Theoretical, Technological and Pedagogical Approaches to Zero Arguments in Japanese Discourse: Making the Invisible Visible

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By

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To Akky

Abstract

This thesis is an interdisciplinary investigation into a linguistic phenomenon commonly found in Japanese discourse, what we call zero arguments (or ZEROS). The present study, therefore, can be characterized by two central themes: (i) an extensive examination of ZEROS, and (ii) an interdisciplinary approach to this phenomenon.

ZEROS are one linguistic realization of "unsaidness," a quality that is often used to characterize the Japanese language. In this thesis, we define ZEROS as "invisible" arguments of verbs or nouns, which are triggered by their syntactic or semantic requirements and are recoverable from linguistic or non-linguistic contexts.

As is apparent from the subtitle, the underlying theme of this thesis is "making the invisible visible." Our sub-goals are: (i) to explore the nature of the invisible ZEROS and "theoretically and empirically" explain why we want to make them visible, with a focus on the coherence that the invisible creates and the inference it demands, (ii) to present how the invisible can "technologically" be made visible, and finally (iii) to discuss where this making visible can be of "pedagogical" benefit. Therefore, we place, in the core of this attempt, an automatic linguistic analysis system that we developed and named *Zero Detector*, which is the outcome of theory-motivated, corpus-verified, and pedagogy-oriented technology.

The organization of the thesis is two-fold. In Part I, we examine the definition and typology of ZEROS and their distribution in texts, and demonstrate how significantly ZEROS contribute to coherence creation. We also show, using the centering framework, that the amount of inference needed to perceive coherence of ZERO-involving discourse segments varies from segment to segment. We first introduce some relevant key concepts, and propose the definition and the typology of ZEROS, and the centering-based inference cost scheme. We then provide ample empirical data from the corpus study that we conducted on naturally-occurring Japanese data.

In Part II, we attempt to put these findings into practice. The implications from Part I motivate the computerization of ZERO recognition as a virtual model of the human ZERO visualization process, and then inform the discussion of the pedagogical profit to be gained by such a computerization within relevant language teaching principles. More specifically, we discuss two sets of linguistically-sound heuristics that we employ for the recognition of the two types of ZEROS in the development of *Zero Detector*, and provide the results of evaluation of its performance. We also discuss two possible areas for the pedagogical contribution of *Zero Detector* to the Japanese as a second language context, that is, (i) teachers' effective instruction of ZEROS in discourse and (ii) learners' recognition of ZEROS and better understanding of ZERO-containing discourses.

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me with hundreds of email messages that we exchanged for discussion between Kyoto and Hiroshima as well as the resulting accomplishment. Above all, this experience helped me “grow up” as a researcher. She also took a tremendous amount of time out of her already busy life to carefully read and comment on every chapter of this thesis. I cannot find enough words to thank her. But I just want to say here -- Laurie, you are great!

I was fortunate that I had another collaborator and friend like Miho Fujiwara throughout these years. She helped me a great deal with the pedagogical aspect of this study and much of the foundation work. Without her help and input, this work would have been less colorful. I am also thankful to all the participants in studies for the thesis: the students at Willamette University and the following people from the JSL teaching community: Yasuko Ehara, Mariko Gomez, Fukuyo Katsu, Mariko Moroishi, Noriko Okamoto, Takae Tsujioka, Mari Takada, Tomoharu Yanagimachi, and Momoko Yokoi.

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It is not possible to enumerate every person who intellectually inspired me during the years that have seen the development of my research, but in particular, I wish to thank numerous centering researchers worldwide whose works have continuously stimulated me. I am also grateful to those who sent me copies of papers, as well as useful comments and suggestions, including Francis Bond, Isao Iori, Shinichi Izumi, Yuko Nakahama, Shigeko Nariyama, Mari Tanaka, Midori Tanimura, and Etsuko Yoshida.

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Last but not least, I am deeply grateful to my family: my husband for his respect for who I am and what I do, and especially, my son for his love, patience and understanding; he knew that his mom had work to do even when he wanted more fun with her. This thesis is dedicated to Little Akky, whose sweet smiles, occasional tears, tender hugs and lots of ‘I love you’s’, have always kept my spirit up.

Contents

List of Acronyms and Abbreviations

ACL	Association for Computational Linguistics
AI	artificial intelligence
AP	adjectival phrase
ANLP	applied natural language processing
ATN	argument-taking noun
CALL	computer-assisted language learning
CALT	computer-assisted language teaching
CASLR	computer-assisted second language research
CL	computational linguistics
CMC	computer-mediated communication
COLING	International Conference on Computational Linguistics
DC	dependent clause
DDL	data-driven leaning
EC	embedded clause
EFL	English as a foreign language
ESL	English as a second language
EUROCALL	European Association for Computer-Assisted Language Learning
ET	educational technology
GB	government and binding theory
IC	independent clause
ICALL	intelligent computer-assisted language learning
ICT	information and communication technology
ILTS	intelligent language tutoring system
ITS	intelligent tutoring system
JFL	Japanese as a foreign language
JLPT	Japanese-Language Proficiency Test
JSL	Japanese as a second language
KWIC	key word in context
L1	first language
L2	second language
LL	language laboratory
LT	language technology
NLE	natural language engineering
NLG	natural language generation
NLP	natural language processing
NLU	natural language understanding

NP	noun phrase
POS	part of speech
PP	particle phrase (for Japanese) / prepositional phrase (for English)
RC	relative clause
SLA	second language acquisition
TBLL	task-based language learning
TBLT	task-based language teaching
VP	verb phrase
ZD	Zero Detector

Acronyms used in Japanese language examples are listed separately in Chapter 1.

List of Figures

List of Tables

Chapter 1

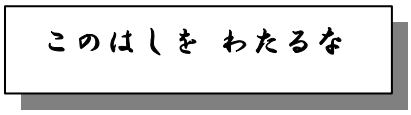
Introduction

1.1 Thesis statement

This thesis is an interdisciplinary investigation into a linguistic phenomenon commonly found in Japanese discourse, what we call zero arguments (or ZEROS). The present study, therefore, can be characterized by two central themes: (1) an extensive examination of the invisible ZEROS, and (2) an interdisciplinary approach to this phenomenon.

1.1.1 Background

The linguistic phenomenon that this thesis centers on is so-called zero arguments. Zero arguments are one linguistic realization of “unsaidness,” a quality that is often used to characterize the Japanese language. This unsaidness is something agreed upon by tacit consent among participants in Japanese discourse. Speakers/writers unconsciously or consciously avoid unnecessary and intrusive repetition or overtness, and leave unsaid what they believe is obvious from a given context or situation. In other words, hearers/readers are supposed to make best-possible guesses, which are normally “required” to understand the speaker/writer’s intended meaning for the purpose of communication. It also “allows” for an arbitrary interpretation by the hearer/reader, in a special context like this:



There was a sign in front of a bridge, which said "Don't cross this bridge." Ikkyu

saw it; he crossed the middle of the bridge without any hesitation. He was arrested for breaking the rule on the sign, but he calmly explained that he did not cross the edge but the middle.

This is a well-known story of a humorous young Zen priest, Ikkyu, who solves with his wits any problems or unreasonable demands that he is challenged by. The sign says in Japanese:

(1.1)	この	はしを	わたるな
	kono	*hasi-o*	*wataru-na*
	this	bridge-ACC	cross-NEG

‘Do not cross this bridge.’

This is a “natural” one-utterance discourse, given the situation in which the sign is in front of the bridge. His witty solution stems from his lexical knowledge of pun on a word *hasi* which has two meanings in Japanese, ‘bridge’ and ‘edge.’[1] It is also driven by his recognition of a zero argument before the word *hasi* in its second meaning. His mental representation of this utterance, when he read the sign, was as in (1.2).

(1.2)	この	Ø	はしを	わたるな
	kono	*(Ø-no)*	*hasi-o*	*wataru-na*
	this	(Ø 'bridge'-GEN)	edge-ACC	cross-NEG

‘Do not cross the edge (of this bridge).’

This is also a “natural” (although a little odd) and possible utterance in this situation. This zero argument is, however, not one that the sign writer intended and left unsaid, but one that the reader voluntarily evokes by switching the sense of the word. Not everyone would make this interpretation and recognize the ZERO. This linguistic sensibility is what makes Ikkyu a quick-witted problem solver.

This is a special case, and we will not deal with this kind of humorous aspect of language use. What we wish to indicate in this Ikkyu anecdote is that recognizing ZEROS (or “making the invisible visible” in one’s mind) could be of crucial importance in communication in the same way that it saved his life!

In more common communicative situations, making guesses about what is unstated is a “required” process in the comprehension of, in particular, Japanese discourse. Conversely, linguistic options for making guesses easy (or at least possible) are

[1] The word actually has a third sense ‘chopsticks,’ but this sense does not work for a solution here.

normally "required" in production, unless you intend to mystify the hearer/reader. Our theoretical interest is in how zero arguments behave to fulfill these requirements, by controlling the demand that "guesses" be make and maintaining "naturalness" in discourse at the same time. In more technical terms, our primary concern is in the interaction of "inference" and "coherence" in particular relation to the use of ZEROS.

Many questions about language itself and language use, including this concern, are explicated in an academic field called linguistics. Linguistics is the study of human language as a system of human communication. Within this broad definition, language has been studied from different perspectives, with different approaches, and for different purposes, in a variety of disciplines or branches, under the name of linguistics.

Theoretical linguistics, for example, aims to establish universal principles for the study of languages, and to determine the characteristics of human language as a phenomenon. **Corpus linguists** are interested in the systematic study or use of corpora, *i.e.*, large collections of real world data, such as text or speech, for the purpose of formulating and empirically testing hypotheses about language.[2] **Applied linguistics**, on the other hand, attempts to use theoretical principles, methods, and findings in elucidating and solving practical problems. The best-developed practical application is to the teaching and learning of foreign languages, referred to as **Second Language Acquisition (SLA)**. The growing field of information technology also includes language in the area of Artificial Intelligence (AI). This has led to a relatively new discipline called **Computational Linguistics**, and also a closely related discipline equipped with a more engineering flavor, termed **Natural Language Processing (NLP)**. In addition, **psycholinguists** explore the effects of psychological constraints on the use of language and study the mental processes underlying the planning, production, perception and comprehension of discourse. **Cognitive linguists** aim to provide accounts of language with reference to the understanding of the human mind.

These linguistic sub-disciplines are highly interdependent: successful ideas from one discipline are likely to influence work in another; insights from one are incorporated into another, and results in one may be supported theoretically or empirically by studies in another. However, researchers in each community have tended to pursue their goals quite separately from one another. ZEROS are not an exception; they have been actively researched in each community for its own goals. Our major challenge, and ultimate goal, in this research, therefore, is to integrate several different sub-disciplinary approaches to or views of one linguistic phenomenon, in a harmonizing fashion, within a single thesis written by a single author.

[2] In early years of corpus linguistics, corpus-restricted linguistic description was the subject of criticism, especially by generative grammarians, who pointed to the limitations of corpora. The wider availability of computerized corpora and analysis tools has encouraged the recent advancement of corpus linguistics.

1.1.2 Goals

As is apparent from the title, the underlying theme of this thesis is “making the invisible visible.” Our sub-goals are: (i) to explore the nature of the invisible and “theoretically and empirically” explain why we want to make the invisible visible, with a focus on the coherence that the invisible creates and the inference it demands, (ii) to present how the invisible can “technologically” be made visible, and finally (iii) to discuss where this making visible can be of “pedagogical” benefit.

We place, in the core of this attempt, an automatic linguistic analysis system that we developed, named *Zero Detector*, which we deem is the outcome of **theory**-motivated, **corpus**-verified, and **pedagogy**-oriented **technology**. This is schematically described in Figure 1.1

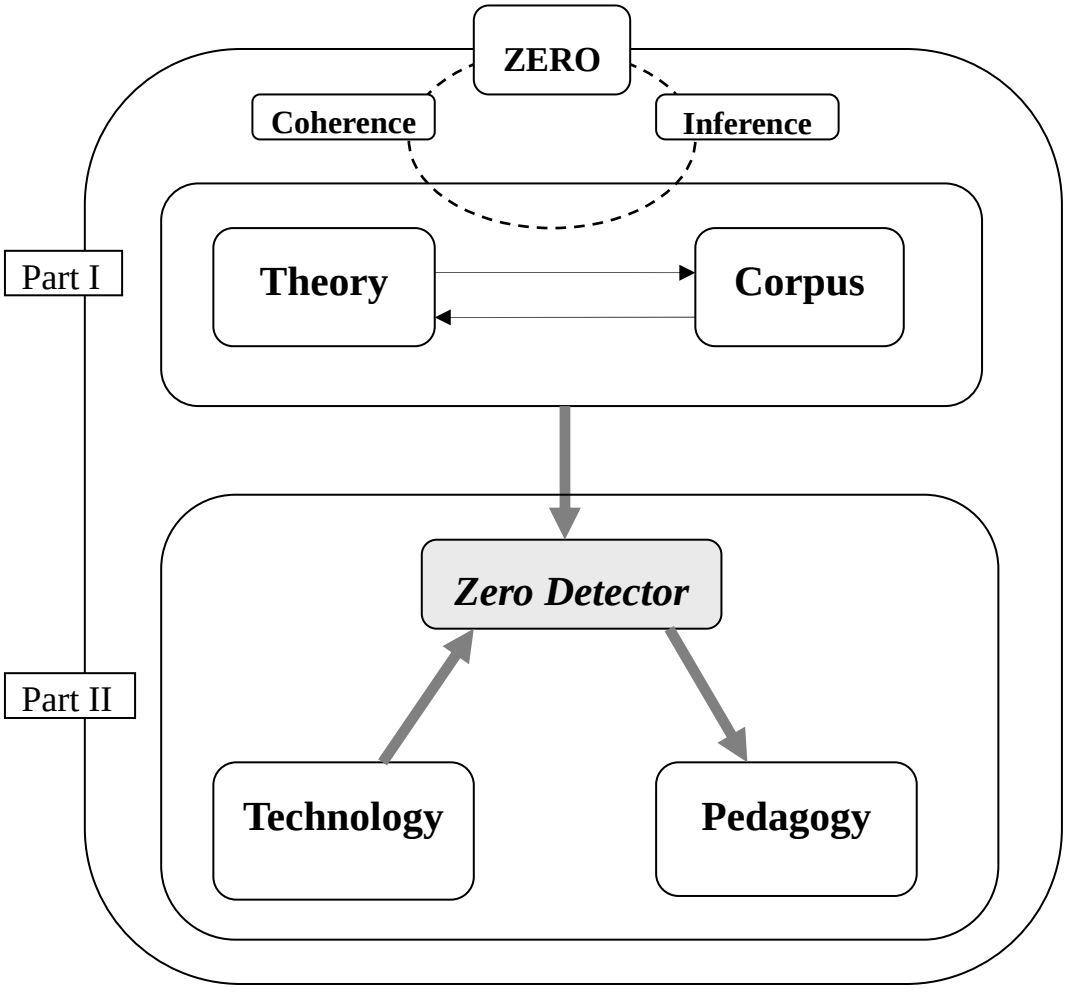


Figure 1.1: Schematic view of the thesis

The linguistic construct that we deal with in this study is a language-particular discourse level phenomenon in Japanese that presents a clear contrast to English. Therefore, we add the flavor of contrastive analysis between the two languages to relevant discussions throughout the thesis. This is also because our pedagogical interest is in the teaching of Japanese to native English-speaking learners.[3]

1.2 Overview of the thesis

The major goal of this thesis, and therefore, its organization, is two-fold, as is shown in Figure 1.1 above. Part I of the thesis aims to theoretically and empirically illustrate the nature and behavior of ZEROS. More specifically, the goals of Part I are: (i) to examine the frequency and typology of ZEROS and their distribution from text to text; and (ii) to demonstrate how significantly ZEROS contribute to coherence creation, and that the amount of inference needed to perceive coherence of ZERO-involving discourse segments varies from segment to segment. Part II, then, aims to put these findings into practice. The implications from Part I motivate the computerization of ZERO recognition as a virtual model of the human ZERO visualization process, and then inform the discussion of the pedagogical profit to be gained by such a computerization within a relevant language teaching principle. A chapter-by-chapter overview of the thesis is as follows:

Part I is devoted to discussion of "theory" that motivates and supports Part II, and comprises Chapters 2 through 4.

Chapter 2 introduces the definition and typology of ZEROS after discussing some key concepts related to the nature of ZEROS. Here and in subsequent chapters, special emphasis is given to a less-studied type of ZEROS, namely zero nominal arguments. It also describes the status of ZEROS as cohesion markers in Japanese, and presents some empirical evidence, from a classroom, for problems that Japanese language learners encounter in their interpretation and production of ZEROS.

Chapter 3 first discusses some fundamental concepts in understanding discourse coherence and overviews approaches to coherence proposed in the literature. It then introduces Centering Theory, a model that we chose as an explanatory tool for the relationship between ZEROS and coherence/inference in Japanese discourse.

Chapter 4 describes our corpus study. It is the main component of the thesis, both in

[3] This study has greatly been benefited from practical and experimental collaboration with teachers of Japanese language courses in a university in the U.S.

volume and in its position as a link between theory and practice, with ample empirical evidence. Following the methodological introduction of our study, two major sets of results are presented. The first set offers some basic facts about the corpus concerning the distribution of various ZERO types, as well as a preliminary centering analysis. The second set provides findings concerning the interrelationship between the distribution of ZEROS and the degree of coherence of discourse that contain them that is predicted by centering rules, as formulated in Grosz, Joshi, and Weinstein (1995), which in fact is a primary objective of this corpus study. In addition, the centering predictions on ZERO use, drawn from the analysis results, are compared to human intuition about the appropriate use of ZEROS. Finally, we discuss the pedagogical implications of the results in reference to the contribution of ZEROS to discourse coherence and the potential resources for inference, besides centering, required to interpret ZEROS.

Part II focuses on "practical" considerations that are the outgrowth of the corpus-based theoretical assumptions discussed in Part I, and comprises Chapters 5 though 7.

Chapter 5 reviews educational technology and in particular, natural language processing techniques and applications. More specifically, we discuss the pros and cons of the use of NLP in language teaching and learning. We also present some previous work on NLP-enhanced language teaching/learning aids, also known as ICALL (Intelligent Computer-Assisted Language Learning) systems.

Chapter 6 describes *Zero Detector*, an automatic ZERO recognition program that we developed on the ground that the recognition of ZEROS would play a part in the human perception of coherence. We first discuss two sets of linguistically-sound heuristics that we employ for the recognition of the two types of ZEROS, then present the system architecture, and finally provide the results of evaluation of its performance.

Chapter 7 discusses possible pedagogical contributions of *Zero Detector* to the Japanese as a Second Language context. The two possible areas for such contribution presented are: (i) (teacher's) instruction and (ii) (learner's) acquisition of ZEROS and ZERO-containing discourse, with focus on their enhancement. Relevant language teaching/learning principles, with insights from cognitive research, are also presented.

Finally, in **Chapter 8**, we conclude with a summary of the contributions of the thesis and future directions.

1.3 Notational conventions[4]

1.3.1 Japanese language examples

As stated earlier, the corpus study plays a crucial part in this thesis. Hence, at many points, we present examples of Japanese discourses, utterances, phrases and words. Most of our Japanese examples are taken from the main corpus that is described in Chapter 4, of which sources are provided in Appendix A. Some other examples are drawn from the email corpus that is used for our earlier works: Fais and Yamura-Takei (2003) and Yamura-Takei and Fais (ms.). References are noted in the text, as "our corpus" and "email corpus" respectively. Also, some constructed examples are used for the sake of simplicity in presentation and no reference is given in such cases.[5] In addition, some writing samples of Japanese learners that we collected are presented in related to relevant discussion.

Examples are numbered and presented in the standard linguistic format with four layers, as shown in (1.3).

(1.3)	Ø	牛乳を	飲みました。
	(Ø –ga)	*gyuunyuu-o*	*nomi-masi-ta.*
	(Ø –NOM)	milk-ACC	drink-POL-PAST

'(She) drank milk.'

[*Hiroko 1*]

The utterance is rendered first in Japanese characters (with a mixture of *Kanji* and *Kana*); in the next line, it is transliterated in italics in the *Kunrei* style romanization system.[6] The third line presents English glosses. Here, delivering a word-by-word gloss is made difficult by the fact that many Japanese morphemes do not correspond to individual English words. One typical case involves particles, such as the morphemes *ga* and *o* in example (1.3). To those elements, we simply supply abbreviations of their

[4] This section is intended mainly for the audience in the community of Information Sciences, for which degree this thesis is submitted. Those in the Linguistics community may be already familiar with what is presented here.

[5] In our constructed examples, a set of human entities will uniformly be used: Taro for a male entity and Hanako for a female entity in Japanese examples, and John/Jane for male/female entities in English.

[6] A more recent style of romanization, called the Hepburn style, is often used in the literature as well. Here, we follow the tradition in Japanese linguistics for our choice. In *Kunrei* style, long vowels are usually notated with a circumflex as in â, ê, î, ô, and û, but we conventionally use aa, ee, ii, oo, and uu, instead.

grammatical or discourse functions, using the notation listed in Table 1.1 below.

Abbreviation	Function	Example
NOM	nominative	*-ga*
ACC	accusative	*-o*
DAT	dative	*-ni*
GEN	genitive	*-no*
TOP	topic	*-wa*
FOC	focus	*-mo*
QUO	quotative	*-to*
Q	interrogative	*-ka*

Table 1.1: Notations for particle morphemes

Other particles that exhibit semantic contents, such as *de*, *kara*, *yori*, for instance, are notated with corresponding English prepositions, such as 'in,' 'from,' 'than' respectively (see 2.2.3 for further discussion of particles).

Another case where the Japanese morpheme to English word mapping is impossible is inflectional suffixes included in verb conjugations, such as *-masi* and *-ta* in example (1.2). The list of these morphemes is given in Table 1.2.

Abbreviation	Function	Example
PAST	past tense	*-ta*
POL	polite form	*-masu*
NEG	negative	*-nai*
COP	copula	*-da*
CAUS	causative	*-sase*
PASS	passive	*-rare*
AB	ability	*-re*
EMP	empathy	*-kureru*
NOMI	nominalizer	*-koto, -no*
COMP	complimentizer	*-to*

Table 1.2: Notations for verb conjugation morphemes

Finally in the fourth line, an English translation is given within single quotation marks. At the end of a quoted example, when it is from our main corpus, the source textbook (from the list in Appendix A) is provided, along the right margin, in square brackets.

A zero argument is indicated as Ø in each line. In transliteration and gloss, it is accompanied by a canonical case (marker) to make explicit its grammatical role in an utterance. In English translation, Ø is replaced by a corresponding pronoun and/or by its antecedent noun.

1.3.2 Terminology

A number of linguistic conventions are used throughout the thesis. Those conventions are notated in several different ways mainly for emphasis. First, SMALL CAPS are used for important terms widely used in the literature on discourse and in particular, in the centering framework. *Italics* are reserved solely for Japanese examples, with a few exceptions of names, such as *Zero Detector*; 'single quotations' are for English glosses and translation. Therefore, emphasis is indicated in **bold** or with "double quotations."

The term "discourse" is used to refer to both written and spoken modes of communication. The term "text" is used when we wish to limit our discussion solely to the written mode that this thesis centers on. "Discourse participants" are generally referred to as "addressers/addressees." "Speaker/writer" and "hearer/reader" distinctions are made when relevant.

Part I

Language Theory and Corpus Study

In this part, we will demonstrate why the development of *Zero Detector* is important, from both theoretical and empirical points of view. Theoretical discussion on the phenomenon of ZEROS and their behaviors in Japanese discourse will be given in Chapters 2 and 3, which will be followed by comprehensive empirical validation in the corpus study in Chapter 4.

Contents

Chapter 2

Zero Arguments

2.1 Introduction

The Japanese language is often described as an “elliptic” language (e.g., Obana, 2000). “Ellipsis” is the omission of elements, normally required by “the grammar,” that speakers/writers assume are obvious from a given linguistic context or from relevant non-linguistic knowledge. Here, we mean by “the grammar” a set of rules governing the use of a language, which covers the levels of morphology, syntax and semantics. Ellipsis as a concept is probably a universal feature of languages. People avoid unnecessary and intrusive repetition, and leave “unsaid” what they believe is recoverable or inferable in the context or in the situation.

However, the linguistic options that realize ellipsis vary markedly. Huang (1984), for instance, classifies languages, according to the permissibility of so-called “empty categories” that are defined, in the Government and Binding (GB) framework, as referentially dependent elements that are phonetically empty, but syntactically present (e.g., Haegeman, 1994). Japanese, along with Chinese and Korean, allows for empty categories in all the following sentence forms (where *e* indicates an empty category) in (2.1), and is labeled a “cool” language.

(2.1) a. *e* came.
b. John saw *e*.
c. *e* saw *e*.
d. John said that *e* saw Bill.
e. John said that Bill saw *e*.
f. John tried *e* to come.

