

Semantic Difference

The difference between passives and benefactives is encoded only in the semantic specification of the higher relation and the semantic role of the matrix subject. Benefactives involve a relation *benefit-rel*, and the matrix subject bears a role BENEFICIARY, while passives involve a relation *affect-rel*, and the matrix subject bears a role AFFECTEE.

[8] See footnote 2. If the direct benefactive is further divided into two types, i.e., the *ni*-direct and the *niyotte*-direct passive as passive, the alternation and omissibility is only caused by the *niyotte*-types.

We have proposed that the lexical rule in Figure 9.5 indicates that direct benefactives also specify a semantic relation referred to as *benefit-rel*. The relevant part of feature structure is shown in Figure 9.7.

$$\left[\text{SEM}\quad \left[\begin{array}{ll} \multicolumn{2}{l}{\textit{benefit-rel}} \\ \text{BENEFICIARY} & j \\ \text{BENEFACTOR} & i \\ \text{EVENT} & \left[\begin{array}{ll} \multicolumn{2}{l}{\textit{act-und-rel}} \\ \text{ACT} & i \\ \text{UND} & j \end{array}\right] \end{array}\right]\right]$$

Figure 9.7: The SEM Feature: Direct Benefactives

Notice that the SEM feature structure in Figure 9.7 is identical to that of the indirect benefactives given in Figure 9.4, relevant part is shown in Figure 9.8.

$$\left[\text{SEM}\quad \left[\begin{array}{ll} \multicolumn{2}{l}{\textit{benefit-rel}} \\ \text{BENEFICIARY} & i \\ \text{BENEFACTOR} & j \\ \text{EVENT} & \left[\begin{array}{ll} \multicolumn{2}{l}{\textit{act-und-rel}} \\ \text{ACT} & j \\ \text{UND} & k \end{array}\right] \end{array}\right]\right]$$

Figure 9.8: The SEM Feature: Indirect Benefactives

As shown in Figure 9.7 and Figure 9.8, essentially the same SEM feature is shared by indirect and direct benefactives. That is, a benefactive relation is defined by a BENEFICIARY, a BENEFACTOR and an EVENT. The BENEFACTOR is coindexed with the ACT of EVENT, meaning that the BENEFACTOR is the one who carries out the EVENT. This SEM structure and the coindexing relation are common to both indirect and direct benefactives.

We take this situation as an advantage of an HPSG approach over other approaches. Just as passives of *ni*-direct and indirect types are identified as such by their SEM feature, with their respective type being identified by their SUBCAT feature, so are benefactives. Uniformity among different types of benefactives is readily captured in the domain of a SEM structure.

Morphological Difference

In 9.2.2, the difference of Subject Honorification (SH) between passives and benefactives has be taken as counter evidence against the parallel analysis here.

(8) Sensee-ga Ken-ni o-tasuke-rare-ninat-ta.
teacher-NOM Ken-DAT HON-help-PASS-HON-PAST
'The teacher was helped by Ken. (honorific)'

(9) a. *Sensee-ga Ken-ni o-tasuke-te-morai-ninat-ta.
teacher-NOM Ken-DAT HON-help-INFL-BEN-HON-PAST

b. Sensee-ga Ken-ni tasuke-te-o-morai-ninat-ta.
teacher-NOM Ken-DAT help-INFL-HON-BEN-HON-PAST
'The teacher was helped by Ken for the teacher's benefit. (honorific)'

(10) Sensee-ga Ken-ni hon-wo o-kak-are-ninat-ta.
teacher-NOM Ken-DAT book-ACC HON-write-HON-PAST
'The teacher had Ken write the book to the teacher's disadvantage. (honorific)'

(11) a. *Sensee-ga Ken-ni hon-wo o-kai-te-morai-ninat-ta.
teacher-NOM Ken-DAT book-ACC HON-write-INFL-BEN-HON-PAST

b. Sensee-ga Ken-ni hon-wo kai-te-o-morai-ninat-ta.
teacher-NOM Ken-DAT book-ACC help-INFL-HON-BEN-HON-PAST
'The teacher had Ken write the book for the teacher's benefit. (honorific)'

As shown in the examples of SH structures for the passives, the morphological order varies depending on the trigger. Both direct passives in (8) and indirect passives in (10) show not only the stem verb but also the passive morpheme *(r)are* occurs between *o* and *ninar*. Both direct benefactive in (9b) and indirect benefactives in (11b), on the other hand, show only the benefactive morpheme *moraw* can occur between *o* and *ninar*. Notice that the direct-type and the indirect-type show no differences in this regard.

At first sight, these patterns of morpheme may seem to undermine our proposed syntactic difference between the direct- and indirect-type.

Recall that according to our approach, the passive and benefactive morpheme of the direct-type is syntactically a part of a word like affix, whereas that of the indirect-type is a syntactic word on its own. The morpheme order patterns seem to suggest, however, that the indirect passive morpheme is no more independent than the direct passive morpheme, and the direct benefactive morpheme is no less independent than the indirect benefactive morpheme.

Here we claim that the crucial difference between passives and benefactives responsible for the contrast in morpheme order is the morphological status of the passive morpheme and the benefactive morpheme. To be more precise, the passive *(r)are* is a bound form, while the benefactive *moraw* is a free form.

We further claim that what causes this apparent contrast is actually a morphological condition on the prefixing of the honorific particle *o*. The honorific morpheme *ni-nar* is sensitive to the syntactic character of the preceding verb, while the honorific particle *o* is sensitive to the morphological property of the following word. The former is suffixed to a syntactic word, while the latter is prefixed to a morphologically free form. The honorific morpheme *ni-nar* is suffixed to the syntactic target verb of the SH; the honorific particle *o* is prefixed to the minimal unit of a free form which contains the target verb. The tree diagrams in Figures 9.9 to 9.12 show schematic structures for SH.

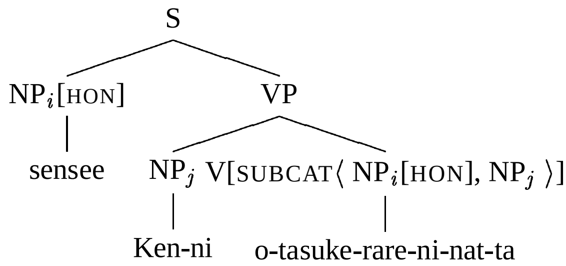


Figure 9.9: Direct Passive

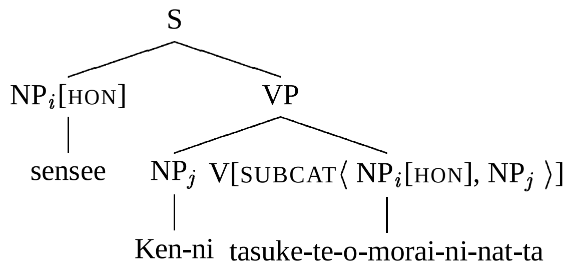


Figure 9.10: Direct Benefactive

By recognizing the dependence and independence of morphological and syntactic properties, the morpheme order for indirect/direct and passive/benefactive is completely predictable thus keeping the parallelism between passives and benefactives.

A Note on Subject Honorification

The question through which the present approach is to be assessed concerns subject honorification (SH). This type of SH can be considered as a form of agreement (Suzuki 1989, Toribio 1990, Sells & Iida 1991) and the triggering condition is presumably encoded in the CONX and/or SEM attribute.

SH is pragmatic and contextal conditioned by the relative status between the speaker and the person denoted by the subject of the sentence. Thus, the sentences from (8) to (11) in which the subject *sensee* 'teacher' is indicated to have an advantage over the speaker are acceptable.

SH is also the most reliable test for subjecthood. Unlike *zibun* binding, non-subject NP's, even those that are prominent in other respects, cannot be the target of honorification. The logical subject, for example, cannot be the target of subject honorification unless it is a grammatical subject at the same time. Consider the following:

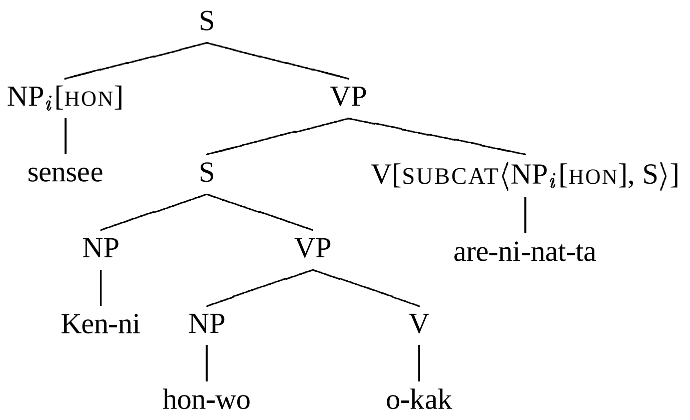


Figure 9.11: Indirect Passive

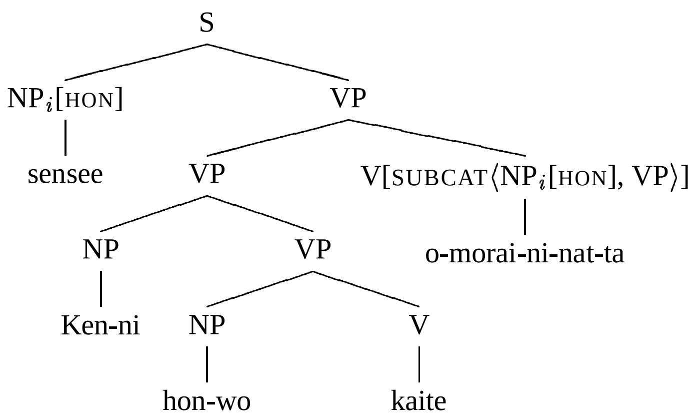


Figure 9.12: Indirect Benefactive

(28) a. Otooto-ga sensee-ni tasuke-rare-ta.
brother-NOM teacher-DAT help-PASS-PAST
'My brother was helped by the teacher.'

b. Sensei-ga otooto-ni tasuke-rare-ta.
teacher-NOM brother-DAT help-PASS-PAST
'The teacher was helped by my brother.'

(29) a. *Otooto-ga sensee-ni o-tasuke-rare-ni nat-ta.
brother-NOM teacher-DAT HON-help-PASS-COP become-PAST
'Ken was saved by the teacher. (honorific)'

b. Sensee-ga otooto-ni o-tasuke-rare-ni nat-ta.
teacher-NOM brother-DAT HON-help-PASS-COP become-PAST
'The teacher was saved by Ken. (honorific)'

Note that (29a) cannot be used to honor the logical subject *sensei* 'teacher.' One might attribute the ungrammaticality of (29a) to the subject NP which is not described as the person who is respected. (29b) reject that possibility.

Thus, we assume that SH is a type of subject agreement; the relevant information is encoded in the SUBCAT and ARG-ST list. We propose that the verb optionally takes honorific form when the least oblique argument i.e., the subject bears such information, is tentatively represented by a feature [+HON] as shown in Figures 9.9 to 9.12.

In this dissertation, we will not present a precise mechanism for the Japanese honorification system. To inquire further into the feature structure and its constraints, etc., would lead us into specific areas describing the CONX and SEM features and designing many aspects on grammar more precisely. See HPSG accounts of Korean (Lee 1996) and Japanese (Siegel 2000b) honorification concerning with CONX feature. We will leave this matter for future research.

9.5.3 Causative Interpretation and Semantic Entailment

In Section 9.4.1, we argued that the benefactive interpretation is obligatory in all types of benefactive, while the adversity interpretation is obligatory only in the indirect passive. In Section 9.4.2, we have also argued that the benefactive construction optionally takes a causative interpretation. It is necessary to show what the *benefit-ref* and the BENEFICIARY really mean in the present approach.

We assume that these are the labels for some set of relations and roles with relevant entailments much in the same way as Dowty (1989, 1991) defines thematic proto-roles. *benefit-rel* is an underspecified relation and the BENEFICIARY is also underspecified in its details. The only condition is that the *benefit-rel* is defined by its primary participant, i.e., BENEFICIARY.