In “hot” languages, including English, all but (f) are ungrammatical, and in “medium-hot” languages, such as Italian and Spanish, the sentence forms of (a), (d) and

(f) are well-formed, but (b), (c) and (e) are ill-formed. In this account, Japanese and English are placed at the extreme ends of this scale.

Kameyama (1985) presents a typology of languages in terms of "zero anaphora permissibility" and "syntactic overtness requirement" which are "two sides of a coin" (page 7). In her typology, English is categorized as Type I; it syntactically requires overt subjects for any finite verbs and objects for any transitive verbs. Japanese is placed at the other end as Type III; it allows zero-subjects/objects extensively in any person, with no obligatory grammatical encoding of its reference.

This thesis focuses on a typical realization of the "unsaidness" in Japanese, what we conventionally call ZEROS, which are triggered by syntactic/semantic gap, but are distinct in their mechanisms and behaviors from ellipsis found in another class of languages (i.e., Huang's "medium" or Kameyama's "Type II/IV") that normally exhibit a rich morphological system of subject-verb agreement. The ellipsis of our concern is pragmatic in nature rather than morphological (as realized by inflection) or grammatical (as realized by switch-reference systems).[1] Hence, we consider ZEROS as a discourse phenomenon that involves structural, cognitive, and pragmatic factors in their distribution.

2.2 Key concepts

Although ZEROS are pragmatic in their distribution and behavior, they are syntactic and semantic in definition. In this subsection, we will give an overview of four key linguistic (largely syntactic and semantic) concepts: argument structure, case, headness, and definiteness, all of which are closely related to the definition and typology of ZEROS that we present in Sections 2.3 and 2.4. Here, we will initially base our discussion on the study of English, since it is a best-researched language in linguistics in general, and then attempt to apply the concepts to Japanese.

2.2.1 Argument structure

"Predicates" and "arguments" are the terms often used to characterize the units of syntactic structures. Haegeman (1994) metaphorically describes "predicates" as the script of a play and "arguments" as central roles defined by the script (and "adjuncts" as supporting parts in the play). Therefore, every predicate has its own argument structure, just as every script requires its own roles. The argument structure of a verb (as a prototypical example of predicate) determines which elements of the sentence are

[1] Huang, Yang (2000) proposed, as a working hypothesis, a novel typology of languages in terms of "pragmaticness" versus "syntacticness." His typology classifies Japanese as a pragmatic language, along with Chinese.

obligatory and is often defined as the "subcategorization frame" in the GB framework.[2]

Also, argument structure is used as the common technical term for one idiosyncratic property of a word. Many works have used this notion to explain lexical properties. According to Grimshaw (1990), the term refers to "the lexical representation of grammatical information about a predicate" (page 1). Hence, argument structure explains "the syntactic behavior of a lexical item" (*ibid*, page 1).

The lexical item that specifies the argument structure is called the predicate. A prototypical example of a predicate is a verb, which usually takes a set of arguments (and also adjuncts). The verb 'draw,' for example, is a two-place predicate, as illustrated in (2.2). It requires two arguments: the one who does the act of drawing and the thing that is being drawn (underlined), with possible additional information, "on what" categorized as an adjunct (in parentheses).

(2.2) John **drew** a picture (on the wall).

The application of argument structure is not limited to verbals. Other syntactic categories than verbs, such as adjectives, as well, have their argument structure, as in (2.3).

(2.3) a. Jane is **familiar** with the Japanese language.

b. Jane is **afraid** that she may fail in the exam.

Predicative adjectives often take one syntactic argument, in addition to a subject (often called an external argument), whose surface realization includes prepositional phrases, as in (2.3a) and clauses, as in (2.3b).

The notion can be further extended to nominals. A prototypical instance of nominals that are claimed to bear argument structure is verbal nouns (e.g., Grimshaw, 1990; Haegeman, 1994; Partee and Borschev, 2003).[3] Look at an example below.

[2] There is an important distinction between argument structure and subcategorization frame. Subcategorization frames only specify the complements of the verb, i.e., the elements that are obligatory inside the VP. The subject NP need not be mentioned in the subcategorization frame because all verbs supposedly have subjects. The argument structure, on the other hand, lists all the arguments, including the subject argument.

[3] Grimshaw (1990) limits the scope of nouns that can project arguments to a subclass that she refers to as process or event nominals. Haegeman (1994) uses the noun 'analysis' which is semantically and morphologically related to the verb 'analyse' which share the same argument structures as its noun counterpart.

(2.4) a. John's **transfer**

b. the **transfer** of John (to the Tokyo Office)

The arguments of the noun 'transfer' are syntactically realized either by pre-nominal possessive NPs, as in (2.4a), or post-nominal prepositional phrases, as in (2.4b).

Let us turn now to the case of Japanese. Japanese exhibits the corresponding argument structures for a verb as in (2.5), an adjective in (2.6) and a noun in (2.7).

(2.5)	太郎が	壁に	絵を	描いた。
	Taro-ga	*(kabe-ni)*	*e-o*	***kai**-ta.*
	Taro-NOM	wall-on	picture-ACC	draw-PAST

'Taro drew a picture on the wall.'

The verb *kaku* 'draw,' in this example, requires a nominative argument and an accusative argument, and also accompanies a locative adjunct.

(2.6) a.	花子が	英語に	詳しい。
	Hanako-ga	*eigo-ni*	***kuwasii**.*
	Hanako-NOM	English-with	familiar

'Hanako is familiar with English.'

b.	花子は	試験に落ちるのが	恐い。
	Hanako-wa	*siken-ni otiru-no-ga*	***kowai**.*
	Hanako-TOP	exam-in fail-NOMI-NOM	afraid

'Hanako is afraid that she may fail in the exam.'

In (2.6), adjectives, *kuwasii* 'familiar' and *kowai* 'afraid' take a *ni*-marked argument and a *ga*-marked nominalizer respectively, in addition to subject arguments.

(2.7) a.	太郎の	転勤
	Taro-no	***tenkin***
	Taro-GEN	transfer

'Taro's transfer'

b. 太郎の　　ニューヨークへの　　転勤
<u>*Taro-no*</u>　　*(nyuuyooku-e-no)*　　***tenkin***
Taro-GEN　　New-York-to-GEN　　transfer

'the transfer of Taro to New York'

A nominalized verbal *tenkin* 'transfer' has the same argument structure as its derived verb *tenkin-suru* 'to transfer' that requires the argument of who performs the act of being transferred, and the information about where the person is transferred is probably supplemental.

As we have seen, the distinction of argument (underlined) and adjunct (in parentheses) is often intuitively perceivable as we tentatively mark them differently, but it is not always easy to make this distinction in a principled way. Also note here that the argument structure of nouns in Japanese is normally realized by adnominal phrases that involve a genitive particle *no*, unlike English which has the options of pre-nominal possessives and post-nominal prepositional phrases, which makes clarifying the distinction even harder. We will return to this issue later in Chapter 6.

2.2.2 Case

Case is a system of marking dependent nouns for the type of relationship they bear to their heads (Blake, 2001). Traditionally, the term refers to inflectional marking, i.e., variation in morphological endings, as is found in Latin (nominative *homo*, accusative *hominem*, genitive *hominis*, *etc*.) In languages that lack morphological variations of this kind, the term "case" as traditionally used, does not apply. In English, for example, case is generally expressed by means of prepositions (as in 'to Jane,' 'with Jane') and word order (as in 'Jane likes John' versus 'John likes Jane'); the only morphologically marked case found in English is the genitive (as in 'John's).[4]

In Japanese, which lacks inflectional endings on nouns and permits relatively free word order, postpositions (in bold below) perform the function of case marking, as illustrated in (2.8).

(2.8)　太郎が　　庭で　　花子の　　犬と　　遊んでいる。
*Taro-**ga***　　*niwa-**de***　　*Hanako-**no***　　*inu-**to***　　*asonde-iru*.
Taro-NOM　　garden-in　　Hanako-GEN　　dog-with　　be-playing

'Taro is playing with Hanako's dog in the garden.'

[4] Pronouns realize case by means of morphological variations, as in 'he', 'him', and 'his.'

These postpositions, often called case marking particles or case markers, can be typologically classified into several groups. The first typology classifies them into two major types according to their function, whether they relate (i) a noun to a verb at the clause level, i.e., "adverbial case," or (ii) a noun to another noun at the phrasal level, i.e., "adnominal case."

Also, case markers are typically grouped either as "grammatical case" or as "semantic case." The grammatical case markers represent the grammatical relations, such as subjects or objects, while the semantic case markers bear a variety of spatial, temporal or other inherent meanings.[5] The typologies for Japanese case can be summarized as in Table 2.1 below.

	Grammatical case marker		**Semantic case marker**	
Adverbial	NOMINATIVE	*-ga*	LOCATIVE/ALLATIVE, *etc*.	*-ni*
			ALLATIVE	*-e*
			LOCATIVE/INSTRUMENTAL	*-de*
	ACCUSATIVE	*-o*	COMMITATIVE	*-to*
			ABLATIVE	*-kara*
	DATIVE	*-ni*	DESTINATIVE	*-made*
			ELATIVE/COMPARATIVE	*-yori*
Adnominal	GENITIVE	*-no*	-	

Table 2.1: Typology of case markers in Japanese

Arguments marked by the (adverbial) grammatical case markers, *ga*, *o*, and *ni*, correspond roughly to subject, object and indirect object, respectively. Note, however, that the mapping from grammatical case to grammatical function is not straightforward (e.g., Ono, 1994; Tsujimura, 1996; Obana, 2000). Subjects can be marked by non-NOMINATIVE cases, as in the phenomena termed "*Ga/No* Conversion" and "*Ga/Ni* Conversion."[6] Similarly, a NOMINATIVE case is sometimes involved in the

[5] Tsujimura (1996) calls the former category "case particles" and the latter "postpositions." She argues that they share some common features; they cannot stand by themselves, and thus are always attached to NPs. They are distinct in whether or not they bear specific semantic content. Also, case particles can often be absent in casual speech, while postpositions need to be present to retain their meanings.

[6] Examples of *Ga/No* Conversion and *Ga/Ni* Conversion from Tsujimura (1996) are presented in (a) and (b) respectively (in next page).

so-called "Double nominative construction," in which *ga* marks object.[7]

Note also that one lexical case marker is not necessarily mapped to a single specific case role (e.g., Obana, 2000). The case marker *-ni*, for example, is notorious for its multi-functionality; it needs to be disambiguated from among DATIVE, LOCATIVE, ALLATIVE, and other functions, in the context in which it occurs.

Ono (1994) summarized this mapping issue, and Obana (2000) adopted his summary, as an annular model of the distribution of the case markers (or a circular system in Ono's terminology). The diagram is reproduced, with some modification, in Figure 2.1.

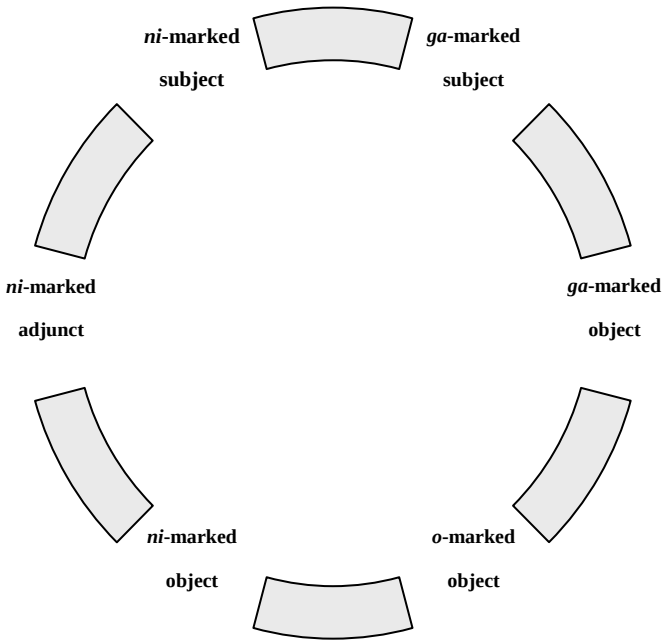


Figure 2.1: An annular model of case-to-role mapping

This model is driven by the fuzziness that lies in the mapping between grammatical

---

(a) *Taroo-ga [Hanako-ga/no kaita] e-o hometa.*
Taroo-NOM Hanako-NOM/**GEN** painted painting-ACC praised
'Taro praised that painting that Hanako drew.'

(b) *Dare-ga /ni sonna koto-ga dekiru no?*
who-NOM/**DAT** that sort of thing-NOM be able to do Q
'Who can do such a thing?'

[7] An example of double nominative construction also from Tsujimura (1996) is (a), in which the verb *dekiru* "be competent" marks its direct object with the nominative case particle.

(a) *sono-gakusei-ga suugaku-**ga** dekiru.*
that student-NOM math-**NOM** be competent
'That student is good in math.'

Another verb *wakaru* "understand," among others, may take this construction.

function and surface case. It suggests that they are not in a simple one-to-one relation, but rather form a non-discrete distribution in a circular fashion.

Another issue to be noted here is that grammatical case markers and semantic case markers are given distinct syntactic treatments in the generative framework. Semantic case markers (i.e., postpositions) are treated as a lexical category that constitutes an independent node in a phrase structure tree. Grammatical case markers, in contrast, are analyzed as part of NPs; case assignment is done by an external source, such as verbs, and case particles are attached to NPs. Some researchers, such as Hosokawa (1991) and Fukuda (1993), however, follow the notion of "functional category" discussed in Fukui (1986) and Abney (1987) and regard case particles as an independent node that constitutes Kase Phrase (KP).

In this study, we will treat both grammatical and semantic case markers uniformly as a lexical category (head) that constitutes what we call **Particle Phrase (PP)** primarily because they both have overt lexical realization and determine the relation of the argument phrases to their predicates.

2.2.3 Headness

The notion of "head" plays an important role in many syntactic theories that configure, for example, "argument structure" that consists of a head and its arguments (e.g., Jackendoff, 1977), "phrase structure" that is made up of a head and its modifiers (e.g., Haegeman, 1994) and "dependency structure" that comprises a head and its dependents (e.g., Hudson, 1984). A linguistic unit at various structural levels, like a sentence, a clause, or a phrase, usually consists of a core element, referred to as "head," and its peripheral elements.

The notion of a syntactic head is used in generative syntax (e.g., GB), for determining a parametric typology in terms of the order of the head in relation to its modifiers. This so-called head parameter classifies Japanese as a head-final language, in contrast to a head-initial language like English. Japanese generally places the head at the end of its whole unit as illustrated in (2.9) below.

(2.9) a. *Taro-no*
Taro-GEN
NP (argument) + particle (**head**) = [particle phrase: PP]

b. *Taro-no ani*
Taro-GEN brother
PP (argument) + NP (**head**) = [noun phrase: NP]

c. *Taro-no ani-ga*

Taro-GEN brother-NOM
NP (argument) + particle (**head**) = [particle phrase: PP]

d. *Taro-no ani-ga kita*
Taro-GEN brother-NOM come-PAST
PP (argument) + V (**head**) = [clause]

Particles are always placed after nouns within PPs, as in (a) and (c); nominal modifiers,[8] including adnominal PPs, precede nouns, as in (b), and verbs appear at the end of the clauses, as in (d).

2.2.4 Definiteness

The notion of definiteness is also an important property of noun phrases, which allows a contrast between an entity that is specific and identifiable (i.e., definite) and one that is not (i.e., indefinite).[9] This contrast is generally conveyed through the use of particular language-specific descriptions.

Definite descriptions in English include noun phrases with the definite article 'the,' such as 'the car,' or with other definite determiners, such as 'this car,' and genitive constructions, such as 'John's car,' and (personal and possessive) pronouns, such as 'it' and 'his (car).'

(In)definiteness is prototypically marked by the use of definite/indefinite articles in English (and other languages that have a binary article system, such as French, Norwegian, Hungarian, and Hebrew), as contrasted in 'the car' and 'a car.'[10] Definite NPs in English have been extensively researched by linguists (e.g., Clark, 1977; Hawkins, 1978; Lyons, 1999) and by computational linguists (e.g., Bean and Rilloff, 1999; Vieira and Poesio, 2000a, b, c), and various classifications of their use have been proposed (see Vieira, 1998 for a comprehensive summary). Let us present here the classification made by Vieira and Poesio (2000b), as an example. The four major groups they proposed are given below with a brief definition (from pages 191-192).

(i) **Anaphoric same head**: the description refers to an entity explicitly given in the text and by means of a same head noun.

[8] Other types of modifiers, such as adjectives and relative clauses, always precede nouns, as well.

[9] Prince (1992) claims that definiteness is also seen as "a conceptual property of entities in a discourse model" (page 299), suggesting that the definite/indefinite distinction is "an approximate marking of Hearer-status (Hearer-old or Hearer-new)" (page 304).

[10] Some languages have only a definite article (e.g., Greek, Arabic) or just an indefinite article (e.g., Chamorro). A large group of languages lack both definite and indefinite articles (e.g., Japanese, Korean, Chinese, most Slavic languages) (Zlatic, 1997).

(ii) **Associative**: the description refers to an associated entity (trigger) that is explicitly given in the text.[11]

(iii) **Larger situation**: the description refers to an entity or event whose existence is of common knowledge.

Unfamiliar: the interpretation of the description is based on additional information attached to the definite NP.

(iv) **Idiom**: part of idiomatic expressions.

Given these definitions and the examples in English they provide, we attempt to examine the Japanese counterparts to English definite NPs, summarized in Table 2.2 below (next page).

[11] The description may refer to the same entity as the antecedent or to an associated one. The antecedent may be a noun phrase (NP) as well as an even represented by a verb phrase, a sentence or even a larger sequence of text.

	Classification	Japanese examples	Linguistic options in Japanese
(i)	**anaphoric** (same head) "directly co-referring"	*hon – sono hon* 'book – the book'	demonstrative adjective + NP
		hon – hon 'book – Ø book'	bare NP
		hon – sore 'book – it'	demonstrative pronoun
		hon – Ø 'book – Ø'	ZERO
(ii)	**associative** (different head / same entity) "indirectly co-referring"	*haadokabba – sono-hon* 'hardcover – the book'	demonstrative adjective + NP
		haadokabaa – hon 'hardcover – book'	bare NP
	associative (different entity) "bridging"	*hon – sono hyosi* 'book – the cover'	demonstrative adjective + NP
		hon – hyosi 'book – cover'	bare NP
		kaisya – Ø (*syain*) 'company – Ø (employee)'	ZERO
(iii)	**larger situation**	*kookyo* 'Imperial Palace'	bare NP
	unfamiliar	*toosann-no uwasa* 'rumor about bankruptcy'	pre-nominal phrase/clause + NP
(iv)	**idiom**	*hone-o oru* 'lit. break bone, take pains'	bare NP

Table 2.2: Classification of definite descriptions in Japanese

There seem to be three linguistic options in Japanese for marking definiteness. The most common lexical device for definiteness in Japanese (and in many other "article-less" languages) is the use of demonstratives that have both anaphoric and deictic functions. As is apparent, the prototypical definite descriptions in Japanese seem to be bare NPs, in addition to a total ellipsis, i.e., ZEROS. Sakahara (2000) points out that there is a strong resemblance between definite NPs in English and bare NPs in Japanese in their behaviors, especially in their referential properties.

Turning now to other more explicit types of definite descriptions, demonstrative adjectives *kono* and *ano* are approximately equivalent to definite adjectives 'this' and

'that' in English.[12] Personal pronouns, such as *kare* and *kanzyo*, are quite constrained in their usage, and ZEROS are normally used in their place; the same is true of possessive pronouns. A demonstrative pronoun *sore* is used only for non-human (either individual or event) entity.

In sum, with the exceptions of some explicit definiteness markers such as demonstrative adjectives/pronouns and pre-nominal genitive phrases, the two major marker-less constructs, i.e., ZEROS and bare NPs, linguistically realize Japanese definite descriptions. Tricky is the fact that bare NPs are also used as "indefinite" descriptions. Therefore, determining definiteness (with non-lexical means) of Japanese noun phrases is an important task in Japanese discourse processing in general (e.g., Heine, 1998; Bond, Ogura, and Kawaoka, 1995; Bond, 2001; Murata and Nagao, 1993),[13] as well as in our computerized system, *ZD*. We will return to this issue later (in 2.4.1.2 and Chapter 6).

2.3 Definition of ZEROS

As we mentioned earlier in section 2.1, ellipsis is defined as unexpressed elements that are required by the grammar. Many types of ellipsis are possible across languages, such as VP-ellipsis in English (Kehler, 2002) and particle ellipsis in spoken Japanese (Maruyama, Hashimoto and Kuwahata, 1996; Fry, 2002). This paper, however, limits its scope to the omission of "arguments" in a "head-argument" construction (see 2.2.1 and 2.2.3). This includes: (i) omitted argument(s) to the head verb within a clause, and (ii) omitted argument(s) to the head noun within a noun phrase construction. In both cases, the arguments are realized as Particle Phrases (PPs). In other words, we limit the scope of arguments to obligatory elements in the form of a particle phrase (PP), excluding particle-less arguments, such as adverbial phrases and pre-copula NPs.[14] Further, we limit the range of particles in PPs to grammatical case markers (see 2.2.2). The omission of heads, realized as VP-ellipsis and particle drop, is also beyond the scope of this thesis.

We will use, throughout the thesis, "zero arguments" or "ZEROS" for short, as a general term that refers to ellipsis of the two argument types that we define, and use the

[12] The distinction among three demonstrative adjectives, *kono*, *ano*, *sono*, in terms of their functions and distributions is an active area of linguistic research, but we will not go into further details here.

[13] Their interests are in machine translation of Japanese into languages that require definite/indefinite determiners for nouns.

[14] Pre-copula NPs are never elided in discourse anyway.

separate terms, "zero verbal arguments" and "zero nominal arguments,"[15] when the distinction is necessary. Detailed descriptions of each type will be presented in 2.4.1.

Zero arguments represent "invisible" entities that discourse participants expect to be present for a clause or a noun phrase to make sense in a given context. Therefore, they are "definite" in nature (see 2.2.4). Native speakers find no difficulty in interpreting those ZEROS, or in comprehending a whole discourse that contains ZEROS, although they may encounter some ambiguous cases where they need to request clarification in conversation,[16] or to read again for reconfirmation in reading.

Ellipsis as in this definition has been termed in various ways in the literature: simply "ellipsis" by Clancy (1980), "argument ellipsis" by Nariyama (2000), "null anaphora" by Tsujimura (1996), "empty pronoun" by Huang (1984), and "zero pronoun" by Walker, Iida and Cote (1994) among others, to name just a few. All these terms refer to virtually the same phenomenon that this thesis is concerned with, though these researchers seem to attend mostly to zero verbal arguments only. Our emphasis, however, will rather be on a less-acknowledged type, zero nominal arguments, for the rest of the thesis, particularly because this type of zero argument has not been as fully explicated as the other type in previous research, and nor has it been treated sufficiently in the centering framework, despite its significant role.

2.4 Typology of ZEROS

2.4.1 Argument types

Given our definition of ZEROS, this section provides some typological classifications of ZEROS. First, in this section, we will present the classification of ZEROS, based on their argument types. Arguments, as we discussed earlier in 2.2.1, are elements that their head predicates require. Thus, the following distinction is made according to their predicate types: verbs or nouns.

2.4.1.1 Zero verbal argument

The first type of ZERO is defined as "zero verbal arguments." As the term implies, these ZEROS are defined as unexpressed arguments that their head verbs are required to take. They are, in other words, elements predictable from the argument structure of

[15] In Yamura-Takei (2003), we call this type "zero adnominal" but it is rephrased in this thesis as "zero nominal argument" to make it parallel to "zero verbal argument."

[16] Request for clarification, such as "*dare-ga* (who does?)" or "*nan-no* (of what?)," is quite common in casual conversation among native speakers.

the verbs with which they occur. This is exemplified in (2.10) and (2.10').

(2.10)	昨日	カレーライスを	食べた。
	kinoo	*kareeraisu-o*	*tabe-ta.*
	yesterday	curry-and-rice-ACC	eat-PAST

The syntactic argument structure of the verb *taberu* 'eat' requires a nominative argument as well as an accusative argument. This implies the presence of a ZERO "*Ø*-(*ga*)" in the sentence (2.10), as indicated in (2.10'). We call this ZERO type the "zero verbal argument."

(2-10')	*kino*	*Ø*-(*ga*)	*kareeraisu-o*	*tabe-ta.*
	Yesterday	Ø-NOM	curry-and-rice-ACC	eat-PAST

'Yesterday, Ø ate curry and rice.'

Zero verbal arguments can be further subdivided, according to their case roles, into several types: zero nominative, zero accusative, and zero dative. Zero nominative, for instance, is indicated as Ø-NOM in examples.

2.4.1.2 Zero nominal argument

The second type of ZERO is the "zero nominal argument," i.e., ellipted arguments to their head nouns. Recall our earlier discussion on definiteness in 2.2.4. We stated that one class of definite descriptions in Japanese is linguistically realized by ZEROS. These ZEROS correspond to our first type of ZEROS, i.e., zero verbal arguments.

Recall also that Japanese does not exhibit an article system and, consequently, there appears to be a strong resemblance between definite NPs in English and bare NPs in Japanese in terms of their behaviors, especially in their anaphoric functions. Associative anaphora, in addition to same-head anaphora, is realized by a definite NP in English and a bare NP in Japanese, as contrasted in (2.11).

(2.11)	a.	There is a house.	The roof is red.
	b.	*ie-ga aru*.	*yane-wa akai*.

The relationship between the two entities, *ie* 'house' and *yane* 'roof" can be explained by lexical association. This is a prototypical approach to this phenomenon in the literature, which has been variously described as, inter alia, "bridging" (Clark and Haviland, 1977), "associative anaphora" (Hawkins, 1978), "inferables" (Prince, 1981), "accommodation" (Heim, 1982), "indirect anaphora" (Erkü and Gundel, 1987),

"semantic cohesion" (Fais, 2004) and "textual ellipsis" (Hahn, Strube, and Markert, 1996).

This phenomenon, on the other hand, can also be interpreted as a missing link that connects the entity *yane* to its antecedent *ie*. In other words, the entity *yane* has an implicit argument that is directly linked to an entity in the previous utterance. Notice that the second utterance, (2.11b), alone is grammatically appropriate, but semantically incomplete. The noun *yane* 'roof" calls readers' attention to "of-what" information and readers recover that information in the flow of text. That missing information can usually be supplied in Japanese by an NP (i.e., 'house,' in this example) followed by a genitive (adnominal) particle *no*, as in (2.11').

(2.11') *Ø*-(*no*) *yane-wa* *akai.*
Ø-(GEN) roof-TOP is-red

'(The house's) roof is red.'

The second entity has an unexpressed argument that in fact makes a direct reference to the entity in the previous utterance. We will take this "zero genitive" approach to treat what is elsewhere called "bridging" or the many other terms listed above.

There are several reasons for this decision. This treatment is chosen primarily because we attend to the notion of argument structure that both verbs and nouns inherently bear; the verbal and nominal arguments are realized in the form of PPs in Japanese. We have also based our decision on insights from Löbner's (1985, 1998) discussion on functional concepts of nouns. He argues that some nouns are defined as "semantic definite" if they "represent a functional concept, independently of the particular situation referred to" (1985, page 299) and they take obligatory arguments, which are often left implicit, as in (2.12) (underlining is ours).

(2.12) Fred discussed a book in his class yesterday. He knows the <u>author</u>.

This is an example of "associative anaphoric use" of Hawkins (1978) and also of Vieira and Poesio (2000). We have also been inspired by Löbner's view of this phenomenon as an "implicit argument" which is virtually equivalent to zero argument.

Secondly, the recognition of this type of ZEROS leads to a more accurate characterization of coherence in the centering framework, which will be discussed in detail in Chapter 4. Since Hahn, Markert and Strube (1996) argued that what they call "textual ellipsis" had only been given insufficient attention, as opposed to the clearer notion of direct realization, several attempts have been made to incorporate indirect anaphors into the centering framework. In order to make this attempt successful in centering work in Japanese, we assume that our "zero nominal argument" approach

works better than so-called “associative” approach for this characterization - at least for a ZERO-prone language like Japanese. In addition, zero nominal arguments have been rather neglected in the past ZERO research in general.

Lastly and most importantly, we prefer this treatment because we need to present referential links (that constitute discourse coherence) as clearly as possible for the pedagogical purposes that will later be discussed fully in Chapter 7. We assume that placing ZEROS will be more recognizable than indicating lexical associations between the two entities involved, in order to help establish coherent relations.

Actually for Japanese, some computational work has already been done on so-called indirect anaphora. Murata, Isahara and Nagao (1999) and Murata and Nagao (2000), for example, present their attempt to construct a noun case frame dictionary by using A *no* B examples, for the purpose of analyzing indirect anaphora. In a similar spirit, Kawahara, Sasano and Kurohashi (2004) view indirect anaphors as “zero anaphors of nouns” and exploit nominal case frames for the resolution of such anaphoric relations.

In addition to unexpressed nominal arguments, we include in the coverage of “zero nominal arguments” the Japanese counterparts of possessive pronouns in English, which are frequently realized by ZEROS, partly due to the constrained nature of lexical pronouns in Japanese.[17] Look at the following discourse (2.13)-(2.14).

(2.13) 花子は いつも おしゃれだ。
Hanako-wa *itumo* *osyare-da.*
Hanako-TOP always fashionable-COP

‘Hanako is always fashionable.’

(2.14) a. Ø 服は ブランドものばかりだ。
(Ø-no) *huku-wa* *burando-mono-bakari-da.*
(Ø-GEN) clothes-TOP brand-name-item-only-COP.

‘(Ø ‘her’) clothes are all brand-name items.’

b. 彼女の 服は ブランドものばかりだ。
kanojyo-no *huku-wa* *burando-mono-bakari-da.*
her clothes-TOP brand-name-item-only-COP.

‘Her clothes are all brand-name items.’

[17] Kameyama (1985) states that overt pronouns are used for contrast, emphasis, or focus (page 30).

c. 花子の 服は ブランドものばかりだ。
Hanako-no *huku-wa* *burando-mono-bakari-da.*
Hanako-GEN clothes-TOP brand-name-item-only-COP.

'Hanako's clothes are all brand-name items.'

All three variants in (2.14) that could follow the utterance (2.13) are grammatical, but are not equally natural as part of the discourse. The most natural sounding is the (2.13)-(2.14a) sequence; (b) is possible, but domain-specific and not as natural as (a), and (c) sounds rather awkward because of the redundant repetition of names. The type of ZERO represented in (a) is also included in our definition of zero nominal arguments.

In sum, we regard an unexpressed 'NP *no*' phrase in the NP *no* NP (a.k.a., A *no* B) construction as our second type of ZERO. Our definition of zero nominal arguments covers the two phenomena often treated distinctively in the study of English (and some European languages): possessives and (subset of) associative definite descriptions.

The relationship established by a genitive (adnominal) particle *no* that links the A noun and B noun is not limited to possession, but exhibits a wide variety of relations, as we will see later in the next section. Note, though, that however wide the variety of relations may be, this construction does not cover all the phenomena that are categorized in the literature as "associative." We limit the coverage of zero nominal arguments to what is possible in the A *no* B construction when they are made "visible." An antecedent-head noun pair, 'Titanic'-'passengers' is one example, because Titanic-*no* passengers are semantically possible. Examples of associative relations between the two entities that are exempt from our definition of zero nominal arguments include: (i) different head-same entity association, such as 'Titanic - passenger boat,' (ii) knowledge-driven association, such as 'Titanic - iceberg,' and (iii) lexical relatedness, such as 'boat - harbor.'

2.4.1.3 Nominal argument

This subsection presents some characteristics of nominal arguments in Japanese, in terms of both the surface (syntactic) realization and the semantic relations they bear. We will use some data both from our earlier corpus study (Yamura-Takei and Fais, ms.), which closely examined the A *no* B construction, i.e., NPs with "explicit" nominal arguments, found in a corpus of Japanese email[18] and from examples found in our corpus (see Chapter 4 for a detailed description of the corpus).

[18] This is the corpus whose portions were used in Fais and Yamura-Takei (2003) in which a description of the nature of the corpus can be found.

Syntax of the nominal argument

In contrast to English that exhibits several types of surface realization for nominal arguments, Japanese allows only a single construction, i.e. adnominal phrases, NPs followed by an adnominal particle *no*, as illustrated in (2.15).

(2.15) ジョンの車
John-no kuruma
John-GEN car

'John's car'

Although they are basically instances of one single construction, there are two cases in which A *no* B phrases are not as simplex as the example (2.15).

One case involves the inclusion of other particles attached to an adnominal particle. This type of A *no* B phrase can arise in two ways. In example (2.16), the particle (underlined) simply adds semantic information to the phrase in a fairly transparent way.

(2.16) 市原での ジェフ VS アントラーズ
itihara-de-no *jehu vs antoraazu*
Ichihara-in-GEN JEF vs. Antlers

'JEF vs. Antlers match in Ichihara'

The information provided by such a particle can also be helpful in avoiding semantic ambiguity; (2.17) is an example in which *kara* 'from' helps identify Mr. Y as the source and not the possessor of the mail.

(2.17) Y−部長からの メール
Y-butyo-kara-no *meeru*
Y-manager-from-GEN mail

'mail from Mr. Y, the manager'

These examples comprise only a small portion, about 4% of the total number of A *no* B phrases (21 in number) in the email corpus, and involve six different particles. Our corpus contains only seven such examples (0.8%).

A second more complex example of this construction concerns multiple constituent examples (A *no* B *no* C…). There are cases in which more than two nominals are joined by *no*'s, as in (2.18).

(2.18) a. プレーヤーの　容姿の　問題
pureiyaa-no　*yoosi-no*　*mondai*
player-GEN　appearance-GEN　problem

‘a problem of the player’s appearance’

b. タベの　テニスの　試合
yuube-no　*tenisu-no*　*siai*
last night-GEN　tennis-GEN　match

‘last night’s tennis match’

These phrases can be bracketed until they are reduced to combinations of phrases containing only two elements (cf. Barker and Szpakowicz, 1998), as illustrated in (2.19).

(2.19) a. ((プレーヤーの 容姿)　の　問題)
((player *no* appearance)　*no*　problem)
‘((the player’s appearance)　problem)’
((A *no* B) *no* C)

b. (タベの　(テニスの　試合))
(last night *no*　(tennis *no*　match))
‘(last night’s　(tennis　match))’
(A *no* (B *no* C))

Note that these two examples of multiple constituents differ from each other in terms of the semantic dependency relations among the constituents of the phrases. Each of these subphrases is assigned an appropriate semantic labeling (see next part).

Further, these types of phrases could contain up to as many constituents as logically possible. Table 2.3 below (next page) gives the frequencies of the types of multiple constituent examples in the email corpus and in our corpus.

The simplest construction comprises the majority in both corpora, but its potential multiplicity has also proven empirically valid.

Multiplicity type	# (%)	
	Email corpus	Our corpus
A *no* B	497 (86.74%)	675 (88.75%)
A *no* B *no* C	68 (11.87%)	86 (11.15%)
A *no* B *no* C *no* D	5 (0.87%)	10 (1.30%)
A *no* B *no* C *no* D *no* E	3 (0.52%)	0 (0.00%)
Total	573 (100%)	771 (100%)

Table 2.3: Frequencies of multiple constituent A *no* B phrases in the two corpora

Semantics of the nominal argument

We have seen that virtually all nominal arguments in Japanese are realized by a single linguistic construct (with the two minor syntactic variations mentioned above), unlike those in English and some other European languages. When it comes to semantic relations, on the other hand, the relationship established by a genitive (adnominal) particle *no* that links the A noun and the B noun is not limited to possession, but exhibits a wide variety of relations. In order to examine the variety of relationships holding between the zero nominal argument noun and its head noun, i.e., (A *no*) B, we use an existing A *no* B classification scheme. We adopted, from among many approaches to the categorizations of A *no* B phrases, a classification proposed by Shimazu, Naito and Nomura (1985, 1986a, 1986b, and 1987, henceforth SNN) who made an extensive analysis of the possible relationships holding between the two entities, A and B.[19] SNN extracted 3,810 A *no* B phrases from a corpus of ten articles from a journal, *Science*, averaging about 200 sentences and 24,750 characters per article. They classified these examples into five main groups according to the semantic dependency relations between the elements of the phrases.

It is important to note that our labeling differs from that of SNN in one significant way. The categories figuring in the labeling of SNN rely largely on semantic definitions of relationships. We opted to make our labeling syntactic as far as possible instead of strictly following SNN in this regard.

Table 2.4 (next page) describes the five main groups that we used to categorize (A *no*) B phrases, modeled on SNN, and the examples listed from SNN research give an indication of the wide variety of relations that are possible.

[19] This is the scheme also adopted in the email corpus study in Yamura-Takei and Fais (ms.). We will present some comparative data concerning semantic relations from this corpus later in Chapter 6.

Group	Definition	Examples from Shimazu *et al*. (1986)
I	A: argument B: nominalized verbal element	*kotoba no rikai* 'word-*no*-understanding'
II	A: noun denoting an entity B: abstract relational noun	*biru no mae* 'building-*no*-front'
III	A: noun denoting an entity B: abstract attribute noun	*hasi no nagasa* 'bridge-*no*-length'
IV	A: nominalized verbal element B: argument	*sanpo no hutari* 'strolling-*no*-two people'
V	A: noun expressing attribute B: noun denoting an entity	*ningen no atama* 'human-*no*-head'

Table 2.4: (A *no*) B classification scheme

In the examples in Group I, B is the nominal form of a verb and A fills some argument role (obligatory or optional) with relation to B. The reverse is true for Group IV, in which A is a nominalized verbal and B fills an argument position. When the argument is the subject, for example, then, the meaning of these expressions may be preserved in the paraphrasing "A does B" (Group I) or "B does A" (Group IV). Where the argument is the object, they may be paraphrased as "(someone/something) Bs A" (Group I) or "someone/something As B" (Group IV), and so on for other possible argument roles.

Group II and III were not possible to define strictly syntactically. While A in both Groups denotes an entity, the B nouns fall into two particular semantic categories. In Group II, B is a member of a particular class of nouns that specify relational properties. Group II B nouns are examples of what are called in the literature *keisiki-meisi* 'formal nouns,' *sootai-meisi* 'relative nouns' or *kankei meisi* 'relational nouns' (e.g., Inoue, 1976). In Group 3, on the other hand, B is an attribute noun, and Group III examples can be paraphrased as "A has (some quality) B."

In both Groups, the B nouns are nouns that are generally not used alone; Group II B nouns, in fact, include some nouns that never occur alone (*ken* 'matter,' and *hoo* 'direction'). While some other B nouns in both Groups II and III are morphologically independent, they are semantically insufficient by themselves, requiring arguments to complete their meaning. Thus, *omosa* 'weight,' or *kaori* 'smell' (Group III B nouns) require an argument to specify "weight of what?" or "smell of what?" These nouns are similar to relational or bivalent nouns in English such as 'mother,' which require the specification of an argument denoting the entity of which 'mother' is the mother.

In Group V, both A and B are generally concrete nouns and they can be thought of as being related by a "hidden" predicate (Torisawa, 2001a). Subdivisions made by SNN refer to particular semantic relationships holding between the two nouns. Examples comprise relationships involving humans and organizations such as "possession" and "belong-to;" they may be thought of in terms such as "A is the possessor of B," "B is a member of A," and so on. Other examples may be paraphrased as "B is A," and "B is in/at/from …A."

This characterization of each Group plays a crucial role in the recognition of zero nominal arguments; we will discuss how we apply this to the recognition algorithm in Chapter 6.

2.4.2 Referent types

ZEROS can also be subdivided into groups according to the types of their referents, and several sets of taxonomy have been proposed. The most basic classification may be the one made by Halliday and Hasan (1976, page 33), who divide referents into two main types: "exophora" that has no mention of its referent in the text, and "endophora" that has an overt referent in the text. Endophora is further divided into two subtypes in terms of the location of the referent: "anaphora" whose referent appears in the preceding text and "cataphora" whose referent is found in the following context.

Here, we adopted the taxonomy used in Fais and Yamura-Takei (2003) which examined a Japanese email corpus. The classification used there, consisting of eight subtypes (highlighted), can be schematically incorporated into Halliday and Hasan's hierarchy, as in Figure 2.2.

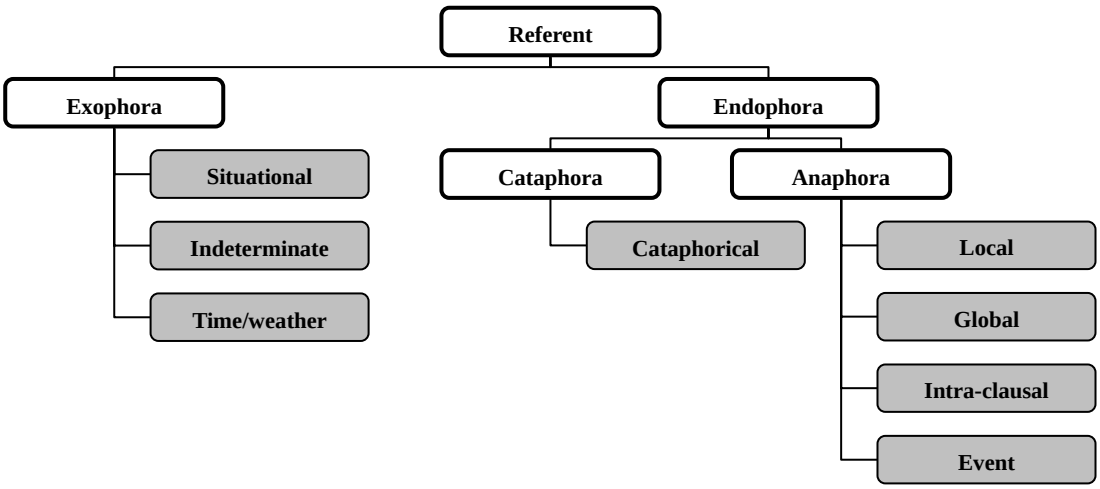


Figure 2.2: Taxonomy of ZERO referent types

In what follows, we will give a brief description of each type, along with some discussion of relevant typological work in the literature. Examples for each reference type will be presented later in Chapter 4.

2.4.2.1 Local reference

"Local reference" indicates ZEROS whose referents can be found locally, i.e., in the immediately preceding utterance.[20] This is the most straightforward case of reference. A number of studies indicate that the referents of ZEROS (or pronouns) tend to be found in the immediately adjacent utterance (e.g., Hobbs, 1978).[21] When there are some competing candidates for the referent within the utterance, semantic information, such as semantic properties of the arguments and the valency requirements of the verb, usually come into play in order to allow a felicitous interpretation.

2.4.2.2 Global reference

"Global reference" is the case in which the ZERO needs to "reach" for its appropriate referent beyond the previous utterance.[22] That is, none of the entities supplied in the immediately preceding utterance are correct referents, and a global search for a correct one is required. Hitzeman and Poesio (1998) reported that "long distance pronominalization" is not rare (8.4% of the total) in descriptive oral texts. Quite a few studies have also discussed this phenomenon observed for Japanese ZEROS (e.g., Takada and Doi, 1994; Okumura and Tamura, 1996; Iida, 1998; Yamura-Takei, Takata, and Aizawa, 2000).

There is no limit to how long the reach is, as long as the referent is in the text. According to the result in Fais and Yamura-Takei (2003), the distance varies from two to eleven utterances, with an average of 3.35; the majority of "global" references are to antecedents that are two or three clauses away.

2.4.2.3 Cataphorical reference

"Local" and "global" types refer to entities in the previous context. There are also references to entities in the subsequent discourse. This type of reference is called

[20] We combine in this category what Fais and Yamura-Takei (2003) define as ZEROS that can be resolved by "centering mechanisms" and those by "centering mechanisms supplemented with semantic information." The referents in both types are locally available (a detailed discussion of centering is given in Chapter 3).

[21] Hobbs (1978) found that 98% of pronoun antecedents in the English corpus examined were either in the same sentence as the one in which the pronoun is located or in the previous one.

[22] Fais and Yamura-Takei (2003) term this type "long distance" reference.

"cataphorical." Cataphora, also called backward anaphora, as a phenomenon, is observed in English, as exemplified in the utterances in (2.20) that show the cataphoric function of 'this' and 'here' respectively.

(2.20) a. This is my suggestion. First, we should …

b. Here is the 7 o'clock news. Prime Minister Koizumi …

Pronouns can also function as cataphorical referring expressions, as in (2.21).

(2.21) When she entered the room, Jane looked ill.

Cataphora is not rare in Japanese, as well. Certain classes of demonstratives are used as cataphoric expressions, as in (2.22).

(2.22)	こんな方法が	ある。	まず、・・・
	konna hoohoo-ga	*aru.*	*mazu, …*
	this-kind-of method-NOM	be.	first, …

'There is a method like this. First, …'

As the example (2.22) is roughly equivalent to (2.20), there is also a construction corresponding to (2.21) found in Japanese, as in (2.23).

(2.23)	Ø	部屋に	入ると、	太郎は	踊りはじめた。
	(*Ø-ga*)	*heya-ni*	*hairu-to,*	*Taro-wa*	*odori-hazime-ta.*
	(Ø-NOM)	room-in	enter-and,	Taro-TOP	dance-begin-PAST.

'When (he) entered the room, Taro began dancing.'

Here, a zero argument in the preceding clause makes a forward reference to a first-mentioned name in the second clause. Compare this with (2.24), in which a lexical pronoun is used instead of a ZERO.

(2.24)	彼が	部屋に	入ると、	太郎は	踊りはじめた。
	kare-ga	*heya-ni*	*hairu-to,*	*Taro-wa*	*odoji-hazime-ta.*
	he-NOM	room-in	enter-and,	Taro-TOP	dance-begin-PAST.

'When he entered the room, Taro began dancing.'

Normally and intuitively, the overt pronoun *kare* in the first clause and the named entity

Taro cannot be interpreted as co-referential in Japanese; *kare* is likely to refer to another entity previously appearing in the context, unlike the English example in (2.21).

This subordinate-main clause construction is the prototypical environment in which cataphoric use of ZEROS appear.

2.4.2.4 Intra-clausal reference

There are ZEROS that refer to entities within the same utterance.

(2.25)	花子が	成績を	心配している。
	Hanako-ga	*(Ø-no) seiseki-o*	*sinpai-site-iru.*
	Hanako-NOM	(Ø-GEN) grade-ACC	worring-do-PRES.

‘Hanako is worried about (her) grades.’

In this example, what Hanako is worried about is naturally interpreted as her own grades, which is realized by a zero genitive co-referring intra-clausally with the subject Hanako. This type of reference has typically been studied in the literature as “reflexives” or “reflexive pronouns.” A ZERO in (2.25) can be replaced by a reflexive pronoun *zibun* ‘self.’[23]

2.4.2.5 Event reference

Pronouns in English may refer to propositions or events, and so may demonstratives, as shown in example (2.26) taken from Gundel, Hedberg, and Zacharski (2002).

(2.26) John insulted the ambassador. It/that happened at noon.

They can make reference to non-NP constituents, such as VPs, clauses, strings of clauses, and sometimes a whole paragraph. This also applies to ZEROS or demonstrative pronouns (such as *kore*) in Japanese, as in (2.27). We call this type “event reference.”[24]

[23] Unlike in English, however, the referent of *zibun* is restricted to animate entities.

[24] This phenomenon has been studied extensively under the name of “discourse deixis” (Webber, 1991), “deictic anaphora” (Eckert and Strube, 1999), and “reference to higher order entities” (Gundel, Borthen, and Fretheim, 1999), among others.

(2.27) a. 太郎は 花子のために 送別会を 開きたかった。
Taroo-wa Hanako-no-tame-ni soobetukai-o hiraki-takkat-ta.
Taro-TOP Hanako-for farewell party-ACC hold-want-to-PAST

'Taro wanted to hold a farewell party for Hanako.'

b. しかし、 これは/Ø 実現しなかった。
sikasi, kore-wa/(Ø-ga) *zitugen-si-nakat-ta.*
but, this-TOP/Ø-NOM realization-do-NEG-PAST

'But this/Ø did not happen.'

A zero nominative, as well as a demonstrative pronoun *kore*, in (b) refers to the proposition described in (a).

2.4.2.6 Situational reference

Up to this point, we have been concerned with reference for "textually evoked entities" (Prince, 1981), i.e., the referents do exist in the text. However, there is also a case in which the appropriate reference is not to an entity represented in the text, but to an entity existing in the situation surrounding the discourse, the social context, or the world knowledge of the participants. Such entities are called "inferables" or "situationally-evoked" entities in the terminology of Prince (1981). The act of referring to these entities instantiates them in this set of local discourse entities (Webber, 1991). It requires an articulated model of world knowledge and of the situation of discourse to interpret them fully. We call this type of reference "situational" reference; (2.28) contains a typical example.

(2.28) a. 太郎は タクシーから 降りるとき、
taro-wa takusii-kara oriru-toki,
Taro-TOP taxi-out of get-out-when

'When Taro got out of the texi,'

b. Ø Ø チップを 渡しわすれた。
(Ø-ga) (Ø-ga) tippu-o watasi-wasure-ta.
(Ø-NOM) (Ø-DAT) tip-ACC give-forget-PAST

'(He) forgot to give (the driver) tip.'

Here, a zero nominative in (b) makes a "local" reference to an entity *Taro* in (a). A zero dative in (b), on the other hand, is not likely to be co-referential with any locally found entity itself (i.e., taxi), but rather, 'the taxi driver' in (b) is inferred from the world knowledge. More precisely put, it is inferred from the knowledge of the relevant script, namely "a taxi script" triggered by the mention of a certain entity, i.e., taxi.[25] We call this type "situational reference."