In the passive, among the entailments, AFFECTEE must be neither volitional nor causative. Thus the option for the role of the matrix subject is restricted to the Experiencer. In the causative, CAUSER must be volitional and/or causative. Thus the option for the role of the matrix subject is restricted to the Causer. BENEFICIARY, on the other hand, has no such restriction. It may be either volitional or causative depending on the case. This means that the matrix subject of benefactives can be either Experiencer or Causer. When Experiencer is selected, Beneficiary and Experiencer are conflated into one and the same role, since the set of entailments for Experiencer constitutes a proper subset of the set of entailments for Beneficiary. When Causer is selected, the matrix subject will be conceived as functioning as both Causer and Beneficiary. This is why benefactive interpretation is obligatory and the causative interpretation is optional.

9.6 Summary

This chapter discussed the structures of the benefactive construction with the main focus on *te-moraw* benefactives. We argued that *te-moraw* benefactives syntactically parallel passives.

These benefactives fall into two types; the direct-types are monoclausal, whereas the indirect-type is biclausal. In the monoclausal structure *moraw* is syntactically a derivational affix, and in the biclausal structure it is syntactically a word, just as in the case of passives.

Unlike the passive morpheme *(r)are*, however, the benefactive morpheme *moraw* is a free form, though, being an auxiliary, it basically has to be adjacent to the gerundive verb.

Chapter 10

WA/GA, Topic/Focus and Information Structure

10.1 Introduction

Japanese is a language in which topic and focus are identified by the use of the particles. In the case of subjects, they are either marked by *wa* or *ga*.

These two particles are illustrated in the following examples:

(1) a. Ken-wa kaet-ta.
Ken-TOP leave-PAST
'Ken left.'

b. Ken-ga kaet-ta.
Ken-NOM leave-PAST
'Ken left.'

The fact that (1a) and (1b) are given the same semantic interpretation, does not tell us what *wa* and *ga* really mean.

This chapter explores the formal representation of the two particles, *wa* and *ga*, with special attention given to the topic/focus articulation behind the syntactic and morpho-phonological realization of these particles.

10.2 *WA/GA* and Contextual/Pragmatic Information

10.2.1 *WA/GA* and Their Usage

The particles in (1) are said to have two uses. Kuno (1973),[1] for instance, distinguishes the use of *wa* by referring to (2a) as a *thematic*, and (2b) as a *contrastive*:

(2) a. 'As for Ken, he left.'

[1] Kuroda (1965b, 1972, 1990) recognizes the same distinction but characterizes it differently.

b. ‘As opposed to other people, Ken left.’

Much syntax-based work has been done on the use of these particles but the basic distinction between them is the same. Whatever the correct characterization of the uses of *wa* shown in (2) may be, the meaning of (1a) that is common to both uses is that the proposition that somebody left is true if that somebody is Ken. When a subject marked by *wa* is uttered the type of *wa* usage cannot be determined without knowledge of the context.

10.2.2 Integrating Context into the Grammar

Information Packaging

Information packaging is a communicative dimension, which is a structuring of sentences by syntactic, prosodic or morphological means that arises from the need to meet the communicative demands of a particular context. The term ‘packaging’ is due to Chafe (1976):

(3) **Citation 2 (Packaging)**
I have been using the term packaging to refer to the kind of phenomena at issue here, with the idea that they have to do primarily with how the message is sent and only secondarily with the message itself, just as the packaging of toothpaste can affect sales in partial independence of the toothpaste inside.

Information packaging, in particular, indicates how information conveyed by linguistic means fits into a context.

There is an increasing awareness of the large degree of cross-linguistic diversity involved in the structural realization of information packaging. For example, in English the focus-ground articulation is realized mostly through prosody, Catalan makes predominant use of the word order dimension to achieve the same information packaging partition.

For an approximation to the effect of packaging in Japanese sentence interpretation, consider the example in (1). As discussed above, (1a) and (1b) are truth-conditionally equivalent. They differ not in what they say about the context, but in how they say what they say about the context, i.e., they differ in the way they are packaged. Compare (1b) and (4)

(4) Ken-ga ki-ta.
Ken-NOM come-PAST
‘Ken came.’

(1b) and (4) differ in their truth conditions. Nevertheless, they exude a certain interpretive equivalence, which is a result of the fact that they are packaged in the same way. It is obvious that (1a) and (1b) are differ in what they say about the context, but not in how they say it.

A Multi-dimensional Approach in HPSG

HPSG is a lexically based theory which has elaborated the Saussurian idea that all linguistic expression are unit of information, and simultaneously specified in various dimensions. In this respect, HPSG differs from versions of transformational grammar where different aspects of a sentence are factored out into separate levels or representations as LF and PF which are related by syntactic derivation.

The multi dimensional units in HPSG are *signs* and one of the most innovative aspects of HPSG is that it includes an explicit connection to the context of use of a sign.

$$\begin{bmatrix} \text{PHON} & \langle \dots \rangle \\ \text{SYNSEM} & \begin{bmatrix} \textit{synsem} & \\ \text{SYN} & \begin{bmatrix} \textit{syn} & \\ \text{HEAD} & \textit{head} \\ \text{VAL} & \begin{bmatrix} \textit{val} & \\ \text{SPR} & \langle \dots \rangle \\ \text{SUBJ} & \langle \dots \rangle \\ \text{COMPS} & \langle \dots \rangle \end{bmatrix} \\ \text{GAP} & \langle \dots \rangle \end{bmatrix} \\ \text{ARG-ST} & \langle \dots \rangle \\ \text{SEM} & \{ \dots \} \end{bmatrix} \\ \text{CONX} & \begin{bmatrix} \text{C-INDICES} & \begin{bmatrix} \text{SPEAKER} & \textit{ref} \\ \text{ADDRESSEE} & \textit{ref} \\ \text{UTTERANCE-LOCATION} & \textit{ref} \end{bmatrix} \\ \text{BACKGROUND} & \{ \dots \} \end{bmatrix} \end{bmatrix}$$

Figure 10.1: Context Feature in HPSG

Each sign contains CON(TE)X(T) which typically looks like a feature in Figure 10.1. The feature CONX encodes information about relevant use conditions for the sign. The value of the feature C(ONTEXTUAL)-INDICES is a feature structure with features like SPEAKER and ADDRESSEE whose values are anchored to the actual speaker and addressee of the utterance. BACKGROUND contain relevant contextual information which may play a role in resolving potential ambiguities, establishing reference and interpreting elliptical utterances.

The feature structure does not contain the locus of describing the difference between (1a) and (1b), i.e., information packaging. If we assume information packaging is inherently a matter in context, we have to revise a feature CONX. As we will see in Section 10.3.4, Engdahl and Vallduví (1996) enrich the CONX with a feature INFORMATION-STRUCTURE , which can express information about so-called focus and topic.

10.3 Previous Analyses

10.3.1 Two Types of *WA*

Thematic *WA*

As is well known, Japanese has a topic marker *wa* and a nominative marker *ga*, and each has two distinct interpretations.

In Kuno's (1973) terminology, thematic and contrastive *wa* must be distinguished.

(1) a. Ken-wa kaet-ta.
Ken-TOP leave-PAST
'Ken left.'

(2) a. 'As for Ken, he left.'
b. 'As opposed to other people, Ken left.'

(2a) is an interpretation of the thematic use of *wa* and the sentence is interpreted to be about *Ken*. Kuno observed that the thematic *wa* is restricted to at most one occurrence and must be the leftmost one in a sentence.

Contrastive *WA*

Kuno also observed that the contrastive *wa* can appear more than once in a single sentence. See, for example, sentences (5a) and (5b), which include two *wa*-marked phrases.

(5) a. Sake-wa nomm-ga, tabako-wa suwa-nai.
alcohol-TOP drink-but tobacco-TOP smoke-NEG
'I drink but I don't smoke.'
b. Ken-wa uten-ni-wa hon-wo yom-u.
Ken-TOP rain-at-TOP book-ACC read-PRES
'Ken read books at rainy day.'

In (5a), *wa*-marked phrases clearly have a contrastive interpretation.

Hoji (1985) has suggested that PP-*wa*, as in (5b) is typically contrastive. The distribution of the contrastive *wa* is not as restricted as that of the thematic *wa*. Kubo (1992) argued that the contrastive *wa* as a secondary reading, when the principal thematic interpretation of *wa* isn't available, for example in a non-canonical position or with extra stress, the contrastive reading arises.

10.3.2 Two Types of *GA*

Neutral Description and Exhaustive Listing *GA*

Following observations by Kuroda (1965b) it has been widely known that the nominative *ga* has also two different interpretations. One is often called the neutral description *ga* and the other the exhaustive listing *ga* following Kuno's (1973) terminology.

Kuroda's (1965b) characterization for a sentence with a neutral description *ga* and exhaustive listing *ga* are cited (6) and (7), respectively.

(6) **Citation 3 (The characterization of the neutral description)**
the subject can be considered neither the premise of some judgment nor something about which a predication is made. Rather, the subject of the sentence is nothing more than an item which stands in a particular relation to the verb of the sentence, just as the object.

(7) **Citation 4 (The charaterization of exhaustive listing)**
sentence [(10)] characterizes [Ken] by the property of sickness, rather than just attributing that property to him.

Now let us again consider the example in (1b).

(1) b. Ken-ga kaet-ta.
Ken-NOM leave-PAST
'Ken left.'

(8) a. (Noticing that Ken's car is gone) '(Oh!) Ken has left.'
b. (In answer to a question: Who left?) 'Ken (and Ken only) left.'

The interpretation in (8a) is neutral one which is just a description of a temporary state, with no special emphasis on the subject *Ken*. (1b) is disambiguated if the word 'are!' *look!* is the leftmost as in (9).

(9) Are! Ken-ga kaet-ta-yo.
Look! Ken-NOM leave-PAST
'Look, Ken left.'

The subject in the sentence in (10), on the other hand gets only exhaustive listing.

(10) Ken-ga byooki-da.
Ken-NOM sick-COP
"Ken (and Ken only) is sick.'

GA and Predicates

Kuno (1973) examined the distribution of neutral and exhaustive *ga*-phrases in a rich range of contexts. Kuno (1973) generalized as follows (11):

(11) **Citation 5 (Kuno's Generalization of the Interpretation of *GA*)**
Roughly speaking, if the predicate is [-stative], as in [(1b)], ga receive ambiguous interpretations between neutral description and exhaustive listing, whereas, if the predicate is [+stative], as in [(10)], only the exhaustive listing interpretation is possible.

Kuno made this generalization by using the distinction between stative predicates, which include all adjectives, nouns and stative verbs, and non-stative predicates, which include the rest of the verbs besides stative verbs.

However, Kuno found an example, (12), where a neutral reading is available with a stative predicate *iru*, and concequently proposed a slightly different generalization in (13).

(12) Ken-ga hon-wo yon-dei-ru.
Ken-NOM book-ACC read-PRES -PROG
'Ken is reading books.'

(13) **Citation 6 (Kuno's Revised Generalization)**
With regard to the descriptive and exhaustive listing ga, only the subject of action verbs, existential verbs, and adjectives/nominal adjectives that represent changing states can be followed by the descriptive ga, while there are no such restrictions in the case of exhaustive listing ga.

The Semantic-Functional Distinction between *WA* and *GA*

In a sequence of works, Kuroda (1969, 1972, 1976, 1990) develops the idea that two kinds of judgments, which had been claimed to exist as a semantic-functional distinction by Anton Mary, are overtly manifested in Japanese as a difference between *wa* sentences and sentences without *wa*.

An explicit contrast can be drawn between *ga* sentences and *wa* sentences such as the following.

(14) a. Inu-ga hasi-ttei-ru.
dog-NOM run-PROG -PRES
'A dog is running.'

b. Inu-wa hasi-ttei-ru.
dog-TOP run-PROG -PRES
'The dog is running.'

(14a), which has a *ga* marked subject, is an example of Kuroda's 'thetic' judgment, and (14b) with a *wa* phrase is an example of Kuroda's 'categorical' judgment. The characterization of these judgment is cited in (15).