2.4.2.7 Indeterminate reference

Example (2.29) contains typical instances of ZEROS that are labeled "indeterminate reference."

(2.29) a.

昔は	Ø	よく	餅つきを	したが、
mukasi-wa	*(Ø-ga)*	*yoku*	*motituki-o*	*si-ta-ga,*
olden times-TOP	(Ø-NOM)	often	rice-cake-making-ACC	do-PAST-but

'In olden times, (they) often used to make rice cakes, but'

b.

最近は	Ø	めったに	Ø	みかけない。
saikin-wa	*(Ø-ga)*	*mettani*	*(Ø-o)*	*mikake-nai.*
nowadays-TOP	(Ø-NOM)	seldom	(Ø-ACC)	see-NEG

'these days, (you) seldom witness (it).'

Both (a) and (b) contain a zero nominative of this type; the referent for this type of ZEROS is some generalized agent, i.e., it is not a particular, previously occurring NP. The cultural knowledge about the custom of rice cake making, in the case of (a), may help narrow down the scope of agents from people in general to Japanese people (or people of a country that has the custom), but it is far from specific. This type of reference is typically translated as 'you' or 'they' in English. Gundel, Hedberg and Zacharski (2002) call this type "vague inferables," which are "loosely referential" and refer to people in general.

These examples are similar to those cases in which the antecedent is supplied by the contextual situation (see 2.4.2.6). However, in the latter case, there is enough information to supply a particular referent, whereas in the case of indeterminate reference, the antecedent can only be identified as some general class of entities, rather than as one entity in particular.

In spite of this definitional distinction between "situational" and "indeterminate,"

[25] Nissim (2001) describes this type of pronouns as "roles" (page 69).

however, there seems to be a continuum from clearly referential inferables to non-referential inferables, or more precisely, from a person who can be inferred from a given situation to people in general (Gundel, Hedberg and Zacharski, 2002). Hence, it is sometimes difficult to label these two types of reference, especially when instances seem to fall in the middle of the continuum.

Note, however, that "indeterminate" reference is generally made to human entities, mostly agents, while "situational" reference is not limited to those.

2.4.2.8 Time/weather

Time and weather statements, for example, 'It is 3:00' or 'It is hot,' require a dummy or expletive 'it' in their subject positions in English. This non-anaphoric pronoun is often termed "pleonastic." Its Japanese counterparts are often classified as subject-less sentences in the literature (e.g., Obana, 2000), and are differentiated from zero-subject constructions. This type of ZEROS, although they are non-referring, has been included for the sake of completeness.

(2.30) a.

Ø	春休みに	なったら、
(Ø-ga)	*haruyasumi-ni*	*nat-ta-ra,*
(Ø-NOM)	spring break-ALL	become-PAST-when

'When (it) gets to be the spring break,'

b.

太郎は	おばあさんのうちへ	行く。
Taro-wa	*obaasan-no uti-e*	*iku.*
Taro-TOP	grandmother-GEN home-to	go

'Taro will visit his grandmother.'

No one may not wonder "what gets to be the spring break" when s/he hears the utterance (2.30a), but syntactically the verb *naru* 'become' requires two arguments: what becomes what.[26]

Another instance discussed in the literature is "zero-argument predicate" such as *samui* 'cold' and *atui* 'hot' that expresses ambient conditions (Shibatani, 1990, page 361).

[26] According to Ishiwata (1983) and *Goi-Taikei*, the valency for the verb *naru* is defined as [N-ga N-ni/-to]. As for adjectives such as *atui* 'hot' and *samui* 'cold,' Shibatani (1990) classifies them as "zero-argument predicates" (page 361), although *Goi-Taikei* defines their valency as [N-ga].

2.4.3 Summary

We have seen two kinds of typological classifications of ZEROS, depending on their argument (case) types and referent types, which are summarized in Table 2.5 below.

Argument (case) type		Referent type		
Zero verbal argument	Nominative	Local	Anaphora	Endophora
		Global		
	Accusative	Intra-clausal		
		Event		
	Dative	Cataphorical	Cataphora	
		Situational	Exophora	
Zero nominal argument	Genitive	Indeterminate		
		Time/weather		

Table 2.5: Typological classification of ZEROS

For instance, one ZERO could be in the “nominative case” of a “verbal argument type” which makes a “situational” reference, while another is a “zero nominal argument” whose referent is “locally” found. Typologically, 32 combinations (out of 4 case types and 8 referent types) are possible, but some combinations are extremely rare or non-existent, as we will see in the corpus analysis presented in Chapter 4.

2.5 ZEROS as cohesion markers

2.5.1 Cohesion types

Cohesion is a linguistically realized device that creates textual unity, i.e., coherence. Coherence represents the natural, reasonable connections among sentences that make for easy understanding. Therefore, good readers take advantage of cohesive devices that writers employ for the text to be coherent. Deficiencies in cohesion recognition/interpretation may cause readers to miss/misinterpret important cohesive links and, consequently, to have difficulties in their comprehension process.

Halliday and Hasan (1987) classified five types of cohesive relations, based on English data: (i) reference, (ii) substitution, (iii) ellipsis, (iv) conjunction, and (v) lexical relation. These grammatical and lexical devices create cohesion between clauses or sentences.

2.5.2 Cohesion in Japanese

Halliday and Hasan's typology is a useful guideline, but it cannot be directly applied to Japanese. Iijima (1983) examined cohesion types and their frequency, based on Halliday and Hasan's classification, in his Japanese data (from a JSL textbook) and found difficulties in labeling cohesion types in Japanese on a one-to-one basis.

In Japanese, reference is made by means of names (e.g., *Tanaka-san*, 'Mr. Tanaka'), repeated nouns (e.g., *inu* 'dog'), demonstrative nouns (e.g., *sono otoko*, 'the man'), demonstrative adjectives (e.g., *kore*, 'this'), quantifiers (e.g., *hutari*, 'the two people'), lexical pronouns (e.g., *kanozyo*, 'she'),[27] and ZEROS. ZEROS are a major realization of "reference" in Japanese that takes the form of "ellipsis." Clancy (1980) reports in her comparative analysis of English and Japanese narratives that 73.2% of the reference found in the Japanese data that she examined is made by ellipsis (i.e., ZEROS) and 26.8% by noun phrases. This is contrasted with the English counterparts: 15.7% noun phrases, 63.8% pronouns, and 20.5% ellipsis.[28] This suggests that in Japanese ZEROS play a distributionally similar role to overt pronouns in English. For this reason, ZEROS are often called, in the literature, "zero pronouns."

Our focus will be on the cohesion made by "reference" in the form of "ellipsis."

2.6 ZEROS for Japanese language learners

As we mentioned earlier (in 2.2.2), English and Japanese clearly contrast in "definiteness" marking. In general, English requires explicitness in its elements; the sentence becomes ungrammatical otherwise. Japanese, in contrast, allows a high degree of implicitness, of which ZEROS are a prime example.

This striking contrast poses a major challenge not only for Japanese-English Machine Translation (MT) developers (e.g., Nakaiwa and Ikehara, 1992) but also for JSL learners who have English or another explicit-argument language as their first language.[29] Very few JSL textbooks, however, have a section addressing formal instruction and/or include intensive exercises on this ellipsis mechanism. Yet, ZEROS do exist in very beginning level materials, as shown later in Chapter 4, not to mention in real-world authentic texts. As a result, many JSL teachers rely heavily on their

[27] The use of (3rd person) lexical pronouns is very constrained and domain-specific. See Hinds (1978) for further discussion of overt pronouns in Japanese.

[28] Clancy observes that ellipsis in English is limited to preserved subject position, as in "the boy picks up the rock and (he) throws it out of the road."

[29] Nakahama (2003) examines how "language distance" plays a role in the L2 learning processes, with a focus on referential topic management.

intuition about naturalness, rather than depending upon systematic knowledge, when they explain ZEROS.[30] Intuition is a conventional tool in teaching one's native language, but from a students' perspective, well-developed, systematic, theory-based instruction can be more convincing and more helpful. This pedagogical discrepancy is the motive for analyzing the behaviors of ZEROS within a well-developed theoretical framework (in Chapter 4), and further, for building a system that is designed for enhancing instruction and acquisition of ZEROS, from which both teachers and students can benefit (in Chapter 6). In what follows, we will present some empirical data from a JSL classroom to verify the claim that ZEROS are one of the critical issues that students face when learning Japanese.

2.6.1 Interpreting ZEROS

Both teachers and learners claim that interpreting ellipsis is not an easy task. In order to verify this claim, we assessed ten upper-intermediate JSL students' understanding of ZEROS in a text. The text contained eight ZEROS. The students, who are all native speakers of English, were requested to translate the text into English, specifying what each pronoun indicates. This was done after all the lexical information was provided. Part of the passage used for this experiment is presented below in (2.31).

(2.31) a. 4月は　　入社の月　　である。
4-gatu-wa　　*nyuusya-no tuki*　　*dearu.*
April-TOP　　joining-companies-GEN month　　be.

'April is the month for joining companies.'

b. Ø　　たくさんの新入社員が生まれるとき　　である。
(Ø-ga)　　*takusan-no sinnyusyain-ga umareru toki*　　*dearu.*
(Ø-NOM) many-GEN new employees-NOM come-into-being time　　is.

'April is a time when there are many new employees.'

c. この人たちが　　よい社員に　　なるように、
kono-hitotati-ga　　*yoi syain-ni*　　*naru yooni,*
these-people-NOM　　good employees-DAT　　become in-order-that

'In order that these people become good employees,'

[30] Nariyama (2000) presents a similar view (page 3).

d. 会社は　教育を　はじめる。
kaisya-wa　*kyooiku-o*　*hazimeru.*
company-TOP　training-ACC　start

‘companies start training.’

e. 教育の方法は　いろいろ　である。
kyooiku-no hoohoo-wa　*iroiro*　*dearu.*
training-GEN method-TOP　various　COP

‘Training methods are various.’

f. Ø　会社によって　ちがう。
(Ø-ga)　*kaisya-ni yotte*　*tigau.*
(Ø-NOM)　company-according-to　different

‘(They ‘methods’) are different according to company.’

g. Ø　有名な人に　講演を　たのむ。
(Ø-ga)　*yuumeina hito-ni*　*kooen-o*　*tanomu.*
(Ø-NOM)　famous person-DAT　lecture-ACC　request

‘Companies request a lecture from a famous person.’

h. Ø　Ø　ことばづかいを　教える。
(Ø-ga)　*(Ø-ni)*　*kodobazukai-o*　*osieru.*
(Ø-NOM)　(Ø-DAT)　use-of-polite-language-OBJ　teach

‘Companies teach use of polite-language.’

i. Ø　団体生活に　なれるため、
(Ø-ga)　*dantai-seikatu-ni*　*nareru tame,*
(Ø-NOM)　working-in-a-group-OBJ　adjust in-order-that

‘In order that employees adjust to working in a group,’

j. Ø　合宿を　する。
(Ø-ga)　*gassyuku-o*　*suru.*
(Ø-NOM)　camp-ACC　do

‘(They ‘employees) go to a camp.’

[*Gendai*]

The deleted subjects in the utterances (f) through (j) switch from one entity to another (‘methods,’ ‘companies’ and ‘employee’). This seems to make the students more puzzled than in the straightforward case of the ZERO in utterance (b).

The results of this experiment had some interesting implications. Firstly, out of a total of 80 ZERO interpretations, only 46% of them turned out to be correct.[31] Some ZEROS were easier to resolve than others; success rates ranged from 10% to 90%. The ZERO in (g) is the hardest, while the one in (b) seems quite easy. Also, some students performed better than others; scores varied from 0% to 80%. Interestingly, the students’ scores roughly agree with their overall proficiency in Japanese.

Overall, the result, despite these variants, was poor enough to demonstrate the validity of the claim that ZEROS are hard to process for human L2 learners. Also, it implied that there is variation among types of ZEROS and among learners in terms of difficulty of interpretation.

2.6.2 Producing ZEROS

For those whose first language does not permit sentence parts to be omitted, it would be a perplexing task to identify what contexts allow omission and which elements can be safely omitted. We might naturally assume that learners tend to underuse ZEROS rather than overuse them, by using the strategy of avoidance.[32] This often results in unnaturalness caused by the redundant use of full noun phrases (NPs). In order to examine this assumption, let us present an intermediate student’s writing sample in (2.32).

(2.32) a.

農民が	いつも	とうぞくに	米やお金を	盗まれて
nomin-ga	*itumo*	*tozoku-ni*	*kome-ya okane-o*	*nusum-are-te*
farmer-NOM	often	thief-by	rice-and-money-ACC	rob-PASS-and

‘The farmers were often robbed of rice and money by thieves, and’

[31] Incorrect interpretations include the cases in which *zeros* are not clearly specified, or students probably avoided (consciously or subconsciously) stipulating them, by using passives or generic pronouns, even though they were asked not to do so. Interestingly, these are the strategies employed by many MT systems.

[32] Polio (1995) shows, as a result of her analysis of anaphor choice in Chinese, that second language learners do not use zero pronouns as frequently as native speakers and that their use increases as proficiency rises.

b. 農民が　　とうぞくを　　たおすために
nomin-ga　　*toozoku-o*　　*taosu tame ni*
farmer-NOM　thief-ACC　　beat in-order-that

'in order that the farmers beat the thieves,'

c. Ø　　七人の侍を　　やといました。
(Ø-ga)　　*7-nin-no samurai-o*　　*yatoi-masi-ta.*
(Ø-NOM)　7 samurai-ACC　　hire-POL-PAST

(They 'farmers') hired 7 samurais"

Japanese language teachers would recommend deleting the subject in the second utterance (*nomin* 'the farmers') for more natural Japanese discourse. As instantiated by this example (as well as other examples found in our data), such omissions are often advised in order to avoid unnaturalness caused by redundancy.

Japanese is known as an elliptic language. Learners understand that Japanese quite freely permits sentence parts to be omitted, but what triggers such ellipsis is not as easily understood. This potentially creates overuse of ZEROS. Let us look at the next sample written by a lower-intermediate student in (2.33).

(2.33) a. むかしむかし　　ある村に　　ある子どもが　　いた。
mukasi-mukasi　　*aru mura-ni*　　*aru kodomo-ga*　　*i-ta.*
once-upon-a-time　a village-in　　a child-SUB　　be-PAST

'Once upon a time, there was a child in a village.'

b. Ø　　おおかみが来たと　　さけんだ。
(Ø-ga)　　*ookami-ga ki-ta-to*　　*saken-da*
(Ø-NOM)　wolf-NOM come-PAST-COMP　　shout-PAST

'(He 'child') shouted that a wolf came.'

c. 村人が　　来たが、
murabito-ga　　*ki-ta ga,*
villager-NOM　　came but

'The villagers came, but

d. おおかみは　　なかった。
ookami-wa　　*nakat-ta.*
wolf-TOP　　be not-PAST

'there was no wolf.'

e. Ø　　なんども　　Ø　　くりかえして、
(Ø-ga)　　*nandomo*　　*(Ø-o)*　　*kurikaesi-te,*
(Ø-NOM)　　many times　　(Ø-ACC)　　repeat-and,

'(He 'child?') repeated (it 'shouting?') many times, and'

f. 村人が　　おこった。
murabito-ga　　*okot-ta*.
villager-NOM　　get-angry-PAST

'the villagers got angry."

g. Ø　　来なくなった。
(Ø-ga)　　*ko-naku-nat-ta.*
(Ø-NOM)　　come-NEG-become-PAST

(They '?') did not come any more. "

The three ZEROS in (e) and (g) are very ambiguous. It is not clear who repeated what many times, and who did not come any more. In this example, teachers would advise not to use ZEROS in order to avoid potential ambiguity.[33]

The use of ZEROS is a double-edged sword precariously balanced on a thin line. Underuse of ZEROS causes redundancy while overuse of ZEROS causes ambiguity. However fine the line may be, there needs to be some theoretical guidelines about where to draw it. We conjecture that Centering Theory (that we overview in Chapter 3) will provide such a base.

[33] In this particular example, lack of other strategic skills (e.g., viewpoint fixation) to enables ZERO use more safely appears to affect the naturalness of this discourse.

2.7 Summary

In this chapter, we first introduced the definition and typology of ZEROS after discussing some key concepts related to the nature of ZEROS. We presented two argument types and eight referent types of ZEROS. We also described the status of ZEROS as cohesion markers in Japanese and presented some empirical evidence, from a classroom, for problems that JSL learners encounter in their interpretation and production of ZEROS.

Discussion in this chapter will serve as a base of the subsequent chapters. Diverse nature of ZEROS will be empirically verified in the corpus analysis presented in Chapter 4. The role of ZEROS as cohesion markers will be more fully explicated in the centering framework, in Chapter 3, and then given evidence from the corpus in Chapter 4. Solutions to potential problems with ZEROS for JSL learners will be technologically proposed in Chapter 6 and pedagogically discussed in Chapter 7.

Chapter 3

ZEROS and Coherence in Japanese Discourse

3.1 Discourse coherence

3.1.1 Key concepts

In order to discuss discourse coherence as dealt with in this section, let us begin with defining some key concepts. A **discourse** refers to a set of language forms that are produced and interpreted as people communicate with each other. As such, it cannot be independent of the purposes or functions that those forms are designed to serve in human activities. A discourse may be written or spoken, and usually consists of two or more sets of utterances that are coherently linked and situated in context.[1]

The term **utterance**, likewise, is defined to be an expression uttered or written by a particular speaker or writer at a particular time and at a particular location for a particular purpose. Utterances thus contrast with possible linguistic constructs, such as sentences or clauses, which do not reside in any specific time and space. That is, there is no utterance possible without a context.

A discourse is considered to be segmented. Factors that determine the boundaries of **discourse segments** (DSs) have been of great interest to many discourse analysts (e.g., Brown and Yule, 1983; Polanyi, 2001); a variety of segmentation algorithms, each focusing usually on a single factor, have been proposed by computational linguists (e.g., Morris and Hirst, 1991; Kozima, 1993; Nomoto and Nitta, 1994; Hearst, 1997; Passonneau and Litman, 1997). The determination of segment boundaries is so complex that researchers have reached little agreement about it. For a written discourse, paragraphing is sometimes employed as a conventional indicator of a

[1] A piece of discourse in context can also comprise as little as one or two words, as in 'Stop' or 'No Smoking' (Celce-Murcia and Olshtain, 2000, page 4).

discourse segment (e.g., Miltsakaki, 2003).

A **discourse model** is an internal representation held by a discourse participant that links linguistic forms (referring expressions) to some referents, e.g., particular individuals, objects or events in some real world. When an addresser uses a referring expression, he or she is specifying, for example, a specific individual in his or her discourse model, with the intention of having the individual introduced or identified in the addressee's discourse model.

A discourse model contains a set of **discourse entities** that are elicited in the discourse, along with their properties and their relations with other entities.[2] Discourse entities are the real, abstract, or imaginary objects introduced by the discourse, and contrast with referring expressions that are linguistic mentions of the discourse entities throughout the text. One may have in mind a particular person, and may refer to this person in one context as 'John,' in another as 'the man who won the race,' in yet another as 'he' or whatever is linguistically possible (Chafe, 1976). Discourse entities may be **evoked** by the discourse via explicit (or implicit) linguistic mention; otherwise, entities can be **inferred** within the discourse model due to generic or specific knowledge of entities and relations holding among them. Entities may also be situationally evoked (Prince, 1981).

Several taxonomies for discourse entities have been proposed in the literature. The given (or old)-new distinction proposed by Chafe (1976) is one of the first classifications that consider psychological or cognitive status of entities. He defines "given" as what the speaker believes is in the hearer's consciousness, and "new" as what the speaker believes is not. Prince (1981) elaborates on this distinction and, by adapting a discourse (rather than hearer) centric view, defines entities, when first introduced in discourse, as "discourse-new," including "brand-new" when the hearer must create a new entity in his/her discourse model, and "unused" when the hearer already knows of this entity. Evoked entities that are already in the discourse are considered to be "discourse-old," and are further classified into "textually evoked" and "situationally evoked." In a similar vein, Gundel, Hedberg, and Zacharski (1993) claim, attending to the cognitive status of discourse entities, that their accessibility is reflected by linguistic forms.

A discourse is not a mere sequence of utterances. For a set of utterances to be a discourse, it must exhibit **coherence**. Coherence, however, is a cognitive state; it is not in the language itself, but is rather perceived by the language users, who unite utterances into a coherent representation of discourse. These utterances may contain linguistic devices that help the perceiver (including the speaker/writer and the hearer/reader) in establishing coherence. Speakers/writers utilize such linguistic devices, called **cohesion**, and hearers/readers recognize them, to establish coherence in discourse, often

[2] "Discourse entity" is a term first introduced by Webber (1979); this term is equivalent to "discourse referent" as used by Karttunen (1976).

supplemented with their knowledge of the world and so on.

The recognition of cohesion in the linguistic input leads to a better perception of coherence or a more coherent mental representation of the discourse, and hence to better **comprehension**. However, this alone is not sufficient. Comprehension is a complex cognitive process that also involves extensive inferential processes drawn on knowledge of the world as well as on memory for the preceding discourse. **Inferencing** that takes place in the comprehension process is a second major mechanism in creating coherence, after cohesion. Inference can be defined as any piece of information that is not explicitly stated in a discourse, but is required to establish a coherent mental representation of the discourse. Not all inferences, therefore, are of the same sort. Researchers in psycholinguistics and discourse processing have proposed several typologies of inferences (e.g., Clark, 1977). The amount of inference required or the processing cost has also been of considerable interest in comprehension research (e.g., Shiro, 1994).

We have reviewed some important concepts for the present study of discourse coherence, which we assume are important in discussing ZEROS, i.e., invisible discourse entities, as well. Our major concerns are: (i) how much of a contribution ZEROS as a unique linguistic device make to discourse coherence, and (ii) how much inference cost they require in comprehending a certain discourse segment or a certain sequence of utterances that contain ZEROS.

All the terminology reviewed here (in bold above) is applicable to both written and spoken discourse. Our focus is, however, on written Japanese monologues, which we call "text" in this thesis. Spoken forms of discourse, such as dialog or conversation, will be excluded from our discussion for the remainder of the thesis.

3.1.2 Approaches to coherence

Discourse coherence concerns the way in which utterances are related to each other in a reasonably meaningful fashion, and many researchers have attempted to describe coherence in terms of the relations among utterances within a discourse.

Such attempts have been made, in the literature, from two major distinct views of coherence. One prominent approach is to characterize the possible ways in which successive utterances can be connected to form a coherent discourse representation, and to enumerate such characterizations in a list of "coherence relations" (e.g., Halliday and Hasan, 1976; Hobbs, 1979; Mann and Thompson, 1987; Kehler, 1995, 2002). Kehler (1995, 2002), for instance, presents a list that includes three major classes, "resemblance," "contiguity," and "cause or effect," and the subclasses therein. This approach concerns the "relational coherence" of discourse.

The other approach, in contrast to relation-based theories of coherence, views coherence in regard to repeated reference to the same entity or event in a discourse.

One of the earliest studies in this approach was made by Kintsch and van Dijk (1978), who proposed that propositional information, abstracted from the incoming text, is connected to previous propositional information via "argument overlap." In a similar vein, Givón (1983) argues for "topic continuity" as one aspect of the complex process of continuity in discourse. This type of approach focuses on "referential coherence" in a discourse, or "entity coherence" as it is called by Poesio, Stevenson, Cheng, Di Eugenio, and Hitzeman (2002), Poesio, Stevenson, Di Eugenio, and Hitzeman (2004), and Karamanis (2003). One important work in this strand presents Centering Theory (Grosz, Joshi, and Weinstein, 1995).

These two approaches are not exclusive of, but rather complementary to each other, as Kintsch and van Dijk (1978) have stated.[3] It is probably a matter of priority or focus of discussion whether one takes the former approach or the latter. In this study, we take the latter approach and adopt the centering model as an explanatory tool that measures coherence of discourse, in relation to a specific referring expression, i.e., ZEROS. This approach makes sense because ZEROS that we are concerned with are "entities" in discourse.

3.2 Centering theory

We have overviewed some major concepts surrounding discourse coherence and approaches to coherence. We adopted, from among different approaches to discourse coherence, Centering Theory, which was officially formulated in Grosz, Joshi and Weinstein (1995; hereafter GJW95) and two previous works (Grosz, Joshi, and Weinstein, 1983, 1986; hereafter GJW83, 86).