(15) **Citation 7 (Kuroda's Thetic/Categorical Judgement)**
The first is a thetic judgment, which is a direct perceptual intake of an actual situation ... The second is the cognitive act of apprehending the subject of the categorical judgment as a substance. And the last is the affirmation or denial of an attribute of the subject.

Thus Kuroda (1965b) distinguishes three types of sentences in which are listed below (16).

(16) i. a sentence with thematic *wa*
ii. a sentence with neutral *ga*
iii. a sentence with an exhaustive *ga*

However, at the same time, he claimed that syntactically only predication, which is marked by a topic *wa*-phrase, is distinguished from both descriptions and characterizations, which are marked by a *ga*-phrase subject. A sentence with a *ga*-marked phrase as the subject is, in general, ambiguous, and that the distinction between the neutral and exhaustive interpretations of *ga* is purely semantic.

An Effect of Contrastive Stress

Now let us examine the example in (1b) and its interpretation in (8) again.

(1) b. Ken-ga kaet-ta.
Ken-NOM leave-PAST
'Ken left.'

(8) a. (Noticing that Ken's car is gone) '(Oh!) Ken has left.'
b. (In answer to a question: Who left?) 'Ken (and Ken only) left.'

With normal intonation, the primary interpretation of (1) is a neutral description in (8a). The exhaustive interpretation in (8b)becomes available only when a strong stress is put on the *ga*-marked NP.

Kubo (1992) claimed that this is not because the sentence in (1b) is semantically ambiguous, as claimed by Kuroda and Kuno, but rather because a contrastive stress provides some kind of focus interpretation.

This claim is based on the observation that even NP marked by other particles can get an exhaustive listing interpretation, as shown in (17)

(17) Ken-wa MANGA-WO yom-u.
Ken-TOP comic-ACC read-PRES
'It is comics that Ken read.'

When the *wo*-marked object NP, capitalized in (17), receives contrastive stress, the sentence means that it is not a novel, not a textbook but comics that Ken reads, and this interpretation is exhaustive listing.

As shown above, the studies of the properties of *wa* and *ga* are contradictory.

10.3.3 Phrase Structure and Subjects

This section provides a short and partial summary of what scholars have claimed about this subject in Japanese.

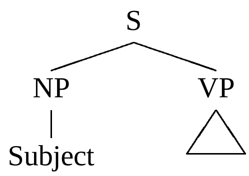


Figure 10.2: Aspect-type Tree Diagram with the Subject

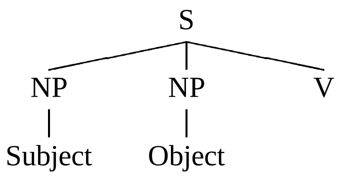


Figure 10.3: Non-configurational Tree with the Subject

The Subjectless Approach

Mikami (1964, 1972) argued that the so-called subject -except for *wa* marked topics-, namely the nominative argument is a complement of the verb.

Chomsky's (1965) Aspects-typeApproach

Kuno (1973) adopted Chomsky's (1965) Aspects-type tree with the rule in (18), which has a structure represented in a tree diagram as in figure 10.2.

(18) S $\rightarrow$ NP VP. The [NP, S] is the subject.

The Logical Subject Approach

Kuroda (1969) argued that a phrase ending with *mo* 'also', *sae* 'even', *dake* 'only' functions as a logical subject. which speaks of what the sentence is mainly about. The ordinary nominative subject, on the other hand, does not necessarily do so.

The Non-configurational Approach

All arguments including the nominative (subject), are immediately dominated by S whose head is the verb (Inoue 1978, Hale 1980, Miyagawa 1980a, Farmer 1984).

In the non-configurational tree represented in Figure 10.3, the order of the subject and object is irrelevant.

The Configurational Approach

Based on the observations and arguments on the notion of VP and some asymmetries between subject and object, Hoji (1985), Saito (1985) proposed a configurational structure for Japanese.

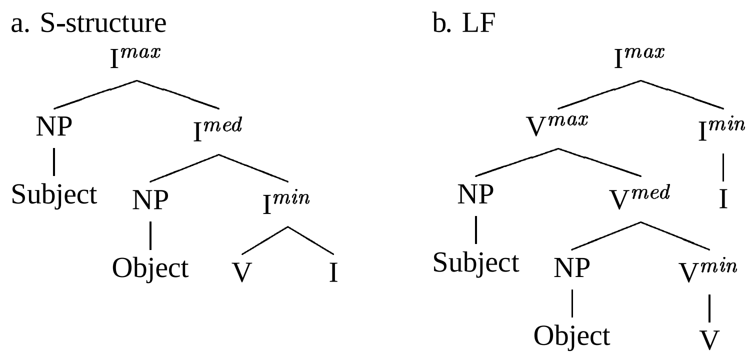


Figure 10.4: VP-Internal Subject with Affix Raising

The VP-internal Subject Approach I

Based on the Strong Lexicalist Hypothesis (Chomsky 1972b, Paul 1982, Pesetsky 1985), Kitagawa claimed the nominative argument, as well as the other arguments, are in the projection of I at S-structure, and interpreted as VP-internal argument at LF as a result of affix raising at LF. The Figure 10.4 shows the relevant part of the derivation.

LF movement of an affix I does not leave a trace, so that the original I^{max} in Figure 10.4a loses its head I and is reinterpreted as a maximal projection of V. As a result, the subject is inside the V^{max} at LF as shown in Figure 10.4b.

The VP-internal Subject Approach II

Fukui's (1986) and Kuroda's (1988) claim is roughly the same as Mikami's subjectless approach. Subjects except for the topic are generated inside VP and can stay there at S-structure.

The No Subject Position Approach

Tonoike (1988, 1989) proposed that all subjects and topics are actually adjuncts and that there is no syntactically determined position, for the subject and the topic. Tonoike assumed that Japanese phrase structure is exact mirror image of the English counterpart, as exemplified in Figure 10.5

Tonoike claimed that the specifier position in Japanese does not function as in English and Japanese has no subject which is necessary in English.

The VP-internal Subject Approach III

Assuming Diesing's (1990) Mapping Hypothesis with some modification for Japanese, Nishigauchi and Uchibori (1992) propose a correspondence between the syntactic structure and the quantificational force associated with each position which the bare

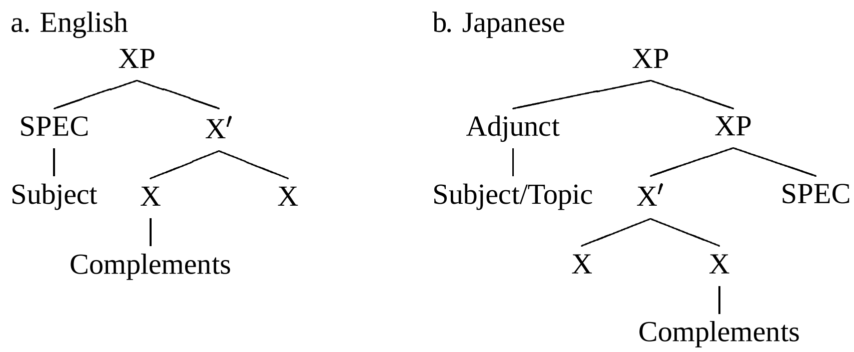


Figure 10.5: Trees with Mirror Images

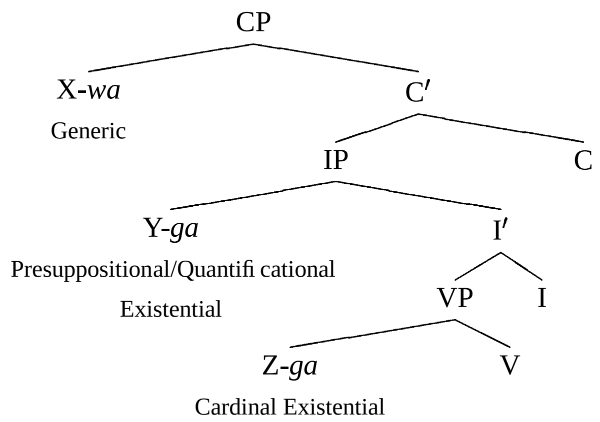


Figure 10.6: Mapping Hypothesis: Tree Diagram

NP subject occupies. Nishigauchi and Uchibori's (1992) tree structure is illustrated in Figure 10.6.

Nishigauchi and Uchibori also argued that the existential interpretation depends on the stage- and individual-level distinction of predicates.

The VP-external Subject Approach

Tateishi (1994) claimed that the θ-marked subject in Japanese must be base-generated in the specifier of Agreement Phrase, i.e. Spec(AgrP), neither in Spec (IP) nor in Spec(VP). He also claimed that there is no special syntax for topics. He classified not only subjects but topics, and discussed that the interpretation of them are determined by the rich hierarchical phrase structure in Japanese being more vivid than in English.

Many scholars have argued that there is no formal syntactic position for the subject in Japanese, but yet there is a class of 'Subjecthood Tests' which are claimed to identify the notion 'subject' in syntax. The studies of notion 'subject' in Japanese are also in a contradictory situation as the studies of *wa* and *ga*.

10.3.4 Information Structure in HPSG

HPSG's multi-dimensional constraint-based architecture discussed in Section 10.2.2 is well-suited to represent information structures which interact with syntax and prosody in principled ways (Vallduví 1992).

In this section, we will examine the previous constraint-based approach to English with a simple example from Engdahl and Vallduví (1996).

The Information Structure Feature

Consider the mini-dialogue in (19), where **bold text** corresponds to so-called B-accent (L+H*), while SMALL CAPITALS correspond to so-called A-accent (H*).[2]

(19) Speaker A: So tell me about the people in the White House. Anything I should know?

Speaker B: Yes. The **president** [$_{foc}$ hates the Delft CHINA SET]. Don't use it. (Engdahl and Vallduví 1996:5, ex.3)

Vallduví (1992) assumes a three-way partition of the Information Structure of a sentence. First, the information conveyed by a sentence is split into new information *focus* and information already present in the discourse *ground*. Second *ground* is further subdivided into *link* (*topic*, in our terms) and *tail*. Under the assumption that every utterance contains new information,[3] this leads to a four-way classification of utterances: *all-focus, focus-tail, link-focus-tail* and *link-focus*.

Engdahl and Vallduví (1996) propose that the Information Structure is represented within *signs'* value of CON(TE)X(T) feature as following way:[4]

As shown in Figure 10.7, CONX is enriched with INFO(RMATION)-ST(RUCTURE) feature, which directly represents the three-way partition of information.

The Instantiation Principle

Engdahl and Vallduví also posit constraints expressing the claim that, for each word, this word's contextual contribution is part of the *focus* if and only if it bears the A-accent Figure 10.8a, and it is part of *link* if and only if it bears the B-accent Figure 10.8b. When accent is u(nmarked), the value of INFO-ST is not specified as in Figure 10.8c.

There are additional principles specifying how a phrases' INFO-ST is constrained by INFO-ST of its daughters:.

(20) **Definition 42 (**INFO-ST **instantiation principle for English:)**

[2]See Jackendoff (1972)

[3]See Chafe (1976)

[4]In HPSG the relevant units of linguistic information like syntax and semantics are called (lexical/phrasal) *signs*.

$$\begin{bmatrix} \text{PHON} & \langle \dots \rangle \\ \text{SYNSEM} & \begin{bmatrix} \textit{synsem} & \\ \text{SYN} & \begin{bmatrix} \text{HEAD} & \textit{head} \\ \text{VAL} & \begin{bmatrix} \text{SPR} & \langle\dots\rangle \\ \text{SUBJ} & \langle\dots\rangle \\ \text{COMPS} & \langle\dots\rangle \end{bmatrix} \\ \text{GAP} & \langle\dots\rangle \end{bmatrix} \\ \text{ARG-ST} & \langle\dots\rangle \\ \text{SEM} & \{\dots\} \end{bmatrix} \\ \text{CONX} & \begin{bmatrix} \textit{conx} & \\ \text{C-INDICES} & \begin{bmatrix} \text{SPEAKER:} \\ \text{HEARER:} \end{bmatrix} \\ \text{BACKGROUND} & \{\dots\} \\ \text{INFO-ST} & \begin{bmatrix} \text{FOCUS} & \{\dots\} \\ \text{GROUND} & \begin{bmatrix} \text{LINK} & \{\dots\} \\ \text{TAIL} & \{\dots\} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Figure 10.7: The Information Structure Feature

> *Either (i) if a* DAUGHTER'S INFO-ST *is instantiated, then the mother inherits this instantiation (for narrow foci, links and tails), or (ii) if the most oblique* DAUGHTER'S FOCUS *is instantiated, then the* FOCUS *of the mother is the sign itself (wide focus).*
>
> (Engdahl and Vallduví 1996:12, ex.15)

This feature structure and the principles expressed in Figures 10.7, 10.8 and (20) lead to the representation in Figure 10.9, the simplified representation of (19:B), in which values of the DTRS attribute are presented in the familiar constituent tree notation.