The development of Centering Theory has been based mainly on two different strands of background work. Firstly, Grosz and Sidner (Grosz, 1977; Sidner, 1979; Grosz and Sidner, 1986) acknowledged the "attentional state" as a basic local-level component of discourse structure, and proposed that it consisted of two levels of focusing: global and local. In Grosz and Sidner's account, centering delivered a model for monitoring utterance-by-utterance changes in the local focus of attention. Secondly, Joshi, Kuhn and Weinstein (Joshi and Kuhn, 1979; Joshi and Weinstein, 1981) proposed centering as a model of the complexity of inferencing required in discourse comprehension. They attempted to explicate how each utterance is integrated into the preceding discourse and is linked to the succeeding discourse, in relation to the inferential complexity involved.

The successful merger of these two lines of work resulted in the original version of the centering model, which accounts for the attentional state factors that are responsible

[3] Poesio et al. (2004) suggested, from their corpus analysis results, "a hybrid view of coherence" that integrates an entity-based account of coherence with rhetorical and temporal coherence, and other factors.

for the differences in perceived degrees of coherence of discourses that convey the same information. One such discourse pair taken from GJW95 is provided in (3.1) and (3.2) below.

(3.1) a. John went to his favorite music store to buy a piano.
b. He had frequented the store for many years.
c. He was excited that he could finally buy a piano.
d. He arrived just as the store was closing for the day.

(3.2) a. John went to this favorite music store to buy a piano.
b. It was a store John had frequented for many years.
c. He was excited that he could finally buy a piano.
d. It was closing just as John arrived.

Discourse (3.1) is perceived as noticeably more coherent than discourse (3.2). Centering explains this difference as the outcome emerging from different degrees of continuity in what the discourse is about. Discourse (3.1) centers around a single individual (John), and hence, is clearly about 'John.' Discourse (3.2), in contrast, seems to focus in and out on two different entities (John, store, John, store). Centering is intended to capture these variations in (dis)continuity in focus.

3.2.1 Main claims

Centering theory is an entity-oriented theory of discourse coherence (see 3.1.2 above). It intends to model the local mechanisms that create local coherence by operating on the discourse entities in each utterance within a discourse segment. The fundamental assumption of centering is that humans continuously update the local attentional state or local focus as they incrementally process a discourse.

The local focus contains a set of FORWARD-LOOKING CENTERS (CFS), along with the information about the relative salience or RANKING of these CFS. The local focus gets renewed after every UTTERANCE within a DISCOURSE SEGMENT. In this renewal, the current CFS are updated into new ones. The set of CFS introduced in the local focus by utterance U_i is presented as CF (U_i). The members of CF (U_i) are defined as discourse entities that are REALIZED in U_i. One unique entity of the CF (U_i) is called the BACKWARD-LOOKING CENTER or CB (U_i). The CB (U_i) links the current utterance to the previous discourse. The intuition that some discourses are perceived to be more coherent than others, as illustrated in (3.1) and (3.2) above, is stipulated such that one way of updating this CB is preferred over another. Different ways of updating are formulated as the TRANSITION types that each utterance is labeled with.

The primary claims of the centering theory in GJW are given in two proposed

centering rules: **Rule 1** establishes constraints on the realization of entities mentioned in an utterance; and **Rule 2** claims a difference in inference load for different centering TRANSITION states between utterances.

The precise definitions of these theory-unique terms (indicated in SMALL CAPS above) are largely left unspecified, allowing for "a large number of possible instantiations of the theory" (Poesio et al., 2004, page 310). Before we give the definition of centering terms that we employ for this study (in 3.2.3 below), we will briefly overview in the next section previous areas of the application of centering and present our objectives, which affect our own definitions.

3.2.2 Applications of the theory

Centering Theory is one of the most influential frameworks in the study of discourse. Since the early development of the theory (GJW83, 86), it has been adopted as the basis for numerous works mainly in computational linguistics. The claims about pronominalization made in Rule 1 have been applied to develop algorithms for both **anaphora resolution** (e.g., Brennan, Friedman, and Pollard, 1987) and **anaphora generation** (e.g., Dale, 1992; Henschel, Cheng, and Poesio, 2000; Yüksel and Bozsahin, 2002). Ideas deriving from Rule 2 about preference order for TRANSITIONS have been increasingly found useful in **text structuring/planning** (e.g., Karamanis, 2003; Kibble and Power, 2004). Some predictions of the theory have also been tested with (and verified by) **psychological experiments** (e.g., Gordon, Grosz, and Gillion, 1993; Hudson-D'Zmura and Tanenhous, 1998).

One promising but rather inactive application area of centering is to **language learning/teaching**. One near-track application is found in work by Suri and McCoy (1993a) in which they utilize Sidner's (1983) local focusing in their algorithm for identifying illegal NP omissions and inappropriate pronominalization in the CALL system designed for native signers of American Sign Language learning English as a second language. In a similar vein, our earlier work attempts to assist learners of Japanese in their interpretation and production of ZEROS with centering-based algorithms (Yamura-Takei, Fujiwara, and Aizawa, 2001a, 2001b; Fujiwara and Yamura-Takei, 2002a, 2002b, 2002c).

One significant work in an attempt to use centering for practical application in an educational context is (Miltsakaki and Kukich, 2000a, 2000b, and 2004), in which ROUGH-SHIFT TRANSITION was used as an indicator of incoherence in students' essays. More recently, Tanimura (2004) employs Centering Theory as an explanatory tool to show the contrast between native speakers and learners of English with regard to coherence establishment and choice of referring expressions. This work is one of only a few that utilize centering in second language acquisition research.

Our present study also aims at an educational application of the theory, but in a

slightly different way from our earlier work. Kameyama (1985) views centering mechanisms as part of "linguistic competence" operational in human discourse production and comprehension (page 91), and also describes the mechanisms as a "hypothetical cognitive process involved in discourse processing of any human language" (page 94). We subscribe to this view and utilize a centering analysis as a measure in our attempt to explicate human perception of coherence and demand on inference in processing ZERO-containing discourses, in the belief that the findings provide significant pedagogical implications.

3.2.3 Concepts and definitions

Centering Theory is a conceptual framework for theorizing about local coherence; some notions and definitions are left unspecified, and rules are provided as preferences, rather than as hard rules. This has motivated much subsequent work that attempts to make further specifications, reformulations and extensions of the theory (inter alia, Walker, Iida, and Cote, 1994; Strube and Hahn, 1999; Kibble, 2001). Many such attempts have been made to develop efficient algorithms for anaphora resolution and generation, and to attempt cross-linguistic applications of the theory.[4]

As Poesio et al. (2004) describes Centering as a "parametric theory;" it allows for language-by-language "parameter" setting (cf. Walker, Iida, and Cote, 1994). That being the case, it should even allow for analysis-by-analysis setting so that it can best suit the objectives of particular applications of the theory.

In this study, as well, we set parameters so that they may best fit the purpose of our analysis, by either choosing from among a variety of previous parameter settings reviewed comprehensively by Poesio et al. (2002, 2004), or making necessary revision and further elaboration.

3.2.3.1 Utterance and discourse segment

The definition of utterance, as a basic CENTER update unit, is a crucial one. There has been a debate concerning how and the previous utterance should be regarded (inter alia, Suri and McCoy, 1993b; Kameyama, 1998; Miltsakaki, 2003). We will follow the suggestions of Kameyama (1998) and consider the basic utterance unit of centering to be the tensed clause. Using this approach, we analyze the CFs and CBs of each clause in a linear manner such that the centering output of one clause is the input to the analysis of the next adjacent clause.

[4] Cross-linguistic work in the centering framework includes Grosz and Ziv (1998) for Hebrew, Miltsakaki (2001) for Greek, Prasad (2000a, 2000b, 2003) and Prasad and Strube (2003) for Hindi, Strube and Hahn (1999) for German, Aroonmanakun (1999) for Thai, Taboada (2002) for Spanish, Turan (1995, 1998) and Hoffman (1998) for Turkish, Kim, Cho, and Seo, (1999) and Roh and Lee (2003a, 2003b) for Korean, among others.

Centering is meant to capture within-segment coherence. Therefore, segment boundaries are as important a concept as utterance boundaries. As we mentioned earlier in 3.1.1, however, reliably identifying segment boundaries is extremely difficult. Therefore, some heuristics have been employed in the centering literature. One is to treat a whole text as one discourse segment, ignoring any other possible segmentation. Some researchers use surface linguistic structure, such as paragraphing (Miltsakaki, 2003) and subsection (Poesio et al., 2004), as a conventional indicator of segments. We regard, in this study, a paragraph as a discourse segment, mainly because it is clearly indicated (by indenting and/or line spacing) in our corpus.

3.2.3.2 CENTERS and realization

The term CENTERS is used to represent "semantic objects, not words, phrases, or syntactic forms" (GJW95, page 208). CENTERS are entities constructed in a discourse in which they occur, thus a sentence in isolation does not have CENTERS. GJW used the notion REALIZE to define the relation between utterance (U) and CENTERS (c), and to relate CENTERS to linguistic expressions, as given in (3.3).

(3.3) U directly realizes c
if U is an utterance of some phrase for which c is the semantic interpretation.

Two linguistic options for English that GJW provide for an "NP that directly realizes c" are a definite description and a pronoun. GJW also discuss another possibility for the realization relation: c is "realized but not directly realized" (GJW95, page 217) in case of utterances containing NPs that express functional relations (e.g., 'the door') whose arguments have been directly realized in previous utterances (e.g., 'a house').

In sum, GJW95 consider two possible ways in which a discourse entity may be "realized" in an utterance: DIRECT realization and INDIRECT realization (cf. Poesio et al., 2004, page 9).

As for Japanese, Kameyma (1985) proposed that "pronouns" in English, as a direct realization of c, correspond to "zero pronominals [in her terminology]" in Japanese with respect to the interactions with centering. Walker, Iida and Cote (1990, 1994) followed this proposal, and claimed that "zero pronouns [in their terminology]" are "realized from information specified in the subcategorization frame of the verb" (1994, page 199). We subscribe to this view and treat ZEROS as a type of "direct" realization. We also regard ZEROS as "implicitly" realized entities, in order to make a contrast to linguistically "explicit" realizations, such as NPs and pronouns that are visible.

As for indirectly realized CENTERS that are claimed to play a crucial role in maintaining CENTERS, and hence in creating coherence (e.g., Hahn, Markert and Strube, 1996; Strube and Hahn, 1999), no work in Japanese explicitly includes them in the

centering analysis, to the best of our knowledge. However, Japanese, as well, does exhibit functionally dependent anaphoric relations, as in the example below.

(3.4) a. 家が ある。
ie-ga *aru.*
house-NOM exist

'There is a house.'

b. 屋根は 赤い。
yane-wa *akai.*
roof-TOP is-red

'The roof is red.'

Recall our discussion of zero nominal arguments in Chapter 2. We give a different treatment to this kind of indirect realization, in which two entities are indirectly related via functional dependency, or elsewhere called "bridging" and "association." In most previous work, mainly for English, an entity 'roof' in (b) is considered to be an indirect realization from the previously mentioned entity 'house.' We see this instead as a direct realization of an entity *ie* by way of an implicit argument of the entity, *yame*, as illustrated in (3.5).

(3.5) Ø 屋根は 赤い。
(Ø-no) *yane-wa* *akai.*
(Ø-GEN) roof-TOP is-red.

'The roof (of Ø) is red.'

Indirect realization, either explicitly or implicitly, in our definition, can be illustrated in (3.6) and (3.7) respectively.

(3.6) a. 太郎が コンビニを 探していると、
Taro-ga *konbini-o* *sagasite-iru-to*
Taro-NOM convenience-store-ACC looking-for-when

'Taro was looking for a convenience store, and'

b. 角に セブンイレブンが あった。

kado-ni	*sebunirebun-ga*	*at-ta.*
corner-at	Seven Eleven-NOM	be-PAST

'Seven Eleven was at the corner.'

In this example, an entity 'convenience store' in (a) is realized as "inferable" in (b) in the form of another head noun 'Seven Eleven' that naturally evokes the entity in the discourse model updated after the utterance (a) is heard. Thus, 'Seven Eleven' is an indirect and explicit realization of a 'convenience store.'

(3.7) a.

太郎が	セブンイレブンに	入ると、
Taro-ga	*sebunirebun-ni*	*hairu-to*
Taro-NOM	Seven Eleven-in	enter-when

'When Taro entered Seven Eleven,'

b.

Ø	いきなり	Ø	あいさつされた。
(Ø-ga)	*ikinari*	*(Ø-ni)*	*aisatu-sare-ta*
(Ø-NOM)	abruptly	(Ø-by)	greet-CAUS-PAST

'(he 'Taro') was abruptly greeted by (them 'shop clerks).'

In (3.7), on the other hand, the entity 'Seven Eleven' in (a) evokes an entity 'sales clerk' in (b) which is realized as a ZERO. Here, a ZERO that denotes 'sales clerk' is an indirect and implicit realization.

Possible linguistic options for CENTER realization in Japanese can be summarized in a two-by-two classification, according to their "directness" and "explicitness," in Table 3.1.

	Explicit (non-ZERO)	**Implicit (ZERO)**
Direct	[A] same head anaphoric	[C-1] zero verbal argument, [C-2] zero nominal argument
Indirect	[B-1] same entity/different head associative [B-2] situationally evoked, inferable	[D] zero argument with situational reference (inferable, situationally evoked)

Table 3.1: Linguistic options for CENTER realization in Japanese

An example entity pair for each of the six sub-groups is given below, out of which [B-2]

and [D] (highlighted) are excluded from our definition of realization.

(A)	豪華客船	客船
	gooka-kyakusen	*kyakusen*
	luxury passenger boat	passenger boat
(B-1)	タイタニック	船
	taitanikku	*hune*
	Titanic	boat
(B-2)	客船	港
	kyakusen	*minato*
	passenger boat	harbor
(C-1)	客船	（客船）
	kyakusen	*(Ø kyakusen)*
	passenger boat	(Ø 'passenger boat')
(C-2)	タイタニック	（タイタニックの）乗客
	taitanikku	*(Ø taitanikku-no) zyookyaku*
	Titanic	'passenger (Ø 'of the Titanic')
(D)	タイタニック	（乗客）
	taitanikku	*(Ø zyookyaku)*
	Titanic	(Ø 'passenger')

[B-1] and [C-2] are normally combined as one type under the name of what is elsewhere called "bridging" and "associative;" the distinction depends on whether or not the relation between the two entities can be expressed in A *no* B form (see Chapter 2 for detailed discussion on [C-2] type). Inclusion of zero nominal arguments [C-2] in our definition of realization is one novel aspect of the centering analysis that follows.[5]

[5] To the best of our knowledge, no work for Japanese has explicitly included zero nominal arguments in a centering analysis and discussion. The inclusion shows that the interaction of zero verbal arguments and zero nominal arguments in the centering mechanism interact in the same way that personal and possessive pronouns (in bold below) interact in the following example discourse in English used in Kameyama (1998, page 104).

1. **Her** entrance in Scene 2 Act I brought some disconcerting applause
2. even before **she** had sung a note.
3. Thereafter the audience waxed applause happy
4. but discriminating operagoers reserved judgment
5. as **her** singing showed signs of strain
6. **her** musicianship some questionable procedure

Excluded is [D] type, what we define as ZEROS with situational reference (see 2.4.2.6 for the definition and wait for 4.4.1.3 for relevant examples from the corpus). Also excluded is type [B-2], which is totally beyond the scope of our study, but Fais (2004) attempts to include this type in her centering study. She proposes, for a better characterization of coherence, a new TRANSITION state named "cohesive shift" that considers lexical relatedness in determining CBs for TRANSITION states otherwise categorized as "NULL" (see 3.2.3.5 below for the definition of "NULL").

3.2.3.3 CF ranking

The basic elements of Centering Theory are the discourse entities that appear in each utterance, called FORWARD-LOOKING CENTERS or CFs. Because the notion of salience is crucial to Centering Theory, these entities are ranked in the CF list for each utterance according to language specific ranking principles that reflect the relative salience of the entities.

CF ranking is one of the best-researched parameters of the "parametric" theory. The factors in determining CF ranking have traditionally been grammatical relations. The CF ranking initially proposed by GJW for English is as follows.

(3.8) SUBJECT > OBJECT > OTHERS

A slight modification was made by Brennan, Friedman, and Pollard (1987), who made a further distinction between objects and indirect objects. In addition, some subsequent cross-linguistic studies have augmented the ranking with other language-specific features, while others have proposed alternative potential factors for certain languages: lexical conceptual structures for English (Cote, 1998), thematic roles for Turkish (Turan, 1998), and information structure for German (Strube and Hahn, 1999) among others. While maintaining the grammatical role-based ranking, Kameyama (1985, 1986) proposed and Walker et al. (1990, 1994) agreed that, in addition to the role of grammatical function hierarchy, two special discourse devices in Japanese contribute to the salience of an entity: topics (marked by a topic marking particle, *wa*) and empathy or IDENT in Kameyama's terminology (normally indicated by certain empathy-loaded verbs). The ranking in (3.9) has since been the dominant ranking used for the centering study of Japanese.

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7. and **her** acting uncomfortable stylization.
8. As **she** gained composure during the second act
9. **her** technical resourcefulness emerged stronger
10. though **she** had already revealed a trill almost unprecedented in years of performances of Lucia

We will present similar samples in Japanese in Chapter 4 and some data in Chapter 7.

(3.9) TOPIC > EMPATHY > SUBJECT > OBJECT2 > OBJECT > OTHERS

Both TOPIC and EMPATHY are placed higher than the otherwise highest ranked SUBJECT. They allow some entities in syntactically less salient positions to be elevated to higher-ranked positions (than subjects) and, as a consequence, to continue to be CENTERS in subsequent utterances. In another view, these features can be seen as strategies that native speakers subconsciously employ for the purpose of continuing CENTERS and maintaining coherence, and that learners need to consciously or subconsciously acquire. We will look further into these two devices and discuss our position for the ranking used in this study.

Topic

One linguistic typology classifies English as a subject-prominent language and Japanese as a topic-prominent language (Li and Thompson, 1976). In the topic-prominent languages, the grammatical units of topic and comment are basic to the sentence structure. Moreover, topics in Japanese are explicitly marked by a so-called topic marker *wa*.[6] Obana (2000) examines the characteristics of topic-prominence from a language learning perspective. She also discusses the discourse function of topic by summarizing the literature including Kuno (1978). Once a topic is introduced in an initial utterance, this *wa*-marked entity may be readily omitted in subsequent utterances until another *wa*-marked NP is introduced to change the topic. It is pedagogically plausible to direct learners' attention to this topic chain phenomenon and topichood (rather than subjecthood) as a strong indicator of salience in Japanese discourse.

However, this argument is made less persuasive by the fact that in Japanese, topics and subjects often coincide. We examined our corpus (see Chapter 4) for *wa*-marked topic NPs and their grammatical functions in the utterances in which they occur. The result is shown in Table 3.2 below (next page).

[6] Here, we tentatively limit our definition of topics to *wa*-marked NPs, but our intuition calls for further investigation on other possible topic constructions, such as NP-*to*-*ieba* 'speaking of NP.' This has not been discussed in either theoretical or centering literature.

Canonical Case	Frequency # (%)
ga (nominative)	616 (83.13%)
de (locative, instrumental)	51 (6.88%)
ni (dative, locative, etc.)	31 (4.18%)
o (accusative)	7 (0.94%)
kara (ablative)	2 (0.27%)
to (commitative)	2 (0.27%)
to-site[7]	1 (0.13%)
particle-less adjunct	31 (4.18%)
total	741 (100%)

Table 3.2: Frequency of *wa*-marked NP according to canonical case

As is apparent, the vast majority of topicalized NPs are canonically nominative, occupying the subject position of utterances. Topicalized accusative NPs, often defined as a theoretically possible construct, are extremely rare in our corpus, a situation which is also pointed out by Kameyama (1985, page 114, ft.). The cases of topicalized non-obligatory arguments are also very infrequent.

Moreover, Kameyama (1985) limits her definition of topic in the CF ranking to topicalized subjects, objects and possessors, excluding topicalized obliques and adjuncts.[8] In fact, it is questionable whether all topicalized NPs, regardless of their canonical case, are equally salient or are always more salient than subjects. These observations taken together lead us to question the validity of specially ranking TOPIC at the most salient position in the CF.

On a related issue, Walker et al. (1990, 1994) demonstrated that topics sometimes affect the determination of preferred interpretation even when they are not overtly *wa*-marked (i.e., zero topics) and proposed the Zero Topic Assignment (hereafter ZTA) rule in (3.10).

(3.10) When a zero in U_{i+1} represents an entity that was the CB (U_i), and when no other CONTINUE transition is available, that zero may be interpreted as the ZERO TOPIC of U_{i+1}.

This rule allows some ZEROS in syntactically less salient positions to continue to be CENTERS. A typical ZTA example is that a zero object (or a zero genitive) is realized as

[7] This is a compound particle that indicates role or function; it can be translated as 'as.'

[8] She states that adjuncts "appear to be associated with global coherence rather than local coherence" (page 116) and leaves further discussion for future studies.

ZERO (in a subject position) in the immediately following utterance. We also disregard this rule in our analysis.

Empathy

The notion of empathy was proposed by Kuno and Kaburaki (1997) and Kuno (1978). Empathy expresses the perspective or position that a speaker takes in describing an event. In Japanese, the speaker's empathy is encoded by using empathy-loaded verbs. These include verbs of giving and receiving. Empathy locus is defined as the argument position whose referent the speaker identifies with. A list of such verbs and their empathy loci are summarized, following Kuno and Kaburaki, Tsujimura (1996) and Obana (2000), in Table 3.3.

Empathy Loci	Verb	Meaning
SUBJECT	*yaru*, *ageru*	giving
	morau	receiving
OBJECT	*kureru*	giving
	-	receiving

Table 3.3: Empathy loaded verbs and their empathy loci

These verbs can also be used as auxiliary verbs, attaching to the main verbs in complex predicates in quite a productive way.

Yanagimachi (2000) reports from his observation of spoken narrative discourse that native speakers of Japanese effectively use these empathy-loaded verbs to fix their viewpoint. This results in infrequent topic shifts and continuous use of ZEROS. Learners, on the contrary, tend to switch from one topic to another due to the lack of mastery of this viewpoint fixation technique. This causes frequent topic shifts and requires the use of overt anaphoric forms each time.

Tanaka (2001, 2004) also points out in her study of cross-linguistic influence on the acquisition of viewpoint fixation (encoded by passives and empathy-loaded expressions) that English speaking learners of Japanese tend to show a delay in the early-stage development, compared to other speakers (Korean and Chinese), and to show gradual progress.

The reports of Yanagimachi and Tanaka suggest that empathy is a critical pragmatic device that learners of Japanese need to "learn" for natural discourse creation and interpretation. This further implies that empathy-involving discourse may not be perceived to be equally coherent between native and non-native speakers of Japanese, and among learners with different proficiency levels.

In conclusion, we decided to eliminate "empathy," in addition to "topic," from

listing in our CF ranking for the purpose of elucidating perceived degrees of coherence by Japanese language learners. Thus, we leave the ranking as simple and syntactic as possible, as formulated in the original centering account, which is given in (3.11).[9]

(3.11) SUBJECT > OBJECT (S) > OTHERS

We regard other semantic and pragmatic factors, including topicalization and empathy, as potential resources for additional information required in inference processes in interpreting CENTER (dis)continuation.

Complex NPs

Standard accounts of centering do not include provision for the ranking of the entities that make up complex nominal phrases. A typical complex nominal construction in Japanese, the A *no* B phrase, is of great interest in this study, as discussed earlier in Chapter 2. Thus, the ranking within the construction is an important issue to discuss. Let us first review how complex nominals have so far been treated in the literature, mainly for English.

Walker and Prince (1996) proposed the Complex NP Assumption as a hypothesis about how to handle the multiple discourse entities evoked in complex phrases in English. This assumption states that such entities are ordered on the CF ranking as they appear from left to right within the complex NP. Other researchers (Gordon and Hendrick, 1997; Gordon, Hendrick, Ledoux, and Yang, 1999; Turan, 1998) reject the notion that surface word order alone can characterize salience (or "prominence"). The work of Gordon and colleagues with the processing of name and pronoun references in complex phrases in English sheds light on the effect that embedding has on the prominence of referential expressions. Based on experiments in which subjects' reading times for short discourses containing possessive structures with both names and pronouns are measured, Gordon and colleagues concluded that the more deeply embedded element, namely, the possessed element, was more prominent.

Tetreault (2001) evaluated the performance of an algorithm based on Walker and Price's Complex NP Assumption and an algorithm based on Gordon et al.'s claim that the possessed entity was the more salient. He based his evaluation on how accurately the two algorithms could resolve pronominal reference to elements of possessive phrases. His conclusion was that the Complex NP Assumption yielded slightly better results. Poesio and Nissim (2001) also compared these two approaches. Their results showed that the Complex NP Assumption not only led to fewer violations of major principles of Centering Theory, but also predicted subsequent reference to the possessor better than Gordon et al.'s hypothesis. Di Eugenio (1998) uses as a "working

[9] The role of grammar in the control of inferences was the original motivation of the centering model (Joshi and Kuhn, 1979; Joshi and Weinstein, 1981).

hypothesis" that a possessed entity that is animate precedes a possessor entity (whether animate or not); otherwise (i.e., if the possessed entity is inanimate), the possessor precedes the possessed entity on the CF ranking list. Poesio and Nissim revise this account with an amendment that the possessor is more highly ranked if it is pronominalized.