Note that Figure 10.9 shows the CONX|INFO-ST value i.e., discourse is not only an independent level of linguistic representation but also interacts with the other grammatical levels, PHON(OLOGY) and SYN(TAX) simultaneously. To see how the value of INFO-ST follows from the principles above, consider the two interpretations of (19:B).

(21) The president [$_{\text{foc}}$ hates [$_{\text{foc}}$the Delft china set]].

(Engdahl and Vallduví 1996:12, ex.16)

One advantage of the present analysis concerns the contextual ambiguity in (21). This sentence, with an A-accent on the object, can be interpreted either with focus on the object NP or with focus on the whole VP, depending on the context. The former interpretation is licensed by (20i) (focus inheritance), while the latter interpretation is licensed by (20ii) (focus projection).[5]

[5]Fuller discussion will be presented in the Section 10.5 and since the *focus projection* is basically

a. $$\boxed{1}\begin{bmatrix} \text{PHON} & \begin{bmatrix}\text{ACCENT} & A\end{bmatrix} \\ \text{INFO-ST} & \begin{bmatrix} \text{FOC} & \{\boxed{1}\} \\ \text{GND} & \begin{bmatrix}\text{LINK} \\ \text{TAIL}\end{bmatrix} \end{bmatrix} \end{bmatrix}$$

b. $$\boxed{1}\begin{bmatrix} \text{PHON} & \begin{bmatrix}\text{ACCENT} & B\end{bmatrix} \\ \text{INFO-ST} & \begin{bmatrix} \text{FOC} & \\ \text{GND} & \begin{bmatrix}\text{LINK} & \{\boxed{1}\} \\ \text{TAIL} & \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

c. $$\begin{bmatrix} \text{PHON} & \begin{bmatrix}\text{ACCENT} & U\end{bmatrix} \\ \text{INFO-ST} & \begin{bmatrix} \text{FOC} & \\ \text{GND} & \begin{bmatrix}\text{LINK} \\ \text{TAIL}\end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Figure 10.8: The ACCENT Feature: Constraint on Words

Another advantage of using a multi-dimensional representation concerns mismatches between informational partitioning and syntactic constituency. In (22) we could have cases where informational partitioning does not correspond to syntactic constituency:

(22) Speaker A: What happened to the China set?

Speaker B: [$_{\text{foc}}$ The BUTLER BROKE] the set.

(Engdahl and Vallduví 1996:16, ex.24)

Constituency-based analysis (Selkirk 1984, 1995) and other pure-syntax theories would have difficulty in predicting that the focus is constituted by the subject and the verb. Within the present analysis, even if the subject and the verb do not form a syntactic constituent, the instantiation of a FOC value on both DAUGHTERS will be inherited to their respective mother.

10.4 Distribution of Topic and Focus

Before going into a detailed discussion, we first summarize how topic and focus are identified throughout this paper since their definitions vary among linguists.

10.4.1 Diagnostics of Topic and Focus

Erteshik-Shir studies the interface between discourse structure and syntax in Erteschik-Shir (1997) and defines a grammatical level of focus structure in which topic and focus constituent are marked.

the same mechanism as an domain extension of restrictive focus in (29).

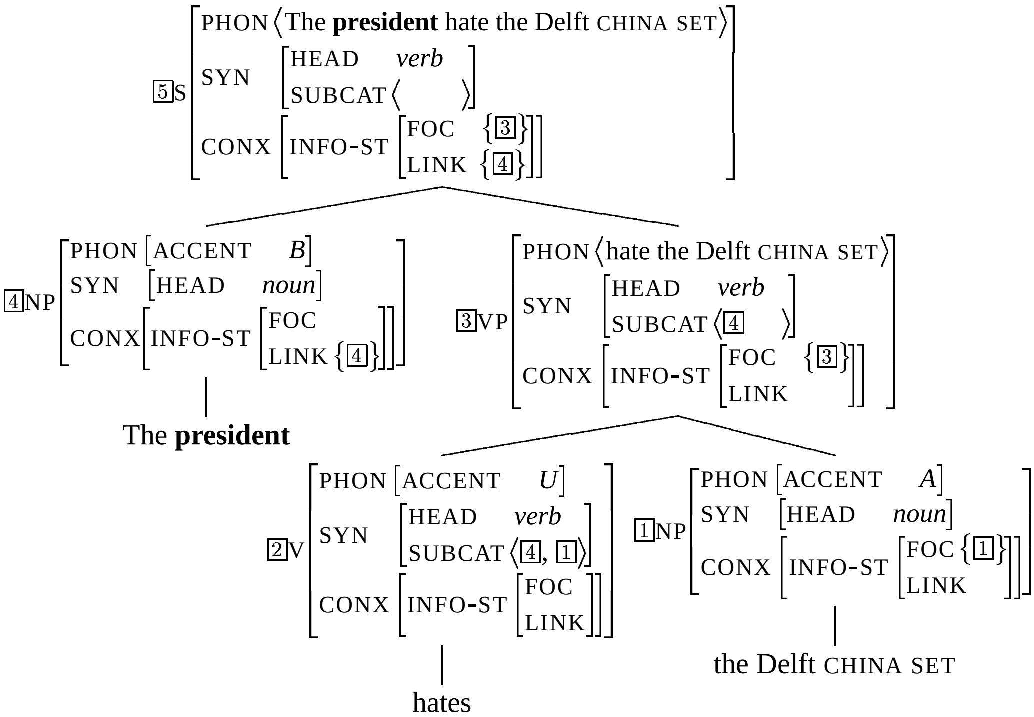


Figure 10.9: '*the president hates the Delft china set*': Information Structure

Topic

To distinguish topic from focus, Erteshik-Shir adopts the topic test originally proposed in Reinhart (1981).

(23) Speaker A: Tell me about X
Speaker B: . . . X. . . . X = TOPIC (Erteshik-Shir 1997:14, ex.11)

Erteshik-Shir also defines the topic as the subject of the predication. Thus, in (24) *The children* is the topic, and the predicate represents the assertion made about the topic.

(24) Speaker A: Tell me about the children.
Speaker B: [$_{\text{top}}$ The children] were eating the candy.

Topic is old information in the sense that it has been introduced in discourse.

Focus

Focus is determined by using question-answer pairs to identify the constituent which answers a Wh-question. Thus, in (25a), for example, only *The children* is the focus and the rest of the sentence is old information.

(25) a. Speaker A: Who ate the candy?
Speaker B: [$_{\text{foc}}$ The children] ate the candy.
b. Speaker A: What did the children eat?
Speaker B: The children ate [$_{\text{foc}}$ the candy].
c. Speaker A: What did the children do?
Speaker B: The children [$_{\text{foc}}$ ate the candy].
(Erteshik-Shir 1997:14, ex.13, slightly modified.)

Based on the definitions and test shown above, we examine the interpretation of a *wa*- and *ga*-marked subject.

10.4.2 Particles and Interpretations of the Subject

As seen in (26), a subject marked by *wa* has a topic interpretation.

(26) Speaker A: Tell me about the children.
Speaker B: [$_{\text{top}}$ Kodomotati-*wa*] amedama-wo tabe-tei-ru.
children-TOP candy-ACC eat-PROG -PRES
'The children are eating the candy.'

When *kodomotati* 'children' is already a topic of context, (26) is pronounced without any contrastive pitch on *kodomotati-wa* and is interpreted as *thematic* (Kuno 1973).

When *kodomotati* is being contrasted with other parties, the phrase receives a high pitch (either on *kodomotati* or on *wa*) and is interpreted as *contrastive* (27).

(27) Speaker A: Who is eating the candy?
Speaker B: [$_{\text{foc}}$ Kodomotati-*wa*] amedama-wo tabe-tei-ru (-kedo...)
children-TOP candy-ACC eat-PROG -PRES -BUT
'It is (at least) the children who are eating the candy. . . '

Wa marked elements can also be interpreted as focus if they bear new information, as in (27). Thus, there is no direct correspondence between *wa/ga* and topic/focus, respectively.

The particle *wa* shows that the constituent marked with it carries a focus interpretation. In (28) the object *amedama* 'candy' is marked with *wa* and it is also interpreted as focus.

(28) Speaker A: What are the children eating?
Speaker B: [$_{\text{top}}$ Kodomotati-*wa*] [$_{\text{foc}}$ amedama-*wa*] tabe-tei-ru (-kedo...)
children-TOP candy-TOP eat-PROG -PRES -BUT
'It is (at least) the candy which the children are eating. . . '

(28) implies that the children are eating the candy, but they were eating nothing else, e.g., chewing gum.

The domain of focus can be extended beyond the constituent marked with *wa*. See (29) below:

(29) Speaker A: What are the children doing?

Speaker B: [$_{\text{top}}$ Kodomotati-*wa*] [$_{\text{foc}}$ amedama-*wa* tabe-tei-ru] (-kedo...)
children-TOP candy-TOP eat-PROG -PRES -BUT
'It is (at least) eating the candy that the children is doing. . . '

In (29) the constituent *amedama-wa tabe-tei-ru* 'eating the candy', not just *amedama-wa* carries a focus interpretation, and the sentence implies that the children are eating the candy, but they aren't doing anything else, such as reading a book. Thus, there is no direct correspondence between the sentence form and its focus interpretation.

Ga differs from *wa* in some respects. See the example in (30) below:

(30) Speaker A: Who is eating the candy?

Speaker B: [$_{foc}$ Kodomotati-*ga*] amedama-wo tabe-tei-ru.
children-NOM candy-ACC eat-PROG -PAST
'It is (only) the children who are eating the candy.'

(30) shows that the subject, marked by *ga*, is also interpreted as focus.

Note that there is a difference between *wa* marked and *ga*-marked focus. In (27) and (30), *kodomotati* 'children' belongs to a set specified in discourse. *Kodomotati-ga* has to be the only members who are eating the candy in the context. Erteschik-Shir (1997) calls both *wa*-marked focus in (27) and *ga*-marked focus in (30) restrictive focus which presupposes a set specified in discourse of which the focus constituent is a subject.[6]

In contrast, the *wa*-marked focus, as shown in (28)-(29) does not require the focused element to be the only member of that set. To distinguish such a focus from restrictive focus, we will call the *wa*-marked focus non-restrictive focus.

When a sentence with the *ga*-marked subject is uttered out-of-the-blue, the whole sentence bears new information. Consider (31) below:

(31) Speaker A: What is happening?

Speaker B: [$_{\text{foc}}$ Kodomotati-*ga* amedama-wo tabe-tei-ru].
children-NOM candy-ACC eat-PROG -PRES
'The children are eating the candy.'

In (31), no set from which *kodomotati* can picked out is presupposed. Hence, it is not restrictive. We call the focus in (31) *all focus*, and distinguish it from *restrictive focus*.[7]

[6]In (30), all members which satisfy the condition have to be listed exhaustively (non-exhaustively in (27)). Kuno (1973) distinguishes the two usage of *ga* by referring to (30) as an *exhaustive listing*, and (31) as a *neutral description* which simply describes an event. Diesing (1988) and Heycock (1994) determine exhaustive listing reading *narrow focus*. See fn.7

[7] This is what Selkirk (1984) and Diesing (1988) call *wide focus*.