These studies were conducted on the English phenomenon of the possessive construction, which is only approximately analogous to the Japanese A *no* B construction, so it is not possible to make very specific arguments by comparing the two. However, we can say that there seems to be no single factor, such as word order or animacy, that determines the ranking. This is also true of the Japanese case, as is suggested by the results reported by Yamura-Takei and Fais (ms.) in which the salience ranking of entities in the A *no* B phrase was examined on the assumption that an entity of the phrase that provides the antecedent for a subsequent anaphor must be the more salient of the two entities. This examination yielded an interesting result, which is far from being as simple as is suggested by the studies for English mentioned earlier. Defining criteria for characterizing salience in this complex nominal construction seem to stem from both syntactic and semantic factors.

Now then, how do we rank entities within complex NPs? As we have stated several times, the purpose of our centering analysis is not to evaluate a centering algorithm for pronoun resolution; efficiency of parameter setting is not an issue. We rather attempt to examine how syntactic constraints affect coherence establishment. So we simply place B nouns, which are syntactic heads, in a higher position in the ranking.

3.2.3.4. Pronominalization: Rule 1

As previously discussed (in 3.2.3.2), we regard ZEROS as equivalent to pronouns in English (and some other languages) that centering is concerned with. Therefore, we directly apply a hypothesis about the relation between centering and pronominalization, which is called Rule 1, to ZEROS. The formulation of Rule 1 defined in GJW is as follows.

(3.12) If any element of CF (U_n) is realized by a pronoun in U_{n+1}, then the CB (U_{n+1}) must be realized by a pronoun also.

3.2.3.5 TRANSITION: Rule 2

Adjacent utterance pairs are characterized in terms of TRANSITION types. In GJW, three types of TRANSITION relations are defined according to two criteria: (a) whether or not the CB (U_{i-1}) is maintained in U_i, and (b) whether or not CB (U_i) is also the most

highly ranked entity (CP) of U_i. This can be summarized as in (3.13).

(3.13) CENTER continuation (CON): CB (U_i) = CB (U_{i-1}), and CB (U_i) = CP (U_i)
CENTER retaining (RET): CB (U_i) = CB (U_{i-1}), but CB (U_i) ≠CP (U_i)
CENTER shifting (SHIFT): CB (U_i) ≠CB (U_{i-1})

Later, Brenann et al. (1987) introduced a further distinction between two types of SHIFT according to whether or not CB (U_i) equals CP (U_i), and Walker et al. (1990, 1994) named the two distinct states SMOOTH-SHIFT and ROUGH-SHIFT, respectively. A widely-used classification, as a result, is as in the following table.

	CB (U_i) = CB (U_{i-1})	**CB (U_i) ≠CB (U_{i-1})**
CB (U_i) = CP (U_i)	CONTINUE	SMOOTH-SHIFT
CB (U_i) ≠CP (U_i)	RETAIN	ROUGH-SHIFT

Table 3.4: TRANSITION definitions

Given these definitions, Rule 2 claims that differences in inference cost in discourse interpretation, and thus in coherence, result from using different sequences of TRANSITIONS. Rule 2 is defined, in GJW, as in (3.14).

(3.14) Sequences of continuation (dubbed CON in this thesis) are preferred over sequences of retaining (RET); and sequences of retaining are to be preferred over sequences of shifting (SHIFT).

Although Rule 2 was originally formulated in terms of sequences of utterances, many applications of this rule to discourse processing algorithms (after the work of Brennan et al., 1987) have restricted the rule to pairs of utterances, as formulated in (3.15).

(3.15) Transition states are ordered. The CONTINUE transition is preferred to the RETAIN transition, which is preferred to the SMOOTH-SHIFT transition, which is preferred to the ROUGH-SHIFT transition.

These uses of Rule 2 fail to capture the intuition that what matters to coherence are centering TRANSITIONS throughout a segment, not only between pairs of utterances. It is, however, easier to evaluate coherence between a pair of utterances than over a whole segment (Grosz and Sidner, 1998, page 48). A somewhat intermediate approach was taken by Di Eugenio (1998) and Turan (1995), who attend to certain pairs of TRANSITIONS (e.g., CON-CON, RET-CON, SHIFT-CON). Strube and Hahn (1999) took a slightly different position. In their formulation, pairs of TRANSITIONS <<U_i, U_j>,

<U_j, U_k>> that are "cheap," i.e., CP (U_j) = CB (U_k) are preferred over those that are "expensive," i.e., CP (U_j) ≠ CB (U_k).

Rule 2 "reflects our intuition that continuation of the CENTER and the use of retentions when possible to produce smooth transitions to a new CENTER provide a basis for local coherence (GWJ95, page 215)." This implies that the CON-RET-SHIFT sequence is a valid way for CENTER movement, or "topic change" to take place.[10] The rule also predicts that certain sequences produce a higher inference load upon the reader than others. The CON-CON sequence is predicted to require a lower inference cost than, for example, the RET-RET or the SHIFT-SHIFT sequence. The CON-SHIFT sequence is hypothesized to be more costly than the CON-RET sequence. We follow these claims as postulated in the original version of centering, and take the TRANSITION-sequence approach to coherence-driven preferences, rather than the single-TRANSITION approach as proposed by Brenann et al. (1987).

In addition to the canonical TRANSITION types (CON, RET, and SHIFT), corpus studies revealed that natural-occurring discourses contain quite a few utterances without a CB, that is, there is no common entity between U_{i-1} and U_i (cf. Passonneau, 1998; Poesio et al., 2002, 2004). Such utterances are labeled "NULL"[11] or elsewhere called "No CB" (e.g., Di Eugenio, 1998).

Single TRANSITION versus TRANSITION sequence

Let us first clarify what we mean, in this thesis as well as in the previous studies, by a TRANSITION and a TRANSITION sequence. Look at the next sample discourse, which consists of utterances (U_1) through (U_4), in (3.16).

(3.16)

(U_1)	よこはまの	おばあさんは	りょうりを
	yokohama-no	*obaasan-wa*	*ryoori-o*
	Yokohama-GEN	grandmother-TOP	recipe-ACC
	たくさん 知っています。		
	takusan sitte-i-masu.		
	many know-POL		
	'Grandma in Yokohama knows a lot of recipes.'		
(U_2)	Ø	いいりょうりの本を	持っています。
	(Ø-ga)	*ii ryoori-no hon-o*	*motte-i-masu.*

[10] This sequence may follow another stretch of continuation to talk about a newly established center.

[11] Poesio et al. (2002, 2004) distinguished the NULL TRANSITION between utterances neither of which has a CB and the ZERO TRANSITION from an utterance with a CB to one without. We collapse these two TRANSITIONS into the NULL TRANSITION.

(Ø-NOM) good recipe-GEN book-ACC own-POL

‘(She) owns a good recipe book.’

(U_3)	ひろこさんの	お母さんは	ときどき	おばあさんに
	hiroko-san-no	*okaasan-wa*	*tokidoki*	*baasan-ni*
	Hiroko-GEN	mother-TOP	sometimes	grandmother-DAT

電話を	かけます。
denwa-o	*kake-masu.*
telephone-ACC	ring-POL

‘Hiroko’s mother sometimes telephones (her ‘Hiroko’s’) grandmother.’

(U_4)	そして	Ø	Ø	いろいろなりょうりを	聞きます。
	sosite	*(Ø-ga)*	*(Ø-ni)*	*iroirona ryoori-o*	*kiki-masu.*
	and	(Ø-NOM)	(Ø-DAT)	various recipe-ACC	ask-POL

‘And (she ‘mother’) asks (her ‘grandmother’) for various recipes.’

Table 3.5 (next page) schematically represents the relationship between CENTER structure and TRANSITION state of each of these utterances, and between TRANSITION and TRANSITION sequence.

U	CF/ CB	TRANSITION			TRANSITION sequence	
1	CF: obaasan, ryoori CB: none					
2	CF: obaasan, hon CB: obaasan	(U1, **U2**) CON				
3	CF: obaasan, okaasan, denwa CB: obaasan		(U2, **U3**) RET		(U1, U2, **U3**) CON-RET	
4	CF: okaasan, ryoori CB: okaasan			(U3, **U4**) SHIFT		(U2, U3, **U4**) RET-SHIFT

Table 3.5: Schematic view of TRANSITION and TRANSITION sequence

"TRANSITION" characterizes the relation, in terms of CENTER movement, between the two adjacent utterances (e.g., U_2 and U_3); it labels the latter utterance (underlined) (e.g., U_3). "TRANSITION sequence," on the other hand, characterizes the relation between the two adjacent TRANSITION states (e.g., CON and RET) that involve three successive utterances (e.g., U_1, U_2, U_3). The label (CON-RET) is assigned to the last utterance in the sequence (e.g., U_3 underlined). Thus, when we say the use of ZERO in a certain sequence, it concerns a ZERO in the last utterance in that sequence.

TRANSITION sequence and inference cost

There are a total of eleven possible sequence patterns out of combinations of CON, RET, SHIFT, and NULL TRANSITION types.[12] We tentatively divide the eleven types into three groups in accordance with the predictions outlined by GJW's Rule 2: "low-cost" sequence types and "high-cost" sequence types, placing in between "medium-cost" sequences, as presented in Table 3.6. Although Rule 2 explicitly mentions only three sequence types, CON-CON, RET-RET and SHIFT-SHIFT (indicated in bold in the table), we take into account the claims made by GJW concerning the rule (see 3.2.3.5 above) and list all possible sequence types accordingly.

[12] The NULL-SHIFT sequence is theoretically impossible.

"low-cost" sequence types	"medium-cost" sequence types	"high-cost" sequence types
CON-CON, CON-RET, RET-SHIFT, SHIFT-CON	**RET-RET**, **SHIFT-SHIFT**, NULL-CON, NULL-RET	CON-SHIFT, RET-CON, SHIFT-RET

Table 3.6: Inference cost-based classifications of sequence patterns (tentative)

This grouping is made because the distinction is not, of course, binary, but rather is graded, as claimed by GJW95: "to the extent a discourse adheres to centering constraints, its coherence will increase and the inference load placed upon the hearer will decrease (page 210)." We then compromise, for the sake of simplicity, with this three-scale hierarchy.

We use this distinction as a starting point to analyze the effect of ZERO use in each sequence type on perceived degree of coherence in a discourse, and hence inference cost required for interpreting the ZERO(S) contained, and ultimately for understanding the discourse. We also attempt not only to estimate the amount of inference that centering concerns, but also to elucidate the types of information resources required for such inference. This will be done by analyzing both textual and contextual environments that enable the use of ZEROS in "high-cost" sequences. In Chapter 4, particularly in 4.4.3, we will make an empirical assessment of the centering-predicted coherence/inference measure, as depicted in the table above, and make adjustments, if necessary, according to the analysis result. The analysis will be accompanied by statistical data and numerous relevant discourse samples from our corpus.

3.3 Summary

In this chapter, we first discussed some fundamental concepts in understanding discourse coherence and overviewed approaches to coherence proposed in the literature. We then introduced Centering Theory, a model that we chose as an explanatory tool for the relationship between ZEROS and coherence/inference in Japanese discourse. We emphasized the original intention of Centering as discussed in GJW, and fully described the "parameter" settings that we adopted for the purpose of characterizing ZERO-involving coherence. We finally proposed a tentative version of inference cost-based classifications of TRANSITION sequence patterns, on which our later corpus analysis is based.

Chapter 4

Corpus Study

4.1 Corpus

Our corpus is a collection of 83 written discourses (texts), either in narrative or expository style, from seven different Japanese as a Second Language (JSL) textbooks published and widely used in JSL teaching contexts in/outside Japan, with levels ranging from "beginning" to "intermediate." The textbooks are given abbreviated names, in this thesis, for the sake of convention: *Hiroko 1*, *Hiroko 2*, *Minna 1*, *Minna 2*, *Gendai*, *Nitizyo*, and *Sokudoku* (see Appendix A for the information of these textbooks). *Hiroko 1* and *Hiroko 2*, and *Minna 1* and *Minna 2*, respectively, are two-level volumes of the same textbook series. The texts are presented in each textbook as teaching materials for reading comprehension, often accompanied by vocabulary lists and comprehension questions. From all the reading materials available, dialogues and first-person monologues (such as letters and diaries) are excluded because of the focus of our analysis.[1]

The compiled corpus includes 314 paragraphs (indicated by line spacing and/or indenting), 1,200 sentences (separated by periods), and 2,007 clauses (manually identified based on our definition of a clause). The corpus contains a total of 1,382 ZEROS (manually located; see Section 4.3 for the locating process), of which further classifications will be presented in 4.4.1. Quantitative information concerning the corpus is summarized in Table 4.1.

[1] We employed this manipulation because we deal only with third person NPs in our centering analysis of the corpus, following the standard assumption that deictic entities are beyond the purview of centering. Byron and Stent (1998a, b), on the other hand, argue for the inclusion of first and second person pronouns in examining two-party dialogues. Our CF lists exclude a very few cases of first and second person NPs found in the corpus.

# of	Texts	Paragraphs	Sentences	Clauses	ZEROS
Hiroko 1	10	25	87	90	38
Hiroko 2	11	44	129	188	135
Minna 1	7	32	105	131	82
Minna 2	12	68	245	390	284
Gendai	15	63	221	364	237
Nitizyo	14	55	255	498	348
Sokudoku	14	27	158	346	258
TOTAL	83	314	1,200	2,007	1,382

Table 4.1: Quantitative information of the corpus

In addition, some qualitative information is presented in Table 4.2 below. The ratio of clause per sentence is given as a very simple metric of structural complexity. On average, a sentence consists of 1.67 clauses, varying from 1.03 to 2.19. The density of ZERO use is indicated by the average number of clause per each ZERO occurrence. On average, one ZERO appears in every 1.45 clause units, ranging from 1.34 (most frequent) to 2.37 (least frequent). These figures roughly match the target levels of the textbooks: less structural complexity and fewer ZERO occurrences for very beginning textbooks (e.g., *Hiroko1*) and more complexity and more ZEROS for intermediate (e.g., *Sokudoku*). Text style is of two types: narrative and expository; some textbooks adhere to a single style, while some others have mixed contents.

	Clause/sentence	Clause/ ZERO	Style
Hiroko 1	1.03	2.37	narrative
Hiroko 2	1.46	1.39	narrative
Minna 1	1.25	1.60	mix
Minna 2	1.59	1.37	mix
Gendai	1.65	1.54	expository
Nitizyo	1.95	1.43	narrative
Sokudoku	2.19	1.34	mix
Average	1.67	1.45	-

Table 4.2: Qualitative information of the corpus

We chose this type of corpus for several reasons, which are driven by the specific aims of our analysis and the overall goal of this thesis. Firstly and most fundamentally, the underlying theme of this thesis is concerned with the pedagogical application of the

theory based on sound empirical evidence from the corpus. Thus, the analysis ought to start with data that is as directly related as possible to a pedagogical context.

Secondly, as the first comprehensive corpus analysis regarding ZEROS in Japanese both in its quality and quantity,[2] we believe that our mission is to provide as "standard" data as we could offer, i.e., a baseline from which the subsequent research can gain insights or with which they can compare the analyses of other types of text or speech. By "standard," we mean free from domain-specific deviation and domain-unique characteristics.

Also, we wish to provide a "standard" centering analysis of Japanese discourse, from which JSL teachers can benefit, gaining a better understanding of mechanisms involving ZEROS and enhancing their instruction. Centering phenomena vary, to some extent, from corpus to corpus, and from genre to genre. The Japanese email corpus that Fais and Yamura-Takei (2003) and Fais (2004) examined, for example, exhibits a very particular TRANSITION distribution, which may be partly due to situation-dependent knowledge shared by the discourse participants. Also, spoken dialogues are still left with a number of open issues (see Byron and Stent, 1998).

For these reasons, our analysis, concerning the interrelationship between ZEROS and coherence, requires as maximally coherent discourse samples as possible, such that such excessive inferential costs as those induced by world or shared knowledge are minimized in the comprehension process. We conjecture that JSL reading materials serve as such a representative text sample. In addition, they are naturally occurring data in the sense that they are not constructed solely for the purpose of analyses or experiments, although they are more or less controlled (intentionally by text writers) in terms of their lexical difficulty and syntactic complexity.[3]

4.2 Purposes

The primary goal of the corpus analysis conducted in this section is to provide statistically reliable and generalizable results concerning the behaviors of ZEROS in naturally occurring Japanese discourse. The results are discussed from various perspectives, with a focus on the diverse nature of ZEROS and their significant contribution to discourse coherence.

[2] The previous corpus studies of ZEROS so far conducted on relatively large sets of naturally occurring Japanese data include Iida (1998) and Nariyama (2000).

[3] We thank Shigeko Nariyama (personal communication) for pointing this out.

4.3 Methodology

The data was subjected to the following stages of manual analysis based on the definitions given in Chapter 2. First, sentences (conventionally indicated by periods) were split into clauses that later served as basic syntactic units for identifying verbal argument structure, and hence for the ZERO detecting operation, and also as CENTER-updating units, i.e., utterances, for our centering analysis. Given this unit, the native-Japanese-speaking author identified the presence of ZEROS by utilizing both intuitive judgment and linguistic knowledge about valency requirements of each given predicate (including verbs and adjectives). We basically followed the definition of ZEROS presented in Chapter 2: ZEROS are unexpressed "obligatory" arguments. However, unexpressed "adjuncts" that are strongly evoked in a given context were also marked. The identified ZEROS were labeled according to their types as defined in Chapter 2. For the identification of zero nominal arguments, we mainly utilized intuitive judgment about semantic "incompleteness" of a given noun, which usually calls for "of-what" information (see 2.4.1.2).

These ZERO identification and labeling processes did not pose too much difficulty, but were subjected to several stages of revision and occasional consultation with another native-speaker collaborator who is a trained linguist and JSL teaching expert, when necessary.

This set of ZERO-specified clauses was later used for the centering analysis, which includes identification of CF and CB and computation of TRANSITION type. This process was also straightforward in many cases, but some tricky cases required clear understanding of centering rules and constraints, and introspective judgment on what an utterance is centrally about.

In order to delineate the behaviors of ZEROS, we present numerous figures and tables that provide frequencies and proportions of certain types of ZEROS and other related linguistic constructs that occur in certain environments. Chi-square tests, the most commonly used significant test in corpus analysis, are conducted wherever relevant. We use chi-square values to determine whether the distributional difference is a genuine reflection of variation in order to make generalizations, from the findings in our analysis, in subsequent discussion.

In the next section, we present the analysis results with supporting statistical data and attempt to interpret them in order to discuss their pedagogical implications.

4.4 Results

4.4.1 Basic facts: Types and distribution

This subsection provides some basic facts from the corpus with respect to the distribution of various types of ZEROS, with numerous examples. Several sub-classifications and supra-classifications of ZEROS will also be proposed.

4.4.1.1 Distribution of zero argument and case types

ZEROS, in our definition, are inferred from two different types of argument structure: verbal argument structure and nominal argument structure. As is easily predicted, there are more zero verbal arguments (1,066 occurrences, 77.13% of total) than zero nominal arguments (316 occurrences, 22.87%) found in our data.

Verbal arguments can further be classified into several case types: nominative (NOM), accusative (ACC) and dative (DAT). Nominal arguments are of one case type: genitive (GEN). Figure 4.1 shows the distribution of each case type of ZEROS (indicated in percentage) found in the corpus.

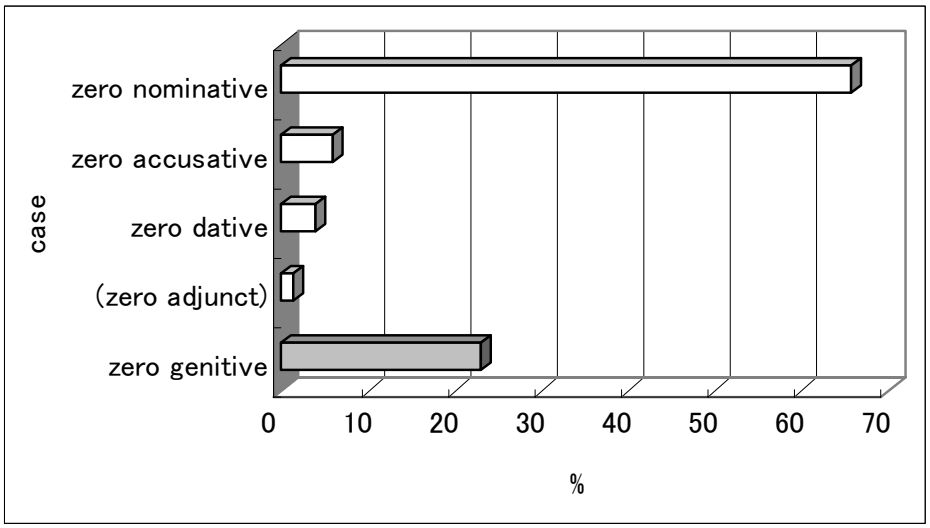


Figure 4.1: Distribution of zero argument case types

As is evident, zero nominatives are the most dominant type of ZEROS (41.38 %, 910 cases) of all ZERO types. An example is given in (4.1).

(4.1) 今年は、 Ø 日本に 留学している。
kotosi-wa, *(Ø-ga)* *nihon-ni* *ryuugaku-site-iru.*
this year-TOP, (Ø-NOM) Japan-LOC study-abroad-do-be

'This year, (she 'Emily') is studying as a foreign student in Japan.'
[*Sokudoku*]

From the utterance (4.1), a nominative NP is missing, and the information of "who is studying in Japan" is not overtly expressed. The high frequency of zero nominatives conforms to the widely acknowledged fact that Japanese often drops its subjects and is often dubbed a "null subject language."[4]

Other types of zero verbal arguments are not so prevalent. Zero accusatives comprise 6.01% (83 cases) and zero datives only 3.84% (53 cases). The sample utterances are given in (4.2) and (4.3) respectively.

(4.2) 六十代、七十代の 人が
60-dai, 70-dai-no *hito-ga*
60's, 70's-GEN people-NOM

もっとも たくさん Ø かく。
mottom *takusan* *(Ø-o)* *kaku.*
most numerously (Ø-ACC) write

'People in their 60's and 70's write (them 'letters') most frequently.'
[*Gendai*]

In (4.2), the information concerning "what they write" is not explicitly given.

(4.3) Ø 「サッチャン」という 名前が ついている。
(Ø-ni) *"Sattyan"-to-iu* *namae-ga* *tuite-iru.*
(Ø-DAT) "Sattyan"-COMPL-say name-NOM assign-be

'The name "Sattyan" is assigned to (it 'to the robot').'
[*Gendai*]

The utterance (4.3) lacks the information concerning "to whom the name is given."

Here is an interesting finding regarding these latter two ZERO cases. Unlike the examples in (4.2) and (4.3), a large number of zero accusatives and zero datives appear

[4] This view is empirically justified by other corpus studies, as well. Fais and Yamura-Takei (2003) report that 72% of subjects (of any person) in the email corpus are ellipted.

in utterances that contain multiple ZEROS (75.90% and 60.38% of the time respectively). In other words, when accusative NPs or dative NPs are ellipted, other NP(s), mostly nominatives, are also dropped, as is shown in (4.4).

(4.4)

Ø	Ø	半分ぐらい	残してしまった。
(Ø-ga)	*(Ø-o)*	*hanbun-kurai*	*nokosite-simat-ta.*
(Ø-NOM)	(Ø-ACC)	half-about	leave-finish-PAST

‘(She ‘Misako’) ended up leaving (it ‘main course dish’) half-finished.’

[*Sokudoku*]

Both “who left unfinished” and “what is left unfinished” are not explicitly stated in (4.4). One extreme case of multiple ellipses is given in (4.5).

(4.5) a.

この犬の	ロボットは	頭が	よくて、
kono-inu-no	*robotto-wa*	*atama-ga*	*yoku-te,*
this-dog-GEN	robot-TOP	brain-NOM	is-good

‘As this robot dog is smart,’

b.

Ø	Ø	Ø	教えてやると、
(*Ø-ga*)	(*Ø-o*)	(*Ø-ni*)	*osiete-yaru-to,*
(Ø-NOM)	(Ø-ACC)	(Ø-DAT)	teach-EMP-if,

‘If (Ø ‘its owner’) teaches (Ø ‘the robot dog’) (Ø tricks),’

c.

Ø	Ø	いろいろ	覚える。
(Ø-ga)	*(Ø-o)*	*iroiro*	*oboeru.*
(Ø-NOM)	(Ø-ACC)	variously	learn

(Ø ‘the robot dog’) learns various (Ø ‘tricks’).