10.4.3 Summary

In (32), we summarize the possible interpretation of *ga/wa*-marked NPs.[8]

(32) a. *Wa* marked NPs are interpreted as *topic, restrictive focus* or *non-restrictive focus.*

b. *Ga* marked NPs are interpreted as either *restrictive focus* or *all/non-restrictive focus.*

10.5 *WA/GA*, Constructions and Information Structure

It has been observed that languages adopt different means to encode their information structure: English employs intonation while Catalan relies on word order (Engdahl & Vallduví 1996). Language like Greek use both (Alexopoulou & Kolliakou 2002). In addition to prosody and constituent order changes from the underlying SOV, Japanese also uses morphology directly in realizing information structure.

In this section, we will introduce Engdahl and Vallduví's (1996). mechanism into Japanese grammar architecture.

10.5.1 Two Types of *WA*

Some Properties of *WA*

A number of properties distinguish the three uses of *wa*, topic and (non-)restrictive focus ((N)RF):

(33) a. The topic is restricted so as to be old information, while (N)RF can mark new information.

b. The topic phrase goes unstressed, while NRF phrase receives a higher pitch.

c. A sentence is restricted to at most one topic phrase, which if present appears in sentence-initial position; however, multiple elements within the sentence can be marked in situ with NRF.

Though pitch accent assignment described in (33b) for Japanese and Figure 10.8 for English are different, the properties of topic and (N)RF in (33a) correspond with Vallduví's (1992) characterization of *link* and *focus*. (33c) also match the characterization, since under Vallduví's system the Information Structure of a sentence is restricted to at most one *link* but any number of *focus* and *tail* elements, and moreover the property of topic in (33c) is consistent with his original conception of *links* as exclusively sentence-initial. Therefore we conclude that topic *wa* and (N)RF *wa* function as *link* and *focus* marker, respectively.[9]

[8] Uechi (1996) also identifi es topic and focus summarized in (32) though he uses his own terms.

[9] See the analyses of *focus* (Heycock 1994), *link* (Portner & Yabushita 1998) and *tail* (Kaiser 1999) in Japanese.

Instantiation of Information Structure in Japanese

Let us consider how information structure, which is a crucial factor for topic/focus articulation, is formally represented in Japanese grammar under the framework of NAIST JPSG.

First, we enrich CONX feature with INFO(RMATION)-ST(RUCTURE) feature, which directly represents the information packaging. This is shown in Figure 10.10.

$$\begin{bmatrix} \textit{synsem\_struc} & \\ \text{MORPHON} & \textit{morphon\_struc} \\ \text{SYN} & \begin{bmatrix} \textit{syn} & \\ \text{HEAD} & \begin{bmatrix} \text{CASE} & \textit{case} \\ \text{ARG-ST} & \textit{list(synsem\_struc)} \\ \text{MOD} & \textit{list(synsem\_struc)} \end{bmatrix} \\ \text{VAL} & \begin{bmatrix} \text{TOPIC} & \textit{list(synsem\_struc)} \\ \text{SPR} & \textit{list(synsem\_struc)} \\ \text{SUBCAT} & \textit{list(synsem\_struc)} \\ \text{ADJCNT} & \textit{list(synsem\_struc)} \end{bmatrix} \end{bmatrix} \\ \text{SEM} & \textit{sem\_struc} \\ \text{CONX} & \begin{bmatrix} \textit{conx} & \\ \text{INFO-ST} & \begin{bmatrix} \text{FOCUS} & \textit{list(synsem\_struc)} \\ \text{GROUND} & \begin{bmatrix} \text{LINK} & \textit{list(synsem\_struc)} \\ \text{TAIL} & \textit{list(synsem\_struc)} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

Figure 10.10: The Information Structure Feature in NAIST JPSG

The INFO-ST feature is the locus describing the information and difference between topic and focus.

Constraints on *WA*

Next, the properties listed in (33a) and (33b) can be captured by means of the ACCENT feature and its constraints also from (Engdahl & Vallduví 1996). We then propose MORPHON feature for two *wa* as in Figure 10.11.

a. $$\fbox{1}\begin{bmatrix} \text{MORPHON} & \begin{bmatrix} \text{MORPH} & \langle \text{X}, \textit{wa} \rangle \\ \text{PHON} & \begin{bmatrix} \text{ACCENT} & \textit{U} \end{bmatrix} \end{bmatrix} \\ \text{INFO-ST} & \begin{bmatrix} \text{LINK} & \{\fbox{1}\} \end{bmatrix} \end{bmatrix}$$

b. $$\fbox{1}\begin{bmatrix} \text{MORPHON} & \begin{bmatrix} \text{MORPH} & \langle \text{X}, \textit{wa} \rangle \\ \text{PHON} & \begin{bmatrix} \text{ACCENT} & \textit{A} \end{bmatrix} \end{bmatrix} \\ \text{INFO-ST} & \begin{bmatrix} \text{FOC} & \{\fbox{1}\} \end{bmatrix} \end{bmatrix}$$

Figure 10.11: The MORPHON Feature: Constraints on *WA*

Figure 10.11a is a skeletal sign which says about itself that it contributes *link* information. Figure 10.11b introduces a word with A-accent that will be interpreted as a *focus*. The value of ACCENT and the value of INFO-ST constrain each other.

Notice that Figure 10.11 characterizes phonological constraints for Japanese rather different from the constraints for English, as exemplified in Figure 10.8. Information structure in Japanese, as in Catalan, depends crucially on morpho-syntactic devices such as *wa* marking. Furthermore, as in English, the prosodic phenomenon of sentence accent is also important. However, the formalization in (10.11) does not describe such phonological aspects and a certain morphological process that removes the case particles *-ga* and *-wo* obligatorily and *-ni* optionally, and keeps any other case particles and postpositions intact. Whatever the correct characterization of the morphological and phonological feature of Japanese may be, it is irrelevant to the main subject of this paper.[10]

It is noteworthy that the skeletal signs in Figure 10.11 show that the value of ACCENT and the value of INFO-ST constrain each other. This is expressed by means of structure-sharing between INFO-ST and the sign itself. The presence of an unmarked or A-accent is sufficient to identify the informational contribution of a lexical sign as *link* or *focal*. And vice versa, the *link* or *focal* status of a lexical sign is sufficient to determine the value of its ACCENT. This means that the constraints in Figure 10.11 express a mutual constraint between ACCENT (phonology) and INFO-ST (context).

Lexical Rules and Schemata

Now we need a mechanism to encode (33c). Following what is commonly accepted in the literature, (Hoji 1985, Saito 1985), we assume that the topicalization lexical rule is divided into two types: the topic *addition* type in Figure 10.12 and the topic *substitution* type in Figure 10.13. [11]

a. $$\begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SUBCAT} & \boxed{1} \end{bmatrix} \rightarrow \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{VAL} & \begin{bmatrix} \text{TOPIC} & \left\langle \boxed{2}\text{NP}\begin{bmatrix} \text{MORPH} & \langle \text{X}, \textit{wa} \rangle \\ \text{PHON} & \begin{bmatrix} \text{ACCENT} & \textit{U} \end{bmatrix} \\ \text{INFO-ST} & \begin{bmatrix} \text{LINK} & \{\boxed{2}\} \end{bmatrix} \end{bmatrix} \right\rangle \\ \text{SUBCAT} & \boxed{1} \end{bmatrix} \end{bmatrix}$$

Figure 10.12: Topic Addition Lexical Rule

[10] See Matsui (1996) for a constraint-based comprehensive study of Japanese Phonology.

[11] This is a reformulation of Fukushima's (Fukushima 1999) idea on lexical account for topicalization.

a. $$\begin{bmatrix}\text{HEAD} & \textit{verb}\\ \text{SUBCAT} & \langle \ldots \boxed{1}\text{XP}\,[\text{MORPH}\,\langle \text{X}\rangle] \ldots \rangle\end{bmatrix} \rightarrow \begin{bmatrix}\text{HEAD} & \textit{verb}\\ \text{SUBCAT} & \left\langle \ldots \boxed{2}\text{XP}\begin{bmatrix}\text{MORPH} & \langle \text{X}, \textit{wa}\rangle\\ \text{PHON} & [\text{ACCENT} \quad A]\\ \text{INFO-ST} & [\text{FOC} \quad \{\boxed{2}\}]\end{bmatrix} \ldots \right\rangle\end{bmatrix}$$

Figure 10.13: Topic Substitution Lexical Rule

In Figures 10.12 and 10.13, we introduce the feature TOPIC, with which we can state the co-occurrence restrictions for the heads that they select.[12] We make the value of TOPIC a list which is restricted to single item.

In addition, we posit two schemata in Figures 10.14 and 10.15 to construct well-formed phrases.

$$\begin{bmatrix}\textit{phrase} & \\ \text{SUBCAT} & \langle\ \rangle\end{bmatrix} \rightarrow \begin{bmatrix}\textit{word} & \\ \text{SUBCAT} & \langle \boxed{1}, \ldots, \boxed{n}\rangle\end{bmatrix}, \boxed{1}, \ldots, \boxed{n}$$

Figure 10.14: Full-Complement Schema

$$\begin{bmatrix}\textit{phrase} & \\ \text{TOPIC} & \langle\ \rangle\end{bmatrix} \rightarrow \boxed{1}, \begin{bmatrix}\textit{phrase} & \\ \text{TOPIC} & \langle \boxed{1}\rangle\end{bmatrix}$$

Figure 10.15: Topicalization Schema

To see how these constraints do play a role in the topic/NRF function and distinction, consider the previous examples which are slightly modified and repeated here.

(34) [$_{top}$ Ken-*wa*] [$_{foc}$ KODOMOTATI-GA kaette-ki-ta].
Ken-TOP children-NOM return-come-PAST
'As for Ken, his children returned.'

(35) a. narrow: Kodomotati-*ga* [$_{foc}$ AMEDAMA-WA] tabe-ta.
children-NOM candy-NRF eat-PAST
'It is (at least) the candy which the children ate'

b. wide: [$_{top}$ Kodomotati-*wa*] [$_{foc}$ AMEDAMA-WA tabe-ta].
children-TOP candy-NRF eat-PAST
'It is (at least) eat the candy that the children did.'

The topicalization lexical rule in Figure 10.12 operates on a verb like *kaettekuru* 'return' in Figure 10.16a, and give rises to corresponding topicalized verbs

[12] A topic *wa* phrase requires modality at the sentential ending (Yamada 1936). It is also prohibited from appearing in a relative clause and a conditional clause, (whereas NRF phrase is not). These characteristics can be straightforwardly explained by assuming that the specific heads have different valence specification for the feature TOPIC.

in Figure 10.16b which is responsible for (34):

a. [MORPHON ⟨kaettekuru⟩
HEAD *verb*
SUBCAT ⟨NP-ga⟩]

b. [MORPHON ⟨kaettekuru⟩
HEAD *verb*
TOPIC ⟨[1] NP-wa [LINK {[1]}]⟩
SUBCAT ⟨NP-ga⟩]

Figure 10.16: ‘*kaettekuru*’: Lexical Rule Applied

The tree in Figure 10.17 shows how the value of INFO-ST of (34) follows from the principle in (20).

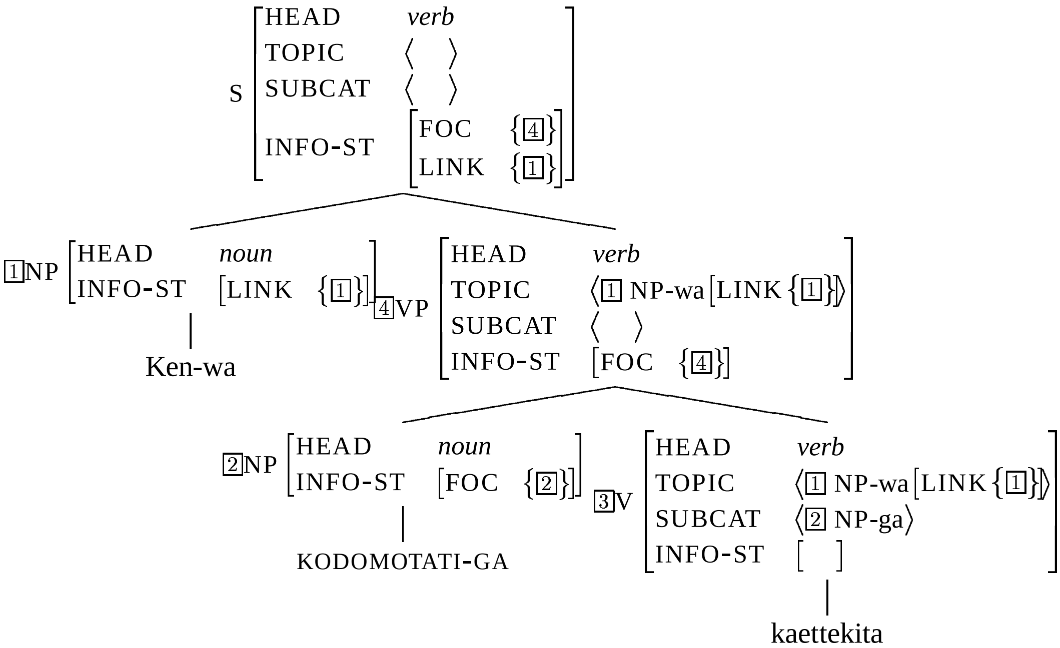


Figure 10.17: ‘*ken wa kodomotati ga kaettekita*’: Information Structure

An instantiation of VP-focus is taken up in the next section. Since the LINK value of a given [1] NP is instantiated, it propagates to the INFO-ST value of its mother. This propagation is ensured by (20i) which is an option of a disjunctive principle for information structure for not only English but also for Japanese.

(20) **Definition 43 (INFO-ST instantiation principle:)**

Either (i) if a DAUGHTER'S INFO-ST *is instantiated, then the mother inherits this instantiation (for narrow foci, links and tails), or (ii) if the most oblique* DAUGHTER'S FOCUS *is instantiated, then the* FOCUS *of the mother is the sign itself (wide focus).*

The topicalization lexical rule in Figure 10.13 also operates on a verb like *taberu* 'eat' in Figure 10.18, and gives rise to corresponding topicalized verbs in Figure 10.19a, b which are responsible for (35a) and (35b), respectively.

$$\begin{bmatrix} \text{MORPHON} & \langle \text{taberu} \rangle \\ \text{HEAD} & \textit{verb} \\ \text{SUBCAT} & \langle \text{NP-ga, NP-wo} \rangle \end{bmatrix}$$

Figure 10.18: '*taberu*': Lexical Entry

$$\text{a.} \begin{bmatrix} \text{MORPHON} & \langle \text{taberu} \rangle \\ \text{HEAD} & \textit{verb} \\ \text{SUBCAT} & \langle \text{NP-ga}, \boxed{1} \text{ NP-wa} \big[\text{FOC} \{ \boxed{1} \} \big] \rangle \end{bmatrix}$$

$$\text{b.} \begin{bmatrix} \text{MORPPHON} & \langle \text{taberu} \rangle \\ \text{HEAD} & \textit{verb} \\ \text{TOPIC} & \langle \boxed{1} \text{ NP-wa} \big[\text{LINK} \{ \boxed{1} \} \big] \rangle \\ \text{SUBCAT} & \langle \text{NP-ga}, \boxed{2} \text{ NP-wa} \big[\text{FOC} \{ \boxed{2} \} \big] \rangle \end{bmatrix}$$

Figure 10.19: '*taberu*': Lexical Rule Applied

Notice that the two rules in Figure 10.15 are applied to the feature structure 10.19b. Since the output of the topicalization rules are still lexical items, it is reasonable to expect that other lexical rules are able to apply to the output. This is the reason why multiple elements within the sentence can be marked with NRF. It is also notice Figure 10.15 are not multiply applied to the output since topic addition is regulated by the single item of TOPIC.

Now let us see how focus is projected in the following tree:[13]

In Figures 10.20 and Figure 10.21, the object NP AMEDAMA-WA is focused not only morphologically (*wa*-marking) but also phonologically (A-accent). This is sufficient to identify the informational contribution of such a NP as *focus*. Consequently two options are available within the principle in (20): (i) accounts for instructions with narrow focus in (35a): it requires a mother to inherit the INFO-ST value of its daughters, as represented by the structure-sharing using $\boxed{2}$ in Figure 10.20. (ii) accounts for instructions with wide focus in (35a): it allows a given

[13] As shown in Figure 10.21, SUBCAT list is unsaturated since additional topic phrase does not cancel off the (logical) subject. We think this is a right prediction because topic sentences allow a resumptive pronoun which may cause cancellation, whereas NRF sentences do not. See Hoji (1985). The relation between topic element and unrealized element is the matter of pragmatics.

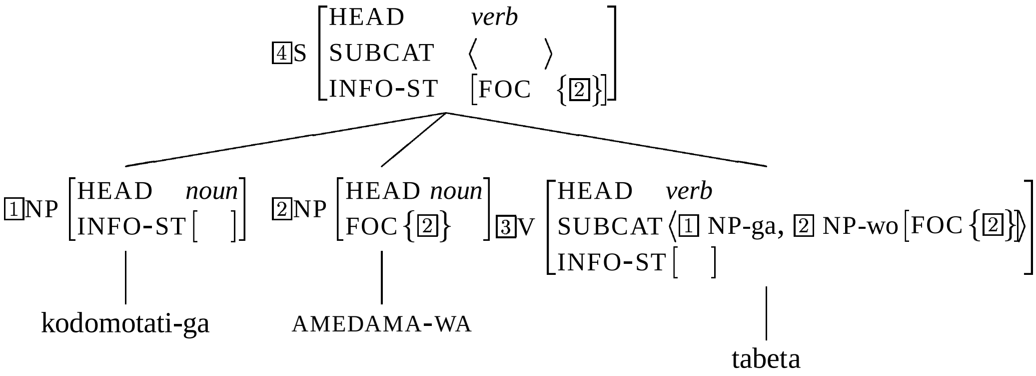


Figure 10.20: '*kodomotati ga amedama wa tabeta*': Information Structure

phrase to be interpreted as focused, if its the most oblique daughter is focused (and, therefore, has its FOCUS value instantiated as specified by 5 in Figure 10.20.

10.5.2 Three Types of *GA*

Sentence-Initial *GA*

The nominative case particle *ga* is often associated with new information and focus. We determine focus by utilizing question-answer pairs following Erteshik-Shir's (Erteschik-Shir 1997) work, and then show that there are at least two usages of particle *ga* i.e., restrictive focus (RF) and all focus.

However this ambiguity of *ga* is not always present. If the predicate is individual-level predicate (Kuroda 1965b) or stative predicate (Kuno 1973), *ga*-marked subject can only be interpreted as RF:

(36) Speaker A: Who is smart?
Speaker B: [$_{foc}$ Ken-ga] kasikoi.
Ken-NOM smart
(Of all the people salient at this point in the discourse,)
'It is (only) Ken who is smart.'

Extensive past study also reveals that sentence-initial *ga*-marked phrase is the realization of focus. The so-called multiple nominative construction exemplified by (37) is one of these phenomena:[14]

(37) Speaker A: Who is it whose father is a teacher?
Speaker B: [$_{foc}$ Ken-ga] titioya-ga sensee-da.
Ken-NOM father-NOM father-COP
'It is (only) Ken whose father is a teacher.'

[14]There are several type of multiple nominative construction that we do not discuss in this paper.

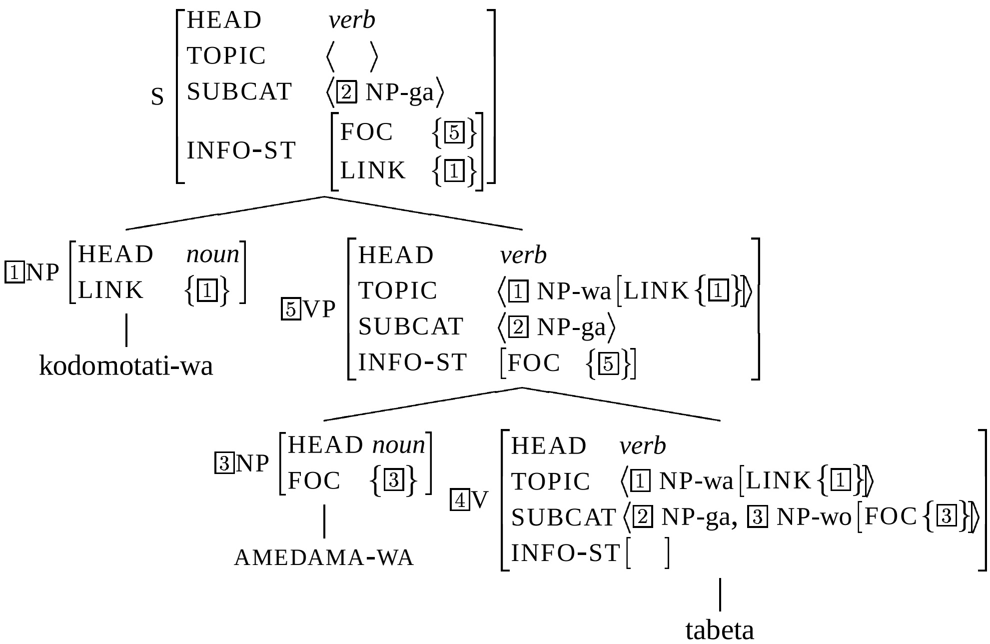


Figure 10.21: '*kodomotati wa amedama wa tabeta*': Information Structure

The evidence that the sentence-initial *ga*-marked phrase is the sole focus comes from several phenomena. One obvious point we can observe here is that only the first *ga*-marked phrase can be WH–questioned as in (38a) while the second one cannot as in (38b).

(38) a. Dare-ga titioya-ga sensee-desu-ka?
WH-NOM father-NOM teacher-COP -Q
'(lit.) Who is it whose father is a teacher?'

b. * Ken-ga dare-ga sensee-desu-ka?
Ken-NOM WH-NOM teacher-COP -Q
'(lit.) Ken's 'who' is a teacher?'

As shown in (39), the second *ga*-marked phrase cannot be a focus.

(39) Speaker A: What did the children eat?
Speaker B: [$_{foc}$ Amedama-*wo*] kodomotati-*ga* tabe-ta.
candy-ACC children-NOM eat-PAST
'It is (only) the candy which the children ate'

(39) also suggests that a sentence-initial *wo*-marked phrase receives focus interpretation.

Constraints on *GA*

Given the examinations and observations here, it seems that the particle *ga* has two functions; in addition to its nominative case marker function, it serves as a focus marker. We thus suggest that there are at least three realizations of *ga* as following:

a. $$\begin{bmatrix} \text{ACCENT} & U \\ \text{HEAD} & \textit{nom} \\ \text{INFO-ST} & [\;\;] \end{bmatrix}$$

b. $$\boxed{1}\begin{bmatrix} \text{ACCENT} & A \vee U \\ \text{MARKING} & \textit{ga} \\ \text{SPEC} & \langle \textit{[topic X]} \rangle \\ \text{FOC} & \{\boxed{1}\} \end{bmatrix}$$

c. $$\boxed{1}\begin{bmatrix} \text{ACCENT} & A \\ \text{FOC} & \{\boxed{1}\} \end{bmatrix}$$

Figure 10.22: The MORPHON Feature: Constraints on *GA*

Figure 10.22a specifies only the nominative value of the head. The second unmarked *ga*-marked phrase in (37), (38) and (39) are constrained by Figure 10.22a. The sentence-initial *ga*-marked phrase in (36) and (37) has obligatory RF interpretation whether it is A-accented or not. It is noteworthy that the subject *Ken* without the particle *ga* as shown in (40a) and (40b) is surely worse that the case of unaccusative in (40c):

(40) a. *Ken-ϕ kasikoi.
b. *Ken-ϕ titioya-ga sensee-da.
c. Kodomotatiϕ kaettekita.

These characteristics are described with the value of FOC, the disjunctive specification of the accent value, the value of MARKING, and value of SPEC X which is not the type *nil*$(= \langle\,\rangle)$[15] in Figure 10.22b.

Like English, accented constituents in Japanese are also interpreted as *foci*. Figure 10.22c is the constraint for RF, as in (30).