[*Minna 2*]

In both (b) and (c), only the predicates (plus an adverb) are visible; all the arguments are covert, but they are either contextually or situationally recoverable. Talking about a pet dog normally involves its owner teaching it some tricks and manners.

Adjuncts, such as locatives and destinatives, are basically outside the scope of our definition of ZEROS (as mentioned in Chapter 2), but ellipted adjuncts are also detected when they are highly evoked in contexts in which they occur, as in the example below.

(4.6) a.

よしお君は	たま川の	土手へ
Yosio-kun-wa	*tamagawa-no*	*dote-e*
yosio-TOP	Tama-river-GEN	bank-to

サイクリングに	行きました。
saikuringu-ni	*iki-masi-ta.*
cycling-for	go-POL-PAST

'Yosio went cycling on the bank of the Tama River.'

b.

人が	たくさん	Ø	来ていました。
hito-ga	*takusan*	*(Ø-ni)*	*kite-i-masi-ta.*
people-NOM	many	(Ø-in)	come-have-POL-PAST

'Many people were already (there 'on the bank').'

[*Hiroko 2*, slightly simplified]

A zero locative in (b) is highly evoked, and also is the only entity that links the two utterances. This case is not very frequent (1.37%, 19 examples), but these ZEROS are worth noting in terms of their role as creator of coherence.

Nominal arguments, on the other hand, are not further classified into subclasses because they all share the same syntactic construct NP *no*, unlike English that allows both pre-nominal possessive constructions and post-nominal prepositional phrases, as illustrated in (4.7).

(4.7) a.

ジョンの	妹
(zyon-no)	*imooto*
(John-GEN)	sister

'(John's) sister'

b.

ジョンの	翻訳
(zyon-no)	*honyaku*
(John-GEN)	translation

'the translation (by John)'

For this reason, all the nominal arguments, in our definition, are labeled zero genitives (GEN), as we mentioned above. Thus, the two terms, zero nominal argument and zero

genitive, are basically identical; we use either term, throughout the thesis, depending on the relevant typological level. The example from our corpus is given in (4.8).

(4.8)

Ø 放送は	1日に	4時間だけ	でした。
(Ø-no) hoosoo-wa	*1-niti-ni*	*4-zikan-dake*	*desi-ta.*
(Ø-GEN) broadcast-TOP	1-day-in	4-hour only	COP-PAST

'(Ø 'TV') broadcast was only 4 hours long per day.'

[*Minna 1*]

The utterance (4.8) alone does not explicitly present any information of "what type of broadcast," which is supplied by the presence of a zero genitive. Surprisingly, zero genitives are the second most frequent (22.94%, 317 cases) after the dominant type of zero nominatives. This result provides us with a first clear indication of the assumingly significant role of zero nominal arguments in Japanese discourse and coherence.

4.4.1.2 Distribution of ZERO referent types

Next, we labeled ZEROS with their referent types, i.e., local, global, intra-clausal, cataphorical, event, situational, indeterminate, and time/weather (see Chapter 2 for the definitions). The frequencies of each type are summarized in Table 4.3 in the descendent order of frequency.

Referent type	Frequency (# / %)	
	Our corpus	Email corpus
local	887 (64.17%)	115 (42.91%)
global	146 (10.56%)	48 (17.91%)
intra-clausal	130 (9.41%)	5 (1.87%)
indeterminate	104 (7.53%)	8 (2.99%)
situational	56 (4.05%)	62 (23.13%)
event	21 (1.52%)	17 (6.34%)
cataphorical	20 (1.45%)	2 (0.75%)
time/weather	18 (1.30%)	11 (4.10%)
total	1,382 (100%)	268 (100%)

Table 4.3: Frequencies of ZERO referent types

As can be seen, local ZEROS are the most prevalent, followed by global and intra-clausal.

These three anaphoric types, with the antecedents located at three different positions, comprise about 84% of all ZEROS. The remaining types each comprise respectable percentages.

For a cross-genre comparison, we also provide in the table, the distribution of the same referent types found in the Japanese email corpus examined by Fais and Yamura-Takei (2003). The distribution is not totally identical, but highlights some characteristics of each genre. Most striking is the high frequency of "situational" ZEROS in the email corpus. This, we assume, may result from a presumably heavy dependence on the common knowledge shared by the discourse participants (who engaged in the email exchange).[5]

We will provide examples of each referent type from our corpus, while discussing how the referent types interact with the two argument types.

4.4.1.3 Interaction of argument types and referent types

We then made a cross-typological comparison, by examining the distribution of each referent type in relation to its argument type. Figure 4.2 indicates the frequency (in number of occurrences) of each referent type that is syntactically realized as either ZERO argument type.

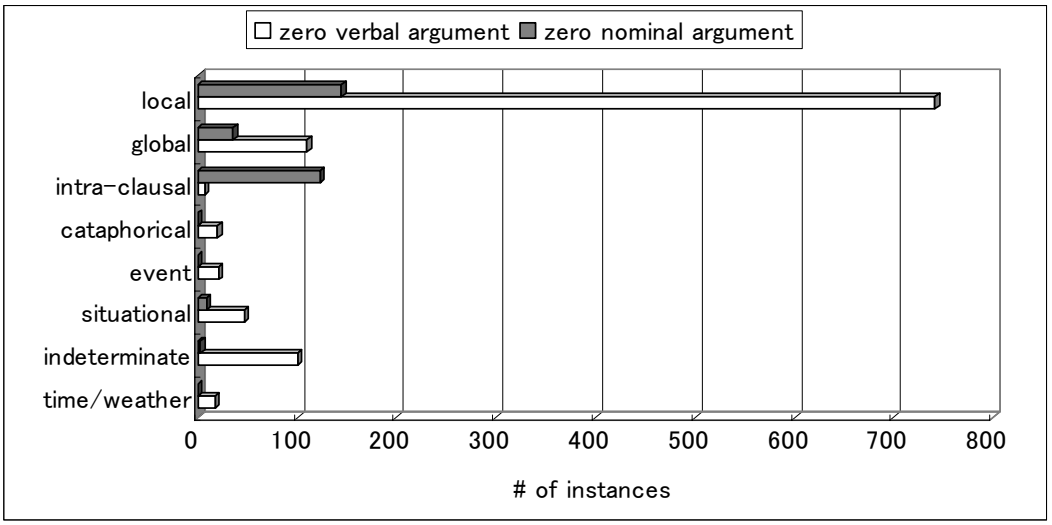


Figure 4.2: Distribution of ZERO referent types according to argument types

The result suggests that the eight referent types can be divided into three groups depending on the tendency as to which argument type they occur as. As is mentioned

[5] This is one domain-specific phenomenon that we attempt to eliminate for the purpose of the coherence analysis (see above for discussion of our motives for the choice of corpus).

earlier, 77.13% of the total of 1382 ZEROS are of the zero verbal argument type. We use this figure as a baseline in order to make the following classification.

The first group includes "local," "global" and "situational," all of which are similarly distributed across both argument types, showing a considerable preference for zero verbal arguments. The average ratio of zero verbal arguments in this group is 82.55%. The second group shows a strong tendency to occur as zero nominal arguments; "intra-clausal" belongs here. For this group, the ratio of zero verbal arguments is only 5.38%. The third group, which includes "cataphorical," "event," "indeterminate" and "time/weather," on the other hand, shows a very strong tendency to appear as zero verbal arguments, with an average ratio of 98.16%. In this group, usage as a zero nominal argument is non-existent or extremely rare. The difference in distribution among the three groups proves to be significant ($x^2 = 438.433$, DF=2, $p < .001$). We will take a closer look at members of each group, with relevant examples from our corpus.

Group 1

For both argument types, local ZEROS are the most prevalent (742 cases for zero verbal arguments; 145 for zero nominal arguments). Examples are provided in (4.9) and (4.10) respectively.

(4.9) a. 花火は 美しいが
hanabi-wa *utukusii-ga*
fireworks-TOP beautiful-but

'Fireworks are beautiful, but'

b. Ø 一瞬で きえる。
(Ø-ga) issyunde kieru.
(Ø-NOM) instantly fade-away

'(they) instantly fade away.'

[*Gendai*]

A zero nominative in (b) is locally linked with an entity *hanabi* 'fireworks' in the adjacent utterance (a).

(4.10) a. 日本では　まだ　オリンピックは
nihon-de-wa　*mada*　*orinpikku-wa*
Japan-in-TOP　yet　Olympics-TOP

ほとんど　知られていなかった。
hotondo　*si-rare-te-i-nakat-ta.*
hardly　know-PASS-be-NEG-PAST

'In Japan, the Olympics were hardly known yet.'

b. Ø 選手を 決めるマラソン大会が　開かれて、…
(Ø-no) sensyu-o kimeru marason-taikai-ga　*hirak-re-te, …*
(Ø-GEN) athlete-NOM choose marathon-race-NOM　hold-PASS-and,

'The marathon race that chose the athletes (for the Olympic Games) was held, and'
[*Minna 2*]

Likewise, a zero genitive in (b) is also locally bound to an entity 'Olympics' mentioned in the immediately preceding utterance (a). The antecedents in both examples are topicalized NPs, but they could appear in other phrase types, too. We will examine a further analysis in 4.4.1.5.

Global reference, another member of the first group, is found in 110 cases of zero verbal arguments, and 36 cases of zero nominal arguments. A verbal argument example is given in (4.11).

(4.11) a. つぎの朝　Ø　おきたとき
tugino-asa　*(Ø-ga)*　*oki-ta-toki*
next-morning　(Ø-NOM)　wake-up-PAST-when

'The next morning when (he) woke up,'

b. 雨は　つよく　ふっていました。
ame-wa　*tuyoku*　*hutte-i-masi-ta.*
rain-TOP　heavily　fall-is-POL-PAST

'it was raining heavily.'

[*Hiroko 2*]

In this example, a zero nominative in (a) is neither intra-clausally nor cataphorically co-referential, but refers a few utterances back to a main character entity 'Takesi.'

Next, a nominal argument example is given in (4.12).

(4.12) a. Ø 眠かったですから、
(*Ø-ga*) *nemuka-tta-kara,*
(Ø-NOM) sleepy-PAST-since,

'Since (they) were sleepy,'

b. Ø まちがいが たくさん ありました。
(*Ø-no*) *matigai-ga* *takusan* *ari-masi-ta.*
(Ø-GEN) mistake-NOM many is-POL-PAST

'many mistakes (in calculation) were found.'

[*Minna 1*]

A zero genitive in (b) refers to an entity 'calculation' explicitly mentioned in the utterance before (a). Both cases had their antecedents somewhere in the previous context. Further analysis concerning the distance between a ZERO and its antecedent will be provided in 4.4.1.6.

Situational reference is found in 47 cases of zero verbal arguments and nine cases of zero nominal arguments.

(4.13) 二人が Ø 注文し終わると、…
hutari-ga *(Ø-o)* *tyuumon-si-owaru-to, …*
two-people-NOM (Ø-ACC) ordering-do-finish-when, …

'When the two finished ordering (dishes), …'

[*Sokudoku*]

From utterance (4.13), a zero accusative is missing. Given that this utterance appears in a restaurant scenario, what they order is naturally inferred by world knowledge to be 'dishes on the menu.'

(4.14) 一人は すぐ Ø 窓を ふきはじめました。
hitori-wa *sugu* *(Ø-no) mado-o* *huki-hazime-masi-ta.*
one-person-TOP soon (Ø-GEN) window-o wipe-begin-POL-PAST

'One person soon began to wipe the windows (of the car).'

[*Nitizyo*]

Utterance (4.14), on the other hand, is part of a gas station scenario; thus a zero genitive should most plausibly refer to an automobile. Compared, however, to the case in (4.13), this inference is to some degree culture-based; in Japan, it is quite common for gas station attendants to wipe the windows and empty the ashtrays of cars while they are filling them with gas for the customers.

Group 2

Intra-clausal ZEROS are apparently a prototypical type for zero nominal arguments (123 cases, 94.62% of total). Typically, this type of zero nominal arguments co-refers with preceding verbal arguments, often subjects, within the clause, as in (4.15).

(4.15)

わかものは	むすめを	Ø 家の	中に
wakamono-wa	*musume-o*	*(Ø-no) ie-no*	*naka-ni*
young-man-TOP	young lady-ACC	(Ø-GEN) house-GEN	inside-in

入れてあげました。
irete-age-masi-ta.
enter-let-POL-PAST

'The young man let the young lady come inside (his**)** house.'

[*Hiroko 2*]

This use of ZEROS is constrained by various syntactic conditions, and can often be replaced with a reflexive, *zibun* 'self,' which in itself is an active area of research in Japanese syntax (e.g., Aikawa, 1993; Inoue, 1976).

The case of zero verbal arguments with intra-clausal referents is very rare (only seven cases). The example (4.16) is counted as such a case.

(4.16)

Ø 兄や友達が	お金を	Ø
(Ø-no) ani-ya tomodati-ga	*okane-o*	*(Ø-ni)*
(Ø-GEN) brother-and-friend-NOM	money-ACC	(Ø-DAT)

集めてくれた。
atumete-kure-ta.
collect-EMP-PAST

'(His) brother and friends raised (him) money.'

[*Minna 2*]

In this case, we count an utterance-initial zero genitive as a local ZERO whose referent is found in the previous utterance, and a zero dative as an intra-clausal ZERO that is co-referential with the preceding zero genitive.

Zero verbal arguments, though not so frequently, also co-refer intra-sententially with entities in embedded phrases or clauses that are left within the whole utterance, as in (4.17).

(4.17) ジェーンがホームステイをしているホストファミリーのお母さんは
Jane-ga hoomusutei-o siteiru hosutofamirii-no okaasan-wa
Jane-NOM homestay-ACC do host family-GEN mother-TOP

毎朝　ジェーンが　出かける時に、
maiasa　Jane-ga　dekakeru-toki-ni,
every-morning Jane-NOM　go-out-when-at,

「今日はどこに行くの？」、「何時ごろ帰って来るの？」と
(Ø-ni) "kyo-wa doko-ni iku-no?," "nanzi-goro kaette-kuru-no?" to
(Ø-DAT) "today-TOP where-to go-Q?" "what-time-around return-Q?" –QUO

Ø　聞きます。
Ø-ni　kiki-masu.
Ø-DAT　ask-POL.

'The mother of the host family whom Jane stays with, asks (Ø 'her'), "where are you going today?" or "what time are you coming back?" every morning when Jane goes out.'

[*Nitizyo*]

In this example, a zero dative is co-referential with an entity (underlined) that appears both in a phrase modifying a topic NP and in an embedded subordinate clause.

Group 3

The vast majority of indeterminate reference ZEROS (101 cases) are zero verbal arguments, and only three are zero nominal arguments; examples of both cases are found in (4.18).

(4.18) a. Ø コーヒーを 飲むと
(Ø-ga) *koohii-o* *nomu-to*
(Ø-NOM) coffee-ACC drink-when

'When (you) drink coffee,'

b. Ø 元気に なります。
(Ø-ga) *genkini* *nari-masu.*
(Ø-NOM) energetic get-POL

'(you) get energetic.

c. Ø 頭の働きが よく なります。
(Ø-no) atama-no hataraki-ga *yoku* *nari-masu.*
(Ø-GEN) brain-GEN function-NOM well become-POL

'(Your) brain functions better.'

[*Minna 1*]

Utterances (a) and (b) contain zero nominatives that refer to people in general, while a zero genitive of the same type is found in (c). These ZEROS are usually translated as 'you' or 'your' in English

The other three types in this group appear only as zero verbal arguments. There are 20 cases of cataphorical reference. All these ZEROS appear in tensed conjuncts and adjuncts,[6] and the referents are found in their main clauses (i.e., the immediately following utterances, with a few exceptions[7]). A stereotypical example is presented in (4.19).

(4.19) a. Ø 美しいかぐや姫のことを 聞いて、
(Ø-ga) *utukusii kaguyahime-no koto-o* *kii-te*
(Ø-NOM) beautiful Princes Kaguya-GEN thing-ACC hear-and

'(They) heard about beautiful Princes Kaguya, and'

[6] Carden (1982) and van Hoek (1997) provide empirical evidence that the majority of cataphorical pronoun instances (in English) are found in fronted subordinate clauses.

[7] There are two cases in which another subordinate clause intervenes between the utterance with ZEROS and the utterances containing their referents.

b. 男たちが　Ø　結婚を　申し込みに　来ました。
otoko-tati-ga　(Ø-ni)　kekkon-o　mousikomi-ni　ki-masi-ta.
men-ACC　(Ø-DAT)　marriage-ACC　propose-to　come-POL-PAST

'some men came to propose marriage to (her).'

[*Minna 2*]

The utterance (a) is in the discourse segment initial position, and there is no previous mention of *okoto-tati* 'men' in the entire discourse. Eight cataphorical cases (out of 20) are of this kind: "first-mention" cataphora.[8] In the other 18 cases, the referents of what we label "cataphorical" ZEROS can also be found in the immediately preceding utterance, across the segment boundary in the adjacent discourse segment; or even beyond several segment boundaries, within the same discourse. These "non-first-mention" types, as well, are intuitively easier to process as (more proximate) cataphorical reference than as (far-reaching) global reference, and thus are labeled as cataphorical.

Event reference is also rare (21 cases), and all of the cases are zero verbal arguments. One example is given in (4.20).

(4.20) a. 映画や漫画の忍者は　水の上を　歩いたり、
eiga-ya manga-no ninzya-wa　mizu-no ue-o　aruitari,
film-and comics-GEN ninja-TOP　water-GEN surface-ACC walk-and

空を　飛んだりしている。
sora-o　tondari-site-iru.
sky-ACC　fly-be-doing.

'Ninjas in films and comics walk on the water and fly in the sky.'

b. でも、　Ø　実際は　無理だ。
demo,　(Ø-ga)　zissai-wa　muri-da.
however,　(Ø-NOM)　in-fact　impossible-COP

'However, that is in fact impossible.'

[*Minna 2*]

The ZERO in (b) refers to the action described in (a), namely, "the act of ninjas walking on the water and flying in the sky." As in this example, ZEROS with event reference

[8] Kuno (1972) claims that there is no first-mention cataphora. However, our corpus contains some counter-examples.

appear with adjectival predicates, such as *taihen-da* 'be-difficult,' *muda-da* 'be-wasteful,' *zannen-da* 'be-pitiable,' and *tanosii* 'be-fun,' or with verbs that require propositional arguments for their subjects or objects, such as *siraberu* 'investigate.'

Lastly, time/weather examples comprise 18 cases, all of which are found in zero verbal argument positions. One such example is given in (4.21).

(4.21) a.

そして、	また	3年が	過ぎて、
sosite,	*mata*	*3-nen-ga*	*sugi-te,*
and,	another	3-year-NOM	pass-and,

'And another three years have passed, and'

b.

Ø	夏に	なりました。
(Ø-ga)	*natu-ni*	*nari-masi-ta.*
(Ø-NOM)	summer-DAT	become-POL-PAST

'(it) became summer.'

[*Minna 2*]

So far, we have seen instances in our corpus of the eight referent types, while examining which argument type they tend to appear as. The interrelationship between argument types and referent types is summarized in Table 4.4 below.

Group	Referent type	Percent as zero verbal argument	Percent as zero nominal argument
1	Local	83.65%	16.35%
	Global	75.34%	24.66%
	Situational	83.93%	16.07%
2	Intra-clausal	5.38%	94.62%
3	Cataphorical	100%	0%
	Event	100%	0%
	Indeterminate	97.12%	2.88%
	Time/weather	100%	0%
	average	77.13%	22.87%

Table 4.4: Interrelationship between argument and referent types

In what follows, we will make some super-classifications of the referent types.

4.4.1.4 NP versus non-NP antecedents

Among the referent types listed above, local, global, intra-clausal, and cataphorical are ZEROS that co-refer with explicit NP antecedents, while event, situational, indeterminate, and time/weather are ZEROS that do not have any explicit co-referring NP antecedents.

The latter type of ZEROS (and pronouns in English) has attracted the attention of researchers who, in particular, are interested in the problem these ZEROS pose for reference resolution. Gundel, Hedberg and Zacharski (2002), for example, claim that 16.1% of the third person personal pronouns found in their English corpus of spontaneous conversation lack NP antecedents. In our corpus, ZEROS with no explicit co-referring NP antecedents comprise 14.40%, while in the email corpus, they made up 36.57%.

The relatively low frequency (14.40%) in our data (compared to the email data) could be accounted for probably by the difference in corpus types. This is an interesting issue to explore, but we will not make any further elaboration here.

4.4.1.5 Referents of local ZEROS

As figure 4.2 above shows, our corpus contains 887 "local" ZEROS, whose antecedents are found in the immediately previous utterance. We examined with which type of entities these ZEROS are co-referential. Figure 4.3 presents the frequency of the antecedent types.

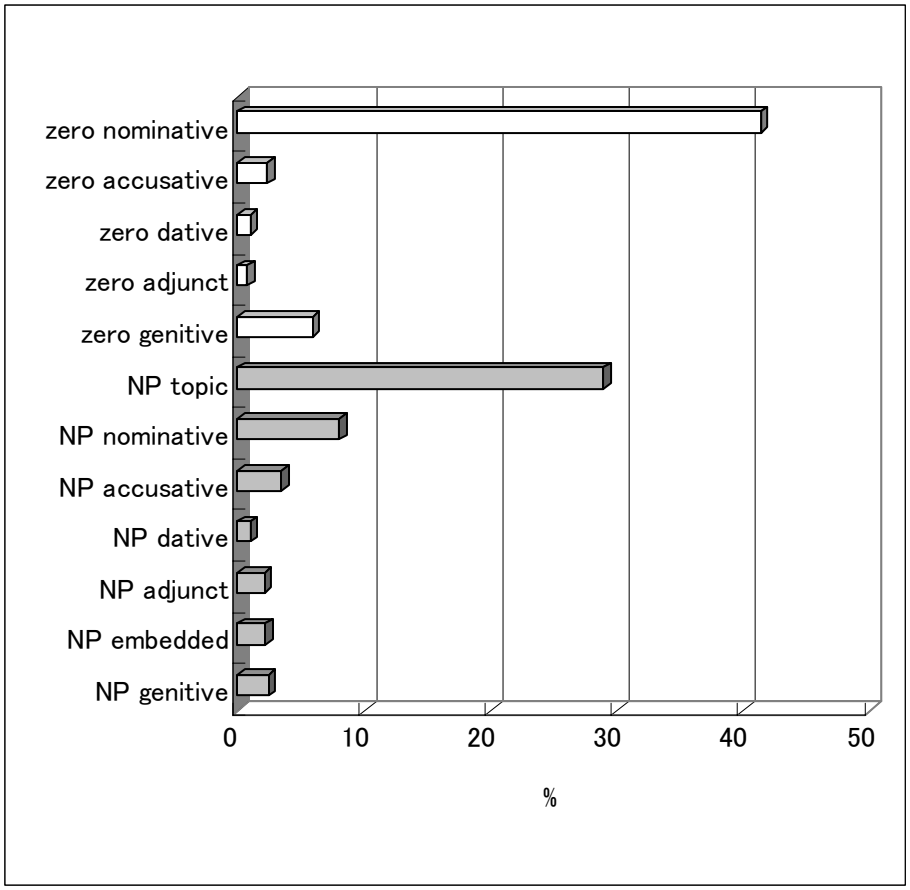


Figure 4.3: Frequency of the antecedent types of local ZEROS

The antecedents of local ZEROS are predominantly zero nominatives (41.38%, 367 instances), which typically occurs as a sequence of utterances with ZERO subjects, as in (c)-(f) in the following example.

(4.22) a 忍者は 昔のスパイだ。
ninzya-wa *mukasi-no supai-da.*
Ninja-TOP old-time-GEN spy-COP

'Ninjas are like spies of olden times.'

b. 忍者は 厳しい訓練を したから、
ninzya-wa *kibisii kunren-o* *si-ta-kara,*
Ninja-TOP hard training-ACC do-PAST-as

'As ninjas did hard training,'

c. Ø　　いろいろなことが　　できた。
(Ø-ga)　　*iroirona koto-ga*　　*deki-ta.*
（Ø-NOM）　　various-thing-NOM　　can-do-PAST

‘(they) could do various things.’

d. Ø　　スポーツの　　選手と　　同じだ。
(Ø-ga)　　*supootu-no*　　*sensyu-to*　　*onazi-da.*
(Ø-NOM)　　sports　　players-as　　same-COP

(They) were like sports players.

e. Ø　　とても速く　　歩いたり、
(Ø-ga)　　*totemo hayaku*　　*aruitari*
(Ø-NOM)　　very fast　　walking

走ったりすることが　　できた。
hasittari-suru-koto-ga　　*deki-ta.*
running-do-NOMI-NOM　　can-do-PAST

(They) could walk or run very fast.’

[*Minna 2*]

The second most frequent antecedent type for local ZEROS is NP topic, i.e., NPs accompanied by the topic marking particle, *wa* (28.97%, 257 cases), as exemplified in (b)-(c) above. Here, almost all the NP topic antecedents (252 instances) turn out to be topicalized subjects. There are only 5 instances of topicalized non-subjects (two objects and three *ni*-marked locative adjuncts), including example (4.23).