Now, we consider how the constraints in Figure 10.22 interact with the other constraints in HPSG.

To begin with Figure 10.22a, there is no need to go into details as it. It is a constraint for an ordinary nominative marked NP, which is not positively related to the instantiation of information structure, and is only subcategorized by the head, like a verb.

Next, Figure 10.22b is for the sentence-initial *ga*-marked phrase which is often analyzed as the subject even if it appears multiply. In Section 10.5.1, we have formalized the constraint on topic which if present appears in sentence-initial position. Let us see the ordering of RF and topic exemplified by (41):

[15]This does not mean the unifi cation failure to the type, but the inequality to the type.

(41) a. [$_{top}$ JR-wa] [$_{foc}$ tokkyuu-ga] untin-ga yasu-i.
JR-TOP super express-NOM fare-NOM low-PRES
'As for JR, it is the super express whose fare is low. '

b. * [$_{foc}$ JR-ga] tokkyuu-wa untin-ga yasu-i.
JR-NOM super express-TOP fare-NOM low-PRES
*'It is JR, as for the super express, whose fare is low. '

(41) shows that RF follows topic. Individual-level predicate subcategorizes for the RF phrases.

Lexical Rules and Schemata

To account for these phenomena, we assume the lexical rule and the schema rules to construct well-formed phrases.

$$\left[\text{HEAD } \textit{verb}\right] \rightarrow \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SPR} & \langle \text{NP-ga}, \ldots \rangle \end{bmatrix}$$

Figure 10.23: Multiple-Ga Lexical Rule

$$\begin{bmatrix} \text{TOPIC} & \boxed{3} \\ \text{FOCUS} & \boxed{2} \\ \text{SPR} & \boxed{5} \end{bmatrix} \rightarrow \boxed{4} \begin{bmatrix} \text{SPEC} & \langle \boxed{1} \rangle \\ \text{FOCUS} & \boxed{2} \end{bmatrix}, \boxed{1} \begin{bmatrix} \text{TOPIC} & \boxed{3} \\ \text{SPR} & \langle \boxed{4} \mid \boxed{5} \rangle \end{bmatrix}$$

Figure 10.24: Focus Schema

The lexical rule in Figure 10.23 introduces multiple *ga*-marked phrases. Note that in Figure 10.24, the focus of the mother is identical not to the head daughter's one, but to the specifier daughter's one. This ensures that only the last adjunction becomes the focus of the whole sentence. Figure 10.25 shows the structure of (41).

Note that *JR-wa* and *tokkyuu-ga* cannot be scrambled because of the constraints on the topic feature (X) within the SPEC feature of *JR-wa*.

10.5.3 A Note on Focus Projection

Finally, let us examine the issues of so-called focus projection, where information structure interacts with phonology by means of Figure 10.22c. However it is not sufficient to constrain the projection.

It is well known that an A-accent on the external argument in English cannot project the focus value up to the mother. Japanese also shows such a sensitivity as shown in below:

(42) Speaker A : What happened?
Speaker B$_1$: #[$_{foc}$ KODOMOTATI-GA] utat-ta.
children-NOM sing-PAST
'The children sang.'

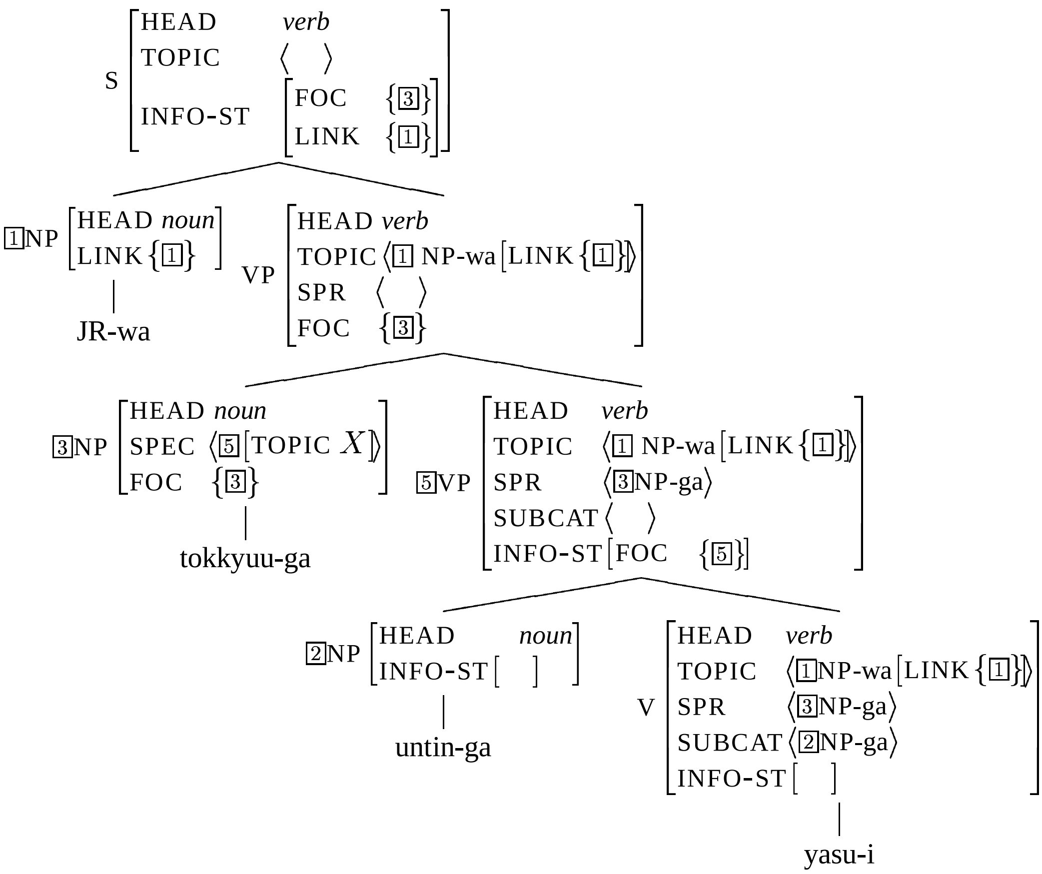


Figure 10.25: '*JR wa tokkyuu ga untin ga yasui*': Information Structure

Speaker B*2*: #[$_{\text{foc}}$ KODOMOTATI-GA] amedama-wo tabe-ta.
children-NOM candy-ACC eat-PAST
'The children ate the candy.'

Speaker B*3*: [$_{\text{foc}}$[$_{\text{foc}}$ KODOMOTATI-GA] kaette-ki-ta].
children-NOM return-come-PAST
'The children returned.'

The A-accent on the subject *kodomotati* on an unergative verb in (42B*1*) and a transitive verb in (42B*2*) cannot include a wide focus reading. This is confirmed by the unsuitability of the answer to an all-focus question in (42A). However focus on the subject of an unaccusative predicate like *kaettekuru* 'return' as in (42B*2*) can be projected up to the mother.

This is not predicted by (20ii), repeated in (43a) below, so we revise it as (43b):

(43) a. if the most oblique DAUGHTER'S FOCUS is instantiated, then the FOCUS of the mother is the *sign* itself.

b. the internal argument's FOCUS is instantiated, then
the FOCUS of the mother is the *sign* itself.

Though (43) captures the external/internal argument sensitivity, we will see a problem below:

(44) Speaker A : What did Ken do?

Speaker B_1: # Ken-wa [$_{foc}$ [$_{foc}$ KODOMOTATI-NI] amedama-wo age-ta].
Ken-TOP children-DAT candy-ACC give-PAST
'Ken gave a candy to the CHILDREN.'

Speaker B_2: Ken-wa [$_{foc}$ kodomotati-ni [$_{foc}$ AMEDAMA-WO] age-ta].
Ken-TOP children-DAT candy-ACC give-PAST
'Ken gave a CANDY to the children.'

The position of an *wo*-marked phrase and its interaction with possible domains of focus pose a problem. If we adopt the principle of (43b), these sentences should have the same possible focus domains: the *wo*-marked phrase and its mother, VP. However, (44B_1) does not have a VP focus interpretation while (44B_2) does. (44B_1) cannot be a faithful representation of a VP-focus question like (44A) whereas (44B_2) can. Focus can only project wide from the object *amedama* as in (44B_2).

Even in scrambled examples like those in (45), this condition holds: it is only when the object *amedama* is focused that the VP can receive the wide focus reading.

(45) Speaker B_1: # Ken-wa [$_{foc}$ amedama-wo [$_{foc}$ KODOMOTATI-NI] age-ta].
Ken-TOP candy-ACC children-DAT give-PAST

Speaker B_2: Ken-wa [$_{foc}$ [$_{foc}$ AMEDAMA-WO] kodomotati-ni age-ta].
Ken-TOP candy-ACC children-DAT give-PAST

This is rather unexpected, considering the generally free constituent order properties of the language. However, (43b) requires only a minor revision:

(46) the most oblique internal argument's FOCUS is instantiated, then
the FOCUS of the mother is the sign itself.

Note that (46) is defined for Japanese. *ageta* 'gave' will look like the following:

(47) [SUBCAT ⟨NP[EXT], NP[INT1], PP[INT2]⟩]

Though the first NP is the most oblique argument, it cannot allow focus projection since it is an external argument. The most oblique internal argument is the Theme NP, thus allowing wide focus. However the Goal PP cannot induce wide focus since it is not the most oblique argument regardless of its syntactic positions.

The only difference from English is that it is the most oblique and not the least oblique.

10.6 Summary

In this chapter, we have demonstrated that the relation between syntactic constituency and contextual information is not the tight one-to-one mapping that purely syntax-based analysis assumes.

We have proposed an analysis with the following characteristics: (i) information structure is an integral part of Japanese grammar and interacts in principled ways with both syntax and morpho-phonology, (ii) the representations of topic/focus in the information structure and its interactions with the particles *wa/ga* show one-to-many relation, and (iii) the ordering of grammatical functions and its interactions with other grammatical parts play an important role in determining the focus domain.

The study of information structure, we argued, is essential in addressing fundamental questions regarding the multi-dimensional grammar. Based on Engdahl and Vallduví's (1996) Information Structure Feature and the constraints, we have explained how topic/focus articulation should be optimally integrated into Japanese grammar.

Conclusion

Part II and Part III are devoted to the analysis of various grammatical constructions and phenomena in Japanese. They were arranged so that the discussion could move from tightly connected linguistic modules to loosely connected modules. We have discussed (i) syntactic locality of subcategorization, (ii) syntactic and semantic dependency of modification, (iii) semantic uniformity with underspecification and (iv) morpho-phonological, syntactic, semantic and pragmatic unity for interpretation are discussed in this order.

The multi dimensional units in HPSG/JPSG are *signs* and one of the most innovative aspects of the constraint-based grammar is that it includes an explicit connection to the semantics, morpho-phonology and pragmatics of use of sign.

1. The underspecification of semantic features for representing cross constructional semantic uniformity is developed.

2. Japanese passives can be classified into three subclasses: *niyotte*-direct passives, *ni*-direct passives, and indirect passives.

   (a) Direct passives are derived through lexical rules but the indirect passive involve syntactic embedding structure.
   (b) Only *niyotte*-direct passives correspond to the passive in English but *ni*-direct and indirect passives (and adversity causative) have a common semantic feature structure.
   (c) The properties separating these passives are best accounted for in terms of not only the structural differences but also the semantic requirements of each type of passive.

3. *Te-moraw* benefactives syntactically parallel passives and fall into two types; among them, the direct-types are monoclausal, whereas the indirect-type is biclausal.

   (a) In a monoclausal structure *moraw* is syntactically a derivational affix, and in the biclausal structure it is syntactically a word, just as in the case of passives.
   (b) Unlike the passive morpheme *(r)are*, the benefactive morpheme *moraw* is a free form, though, being an auxiliary, it basically has to be adjacent to the gerundive verb.

4. The principles of information structure which is an integral part of Japanese grammar and interacts in principled ways with both syntax and morpho-phonology were introduced.

   (a) The morpho-phonological and syntactic constraint of the subject marked with two particles,*wa* and *ga* were examined.

   (b) A constraint-based one-to-many mapping mechanism which captures some aspects of topic/focus interpretation was proposed.

Part III has presented an analysis of the rich variety of candidates for complex linguistic information in Japanese to show the validity of information-based multi-level theory under the framework of NAIST HPSG. In JPSG about an empirical domain, the phenomena of interest are modelled by linguistic object by constraint-based formalism, certain aspects of which are conventionally understood as corresponding to observables of the domain.

Specifically, Chapter 10 attempts to integrate the all linguistic constraint determined in the modules of morpho-phonology, syntax, semantics and pragmatics, respectively. NAIST JPSG's multi-dimensional constraint-based architecture discussed in Part II is also well-suited for representing not only the relations betwee various grammatical constructions but information structures which interact with syntax and prosody.

However our analysis has only mentioned few topics within the phenomenon referring to context. The formalization itself does not talk directly about the empirical phenomena; instead, it is interpreted by modelling structures. Thus the predictive power of the JPSG arises from the conventional correspondence between the model and the empirical domain. If our study of information structure is essential in addressing fundamental questions regarding the multi-dimensional grammar for Japanese, we should get more empirical and theoretical supports.

Chapter 11

Concluding Remarks

11.1 Summary

11.1.1 Grammar Implementation

Our work has concentrated mainly on describing constraint-based phrase structure grammar, which is an implementation of ideas from recent developments in HPSG. Figure 11.1 illustrates the part of the system of our grammar, NAIST JPSG, especially referring to the constraints which are fully implemented, and the relevant linguistic phenomena which we discussed.

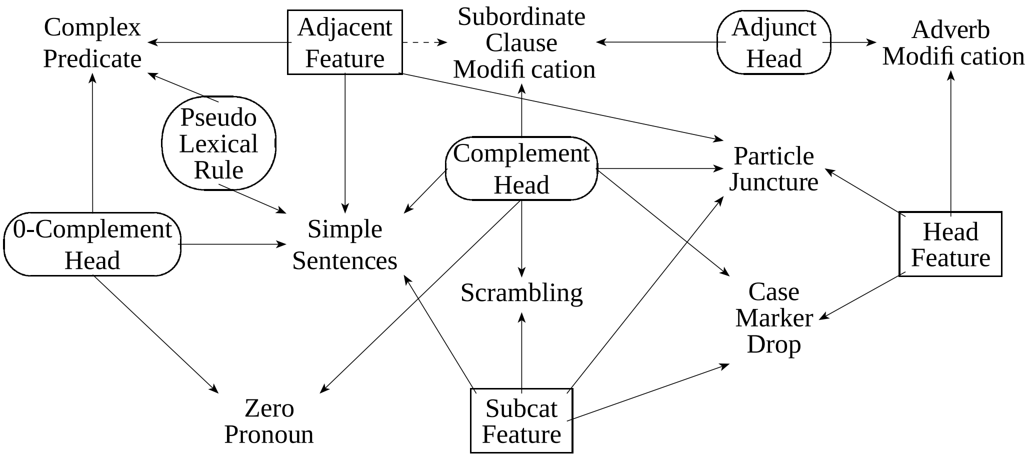


Figure 11.1: NAIST JPSG's Constraints and Relevant Linguistic Phenomena

As has been made clear in the course of discussion, the constraint-based grammar approach enables us to map out complex linguistic knowledge onto several levels of information which are compositionally organized by the constituents and the constraints among them. It also enables us to analyze them in their own proper grounds and to make them simultaneously available for current purposes, since such pieces of information are fully sorted based on not only linguistic but the mathematical, computational and philosophical background.

11.1.2 Grammar Formalization

NAIST JPSG only assumes the relationships among the three constituents in a minimal branching i.e., local phrase structure, consisting of a mother, a head daughter and a dependent daughter. Those constituent structures are constrained only by a small number of the set of schemata, exhibited in Figure 11.2.

The structure shown in Fig 11.2 virtually exhausts the general configurations in Japanese. The local phrase structures are essentially of two types.

1. Dependent Daughter
   (a) Complement
   (b) Adjacent Complement
2. Adjunct

In this view, the apparent variety in phrase structure building by the constituents can be reduced to these two fundamental structures.

Each node in a local tree has a complex feature structure, which is represented as an attribute-value matrix and is related to other nodes by a set of constraints. The feature structures contain information about morpho-phonology, syntax, semantics and certain potions of pragmatics as well, and are related to each other by constraints specifying the value or the range of values for those features.

The following are the constraints discussed in this thesis.

1. Head Feature Principle
2. Valence Feature Principle
   (a) Argument Realization Principle
   (b) Subcategorization Feature Principle
   (c) Adjacent Feature Principle
   (d) Modification Feature Principle
3. Semantic Feature Principle
4. Information Structure Instantiation Principle

We have made some revisions to the principles for purpose of both practical parsing and theoretical analyzing. However universality of the principles is maintained since all language-particular and/or process-oriented constraints are disjunctive.

Grammatical descriptions take the form of statements about the sharing of partial feature structures among constituents. Thus in NAIST JPSG, not only can regularities within morpho-phonology, syntax, semantics or pragmatics be expressed, but interactions among these can be described in a uniform environment.

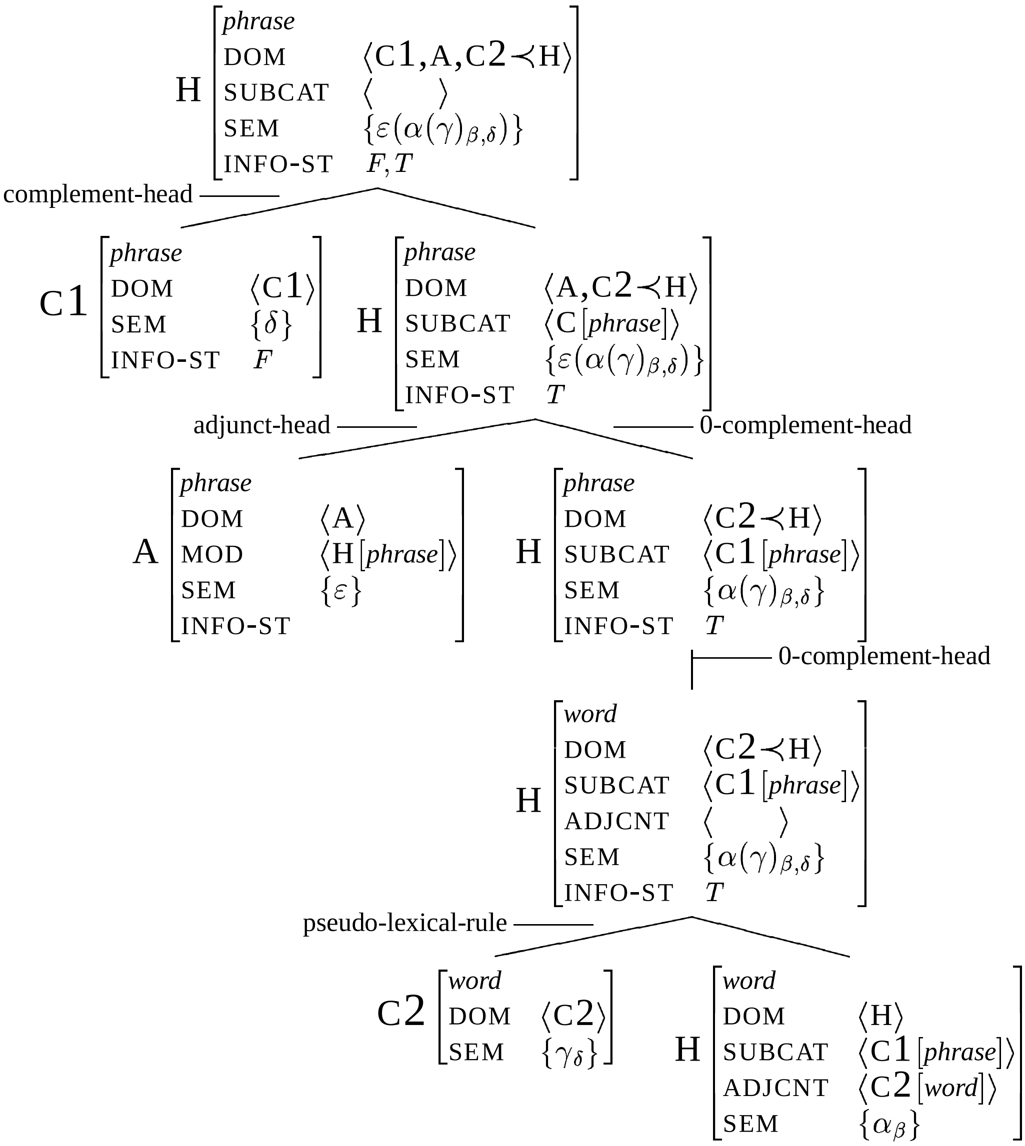


Figure 11.2: Local Configuration in Japanese

We think a grammar, especially lexical information, should be a fundamental platform on which the various constraints that explain various linguistic phenomena are built. So the grammar itself should be as simple as possible and distinction between basic features and extended ones in order to explain a specific linguistic phenomenon should be clear.

11.2 Future Directions

This thesis has offered a new way of analyzing Japanese grammar, and we believe that it has proven itself to be promising. However, there still remain problems and issues. We conclude this thesis with a list of possible future research directions.

To investigate a wider area of linguistic phenomena Although we have not completely reviewed the essentials of the Japanese grammar nor have we discussed the JPSG/HPSG treatment of various fundamental phenomena, the current framework misses the important aspects for inquiring various properties of Japanese language.

- (Morpho-)Phonological Phenomenon
- Unbounded/Long-distance Dependency
- Compound Sentence
- Other (Lexical) Compound Verbs(Chapter 5)
- Case Alternation
- Interrogative, Directive, . . .

To develop a wider coverage grammar The grammar is still in a prototype form since it does not succeed in parsing long sentences by oneself. For real-world text processing, we have to elaborate and introduce more rules and linguistic knowledge which have linguistic background.

- Hierarchical Clause and Modification (Chapter 6)
- Interpretive Condition for Binding Principle
- Anaphora Resolution
- Thematic Underspecification (Chapter 8)

To refine not-fully implemented constraints Some Principles still have problems.

- Linearization (Chapter 7)
- Information Instantiation (Chapter 10)

As shown in above, the next theoretical goals of this thesis are articulated.

The most important aspect of the theory in our attempt is that it is an information-based multi-level theory. Within JPSG/HPSG, language is considered as feature structures which convey morpho-phonological, syntactic, semantic and pragmatic information. Such organization of information in a feature structure will prove to be very effective in representing and analyzing the formal and computational aspect of Japanese.

We have devoted our discussion to the analysis of language-specific phenomena, but the explanation and the generalization interact in principled ways with universal constraints for natural language. This thesis is thus intended to contribute to not only the research of Japanese grammar in general but the HPSG community which has addressed grammar engineering extensively.

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(2) Ohtani, A. & Matsumoto, Y. (2005). Japanese Subjects and Information Structure: A Constraint-based Approach. In *Proceedings of the 18th Pacific Asia Conference on Language, Information and Computation (PACLIC18)*, pp.93–104. Tokyo, December.

(3) Ohtani, A. (1999). An HPSG Account of the Japanese Passive. In *Proceedings of the 2nd International Conference on Cognitive Science and the 16th Annual Meeting of the Japanese Cognitive Science Society Joint Conference (ICCS/JCSS99)*, pp.527–530. Tokyo, July.

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(4) Ohtani, A. & Miyata, T. (in printing). Representing the Information Structure of the Japanese Focus/Topic Subjects: A Constraint-based Approach. In *Proceedings of the 29th Annual Meeting Kansai Linguistic Society (KLS 25)*. Kyoto, October.

(5) Ohtani, A. & Matsumoto, Y. (2002). Formal Representation of Benefactive Constructions in NAIST JPSG. In *Proceedings of the 19th Annual Meeting of the Japanese Cognitive Science Society*, pp.86–87. Ishikawa, June. (in Japanese).

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