(4.23) a. 高層住宅には　　エレベーターが　　あるが、
koosoozyuutaku-ni-wa　　*erebeetaa-ga*　　*aru-ga,*
high-rise-apartment-in-TOP　　elevator-NOM　　is-but,

‘Although there are elevators in high-rise apartments,’

b. それでも　Ø 外へ出るのは　　めんどうなのだろうか。
soredemo (Ø-no) soto-e deru-no-wa　　*mendoona-no-daroo-ka.*
still　　(Ø-GEN)outside-to go-out-NOMI-TOP　　troublesome-Q

‘is going out (of the apartments) still troublesome?’

[*Gendai*]

Apparently, it is 'troublesome' to 'go out of the apartment,' not 'out of the elevator'; the antecedent of a zero genitive in (b) is not an elevator (nominative NP) but an apartment (topic NP, underlined). On the other hand, in example (4.24) below, the antecedent of a zero in (b), underlined, turns out to be a nominative argument 'boat' in (a), setting aside a topicalized locative argument 'ship.'

(4.24) a.

船には	十分な	ボートが	なかったので、
hune-ni-wa	*jyuubunna*	*booto-ga*	*nakat-ta-node,*
ship-on-TOP	enough	boat-NOM	lack-PAST-since

'As there were not enough boats on the ship,'

b.

まず	女の人と	こどもが	Ø	乗りました。
mazu	*onnanohito-to*	*kodomo-ga*	*(Ø-ni)*	*nori-masi-ta.*
first	women-and	child-NOM	(Ø-in)	get-POL-PAST

'Women and children first got in (them 'the boats').'

[*Minna 2*]

There seems to be a difference between topicalized subjects and topicalized non-subjects as far as their topicality (or saliency) status. Recall that Kameyama (1985) excluded topicalized adjuncts (e.g., locatives) from entities entitled to be considered highest-ranking TOPICS in her CF lists.

Still, some ZEROS directly follow NP nominatives, i.e., NPs marked with the nominative particle, *ga*, without initial topicalization (8.13%, 72 cases), as in (4.25).

(4.25) a.

むかし	ある村に	びんぼうなわかものが
mukasi	*aru mura-ni*	*binboona wakamono-ga*
long ago	certain village-in	poor young-man-NOM

住んでいました。
sunde-i-masi-ta.
live-be-POL-PAST

'Long ago, a poor young man lived in a village.'

b. ある日、 Ø 道で 矢がささったつるを
aru-hi, (Ø-ga) miti-de ya-ga sasatta turu-o
one-day, (Ø-NOM) road-on arrow-NOM stuck crane-ACC

見つけました。
mituke-masi-ta.
find-POL-PAST

'One day, (he) found a crane stuck with an arrow on the road.'

[*Hiroko 2*]

Also, referential chains created by a zero-genitive-ZERO (of any type) sequence are not rare; in fact, they are the fourth most frequent (5.98%, 53 cases). This is instantiated in (4.26).

(4.26) a. Ø 値段も 高すぎましたから、
(Ø-no) nedan-mo taka-sugi-masi-ta-kara,
(Ø-GEN) price-FOC high-too-POL-PAST-since

'As (its 'curry's) price was too expensive,'

b. 普通の人は あまり Ø
hutuu-no hito-wa amari (Ø-o)
ordinary-GENpeople-TOP often (Ø-ACC)

食べることができませんでした。
taberu-koto-ga deki-mase-n-desi-ta.
eat-ing-NOM able-POL-NEG-COP-PAST

'ordinary people could not eat (it 'curry') often.'

[*Minna 2*]

The remaining antecedent types comprise less than 4% each. This data provides suggestive evidence that (overt or covert) subjects, regardless of whether they are topicalized or not, are the most likely antecedent candidates for local ZEROS. Here again, the role of zero genitives may be worth noting; we will return to this topic later.

4.4.1.6 How far is global?

"Global" ZEROS are the second most frequent type after "local" both in our corpus (146 occurrences, 10.56%) and in the email corpus (48 occurrences, 17.91%). Like "local" ZEROS, the referents of global ZEROS do exist somewhere in the previous discourse; unlike "local," they occur at a long distance. This brings up the question, "how far is global?" That is, how many utterances typically separate a ZERO from its antecedent in these cases? Figure 4.4 shows the results from our corpus.

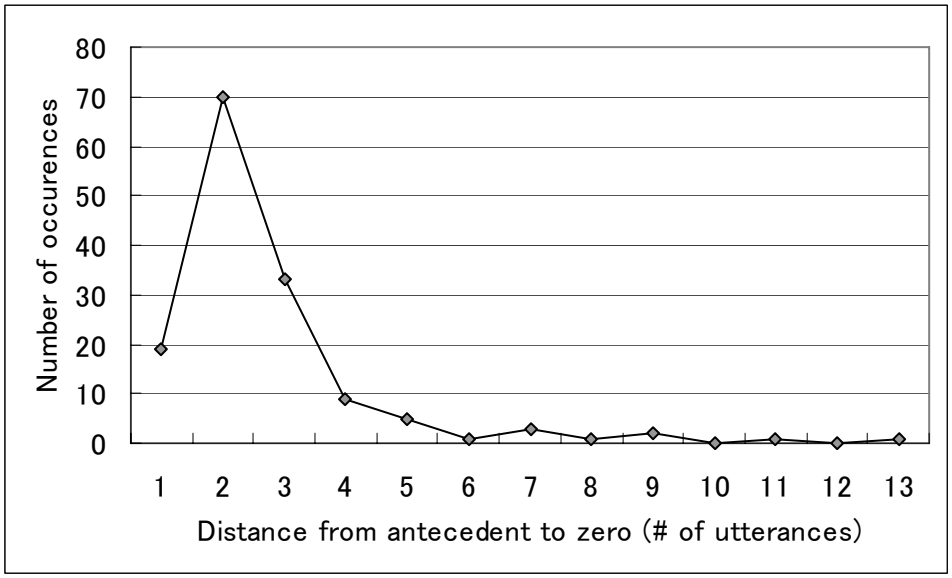


Figure 4.4: Distance from antecedent to "global" ZERO measured in # of utterances

Here, the ZEROS whose antecedents are found in the utterances immediately adjacent (i.e., at a distance of one), but beyond the discourse segment boundary, are also counted as "global." Thus, the distance ranges from one to 13 utterances, averaging 2.51 utterances.[9] In this corpus, the majority of "global" references are to antecedents that are only two or three utterances away from their ZERO references. However, there are 55 cases in which the reach is across one or more discourse segment(s), regardless of the distance.

[9] This average distance is a little shorter than that of the email corpus (3.35 utterances).

4.4.2 Basic facts: CENTERS and TRANSITIONS

In this subsection, we present some basic facts concerning the corpus regarding CENTER realization and TRANSITION distribution, before we go on to detailed TRANSITION sequence-based analyses of ZERO-involving coherence in Section 4.4.3.

4.4.2.1 CENTER realization

Our main concern is the behavior of ZEROS that is explicated by the centering mechanism. For the sake of comparison, we divide the possible CB forms linguistically realized in an utterance into two major types: ZERO and non-ZERO. Here, non-ZERO forms include repeated names (e.g., *Tanaka-san*, 'Mr. Tanaka') and bare nouns (e.g., *kaisya*, 'the company'), demonstratives (e.g., *kore*, 'this'), demonstrative nouns (e.g., *kono kawa*, 'this river') and lexical pronouns (e.g., *kare*, 'he'). ZEROS include, according to what we defined in Chapter 2, both zero verbal arguments and zero nominal arguments. As for ZERO referent types, only "local," "situational" and "cataphorical" are considered as CB candidates, i.e., entities listed in CF.[10]

Figure 4.5 shows the distribution of CENTER realization forms.

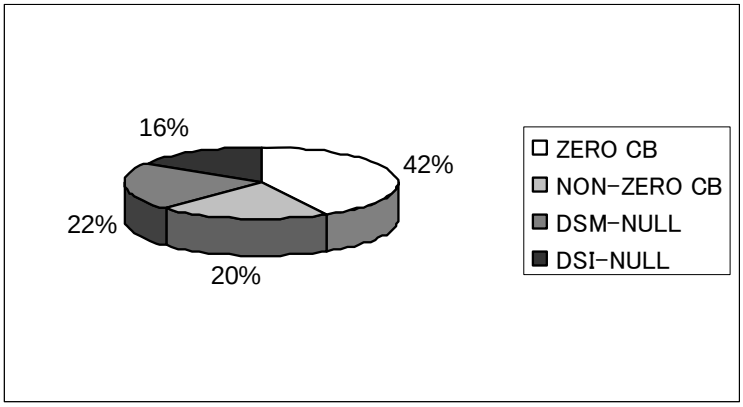


Figure 4.5: CENTER realization

Out of the total of 2,007 utterances in the corpus, 314 (15.65%) have no CBs because of their discourse segment-initial (DSI) positions, and another 445 (22.17%) utterances in discourse segment medial (DSM) positions have no CBs either, for some

[10] "Global" ZEROS are naturally excluded by the centering constraint on CENTERS. "Intra-clausal" is outside the scope of centering, and is instead treated by a syntactic constraint, like binding (see Yamura, 1996 for discussion). "Time/weather" corresponds to expletives that are also outside the scope of centering. The remaining two types, "event" and "indeterminate," are often the subject of debate concerning their validity as .CENTERS. We exclude these two from the CB candidates for the present study.

possible reasons that we will investigate and discuss in 4.4.3.5. These utterances with no CBs are labeled NULL (see Chapter 3). The remaining 1,248 utterances do have CBs that are realized by either ZEROS (841 utterances, 41.90%) or non-ZEROS (407 utterances, 20.28%). The occurrence of ZERO CBs is more than double that of non-ZERO CBs. This result shows the significant role of ZEROS in creating entity-based coherence.

According to Iida (1998) who examined Japanese newspaper texts (which consisted of 250 utterances), CBs in 51.11% of utterances are realized by ZEROS, which is roughly comparable to our result.

4.4.2.2 CB types

Next, we further examined what forms and grammatical roles those CBs take. The result is summarized in Figure 4.6.

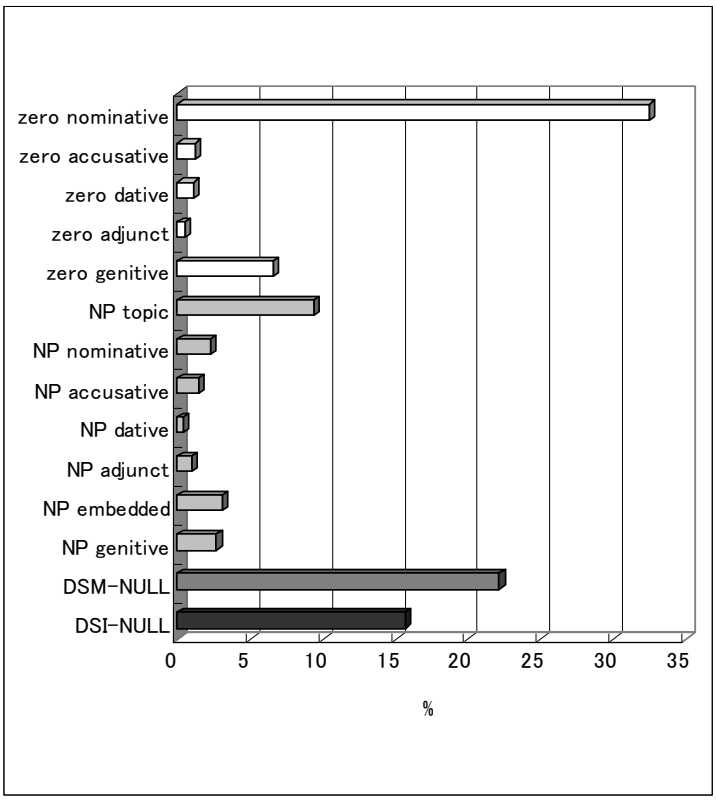


Figure 4.6: Frequency of CB forms

At the top come zero nominatives (651 cases, 32.44%). This is followed by topic-marked NPs (188 cases, 9.37%), 180 of which are topicalized subjects. These two major CB realization forms suggest the prominent role of subjects in centering, as is

observed in other languages as well (e.g., Turan, 1998).

The next most frequent type is zero nominal arguments (132 cases, 6.58%). This figure is striking, particularly when compared to the other zero verbal argument CBs: zero accusatives (24 cases, 1.20%); zero datives (23 cases, 1.15%); and zero adjuncts (11 cases, 0.55%). Apparently, zero nominal arguments deserve more attention than they have previously received in the centering literature. We will further discuss the role of zero nominal arguments in the centering mechanism in the following sections.

4.4.2.3 Sample centering analysis

Before we go on to examine the distribution of TRANSITION types, this subsection presents a sample discourse segment from our corpus (4.27), in order to characterize each TRANSITION type both in intuitive and centering terms. The segment consists of the following eight utterances.

(4.27) a. 江戸時代は 藩が ありました。
edo-jidai-wa *han-ga* *ari-masi-ta.*
Edo-era-TOP feudal clan-NOM exist-POL-PAST

'In the Edo era, there were feudal clans.'

b. Ø 今の 県と だいたい 同じです。
(Ø-ga) *ima-no* *ken-to* *daitai* *onaji-desu.*
(Ø-NOM) current-GEN prefecture-to roughly equivalent-COP

'They are roughly equivalent to the current prefectures.'

c. 藩に 大名が いました。
han-ni *daimyo-ga* *i-masi-ta.*
clan-in feudal lord-NOM be-POL-PAST

'In each clan, there resided a feudal lord.'

d. 大名は 自分の 藩と 江戸に Ø うちが あって、
daimyo-wa *zibun-no* *han-to* *edo-ni* *(Ø-no)* *uti-ga* *atte,*
clan-TOP self-GEN clan-and Edo-in (Ø-GEN) home-NOM be,

'Feudal lords had (their) homes both in their clans and in Edo, and'

e. Ø Ø 藩に 1年、 江戸に 1年
(Ø-ga) (Ø-no) han-ni 1-nen, edo-ni 1-nen
(Ø-NOM)(Ø-GEN) clan-in 1-year, Edo-in 1-year

住まなければなりませんでした。
sum-anakereba-narimasen-desi-ta.
live-have-to-POL-PAST

'(they) had to live one year in (their) clans and another year in Edo.'

f. Ø 奥さんと子どもは 江戸に 住んでいました。
(Ø-no) okusan-to kodomo-wa edo-ni sunde-i-masi-ta
(Ø-GEN) wife-and children-TOP Edo-in live-be-POL-PAST

'(Their) wives and children lived in Edo.'

g. Ø 江戸まで 歩いて行かなければなりませんでしたから、
(Ø-ga) edo-made aruite-ik-anakereba-narimasen-desi-ta-kara,
(Ø-NOM) Edo-as far as walk-go-have-to-POL-PAST-because

'(They) had to walk as far as Edo, so'

h. Ø[11] とても 大変でした。
(Ø-ga) totemo taihen-desi-ta.
(Ø-NOM) very tough-COP-PAST

'it was very tough.'

[*Minna 1*]

Let us first describe this segment in intuitive terms. This segment starts by talking about *han* 'feudal clan' and gradually shifts its topic from *han* 'feudal clan' to *daimyo* 'feudal lord.' Although the segment introduces a potential new topic *okusan-to-kodomo* 'wife-and-children,' it provides no further mention of them. Instead of this short-lived entity, the segment keeps talking about the previous topic 'feudal lord.' The segment ends with commenting on the tough feudal system described in the previous context.

Now we will offer a more technical characterization of the segment, as in (4.28).

[11] This is an example of an "event" ZERO, which is beyond the scope of our centering analysis; thus the utterance is labeled NULL.

(4.28) Utterance (a) provides 'clan' as a potential topic,
Utterance (b) continues 'clan,'
Utterance (c) retains 'clan' and introduces 'feudal lord,'
Utterance (d) shifts attention to 'feudal lord,'
Utterance (e) continues 'feudal lord,'
Utterance (f) retains 'feudal lord' and introduces 'wife and children,'
Utterance (g) continues 'feudal lord,' and
Utterance (h) sums up, without referring to any specific entity.

Finally, a very technical centering account for this segment is provided; the CENTER structure and TRANSITION state are computed for each utterance in the segment in (4.29).

(4.29)

a.	CB: none	CF: clan > Edo era	NULL
b.	CB: clan	CF: (clan) > prefecture	CON
c.	CB: clan	CF: feudal lord > clan	RET
d.	CB: feudal lord	CF: feudal lord > home > clan > Edo	SHIFT
e.	CB: feudal lord	CF: (feudal lord) > clan > Edo	CON
f.	CB: feudal lord	CF: wife and children > (feudal lord) > Edo	RET
g.	CB: feudal lord	CF: (feudal lord) > Edo	CON
h.	CB: none	CF: none	NULL

The centering account perfectly matches the intuitively perceived topic (dis)continuity. For instance, the "gradual shift" to a new topic is realized by a RETAIN in (d) followed by a SHIFT in (c). A "short-lived" entity is accounted for by a CONTINUE in (g) followed by a RETAIN in (f), and so on.

We will use this 'feudal lord' discourse segment several times later, when we discuss TRANSITION sequences in more detail in 4.4.3.1.

4.4.2.4 TRANSITION types

Figure 4.7 shows the distribution of the four TRANSITION types (CONTINUE, RETAIN,[12] SMOOTH-SHIFT, and ROUGH-SHIFT), plus DS-initial NULL and DS-medial NULL, assigned to all 2,007 utterances in the corpus.

[12] Our CONTINUE and RETAIN include what Kameyama (1985) calls "Center Establishment" (i.e., the TRANSITION between an utterance without a CB and one with a CB). Here, we follow Walker, Iida and Cote (1994) and include, in the definition of CONTINUE and RETAIN, TRANSITION states from utterances without CBs.

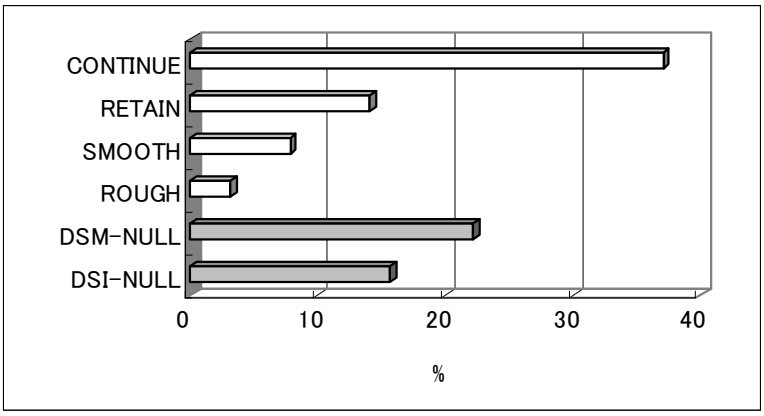


Figure 4.7: Distribution of centering TRANSITIONS

As Table 4.4 below shows, the relative proportion of each TRANSITION type is in the order of the single TRANSITION preferences predicted by Brenann et al. (1987), with a considerable number of CONTINUEs, followed by a respectable number of RETAINs, and then SMOOTH-SHIFTs, and a very few ROUGH-SHIFTs. This proportion is roughly equivalent to those examined for other languages.[13]

	Our study: **Japanese**		Poesio et al. (2004): **English**		Roh and Lee (2003): **Korean**	
CONTINUE	744	37.07%	260	25.87%	374	47.83%
RETAIN	282	14.05%	41	4.08%	218	27.88%
SMOOTH-SHIFT	158	7.87%	32	3.18%	86	11.00%
ROUGH-SHIFT	64	3.19%	29	2.89%	104	13.30%
NULL	759	37.82%	643	63.98%	-	-
TOTAL	2007		1005		782	

Table 4.4: Cross-linguistic comparison of TRANSITION distribution

In earlier studies of centering based on constructed examples, the existence of the NULL TRANSITION state (or elsewhere called "No CB" condition) had not been recognized. More recent corpus-based studies, however, reveal an abundance of occurrences of NULL in naturally-occurring data. The proportion of NULL, counting both DS-initial and DS-medial, in our corpus turns out to be 37.82%. In Poesio et al.'s data, the utterances with NULL TRANSITIONS make up 63.98%. The NULL

[13] Poesio *et al*. (2004) examined an English corpus and Roh and Lee (2003a, b) analyzed Korean data taken from news, story and descriptive texts. Roh and Lee did not provide the number of NULL utterances, if any, so the percentage presented in the table cannot be compared directly to those in the other two studies.

TRANSITION, however, does not necessarily indicate coherence breakdown in a discourse, nor is a sequence of NULL-labeled utterances always perceived as totally incoherent. This, in a sense, argues that a centering-based account of coherence should be supplemented by a more global view of coherence or by other approaches to coherence, such as a so-called relation-based approach.

4.4.2.5 Distribution of ZERO/non-ZERO CBs

Figure 4.8 presents the distribution of the TRANSITION types according to ZERO/non-ZERO CBs realized in each utterance. This result presents a significant difference among the four TRANSITIONS in terms of their preference for ZERO/non -ZERO CBs ($x^2 = 83.82$, DF=3, $p < .001$).

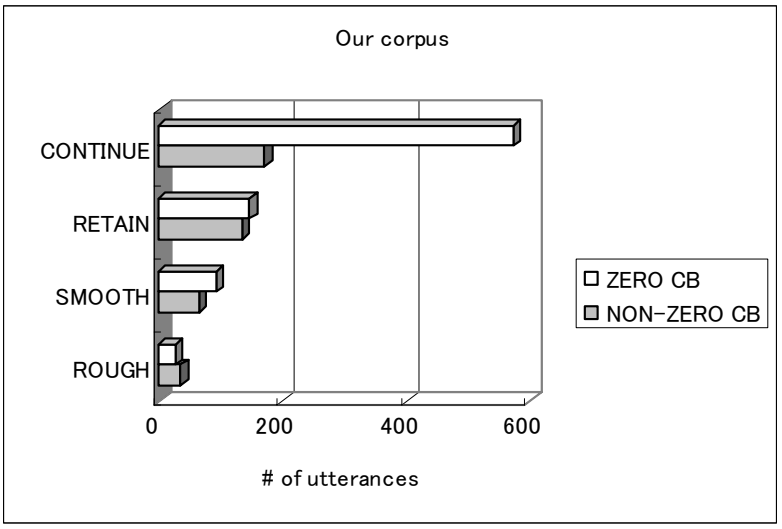


Figure 4.8: Distribution of TRANSITIONS in terms of ZERO/non-ZERO CBs

ROUGH-SHIFT is the only TRANSITION state in which non-ZERO CBs are preferred over ZERO-CBs, but the degree of preference (measured simply by the frequency) apparently varies among the other three TRANSITION states; CONTINUE shows the strongest preference for ZERO-CBs, followed by SMOOTH-SHIFT, and RETAIN shows a weaker preference. This result is roughly compatible with that reported by Tanimura and Yoshida (2003) who examined Japanese narratives based on the Pear Film (Chafe, 1980) produced by native speakers. The frequency of the TRANSITION types with respect to ZERO/non-ZERO CBs in their data is reproduced in Figure 4.9

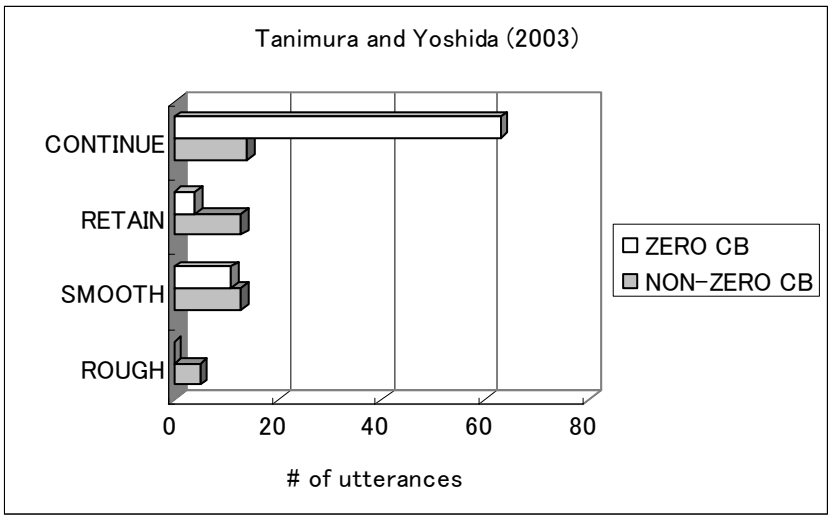


Figure 4.9: Distribution of TRANSITIONS in terms of ZERO/NON-ZERO CBS in (Tanimura and Yoshida, 2003)

On the other hand, the result in Iida (1998) presents a rather unique distribution, as shown in Figure 4.10 below.

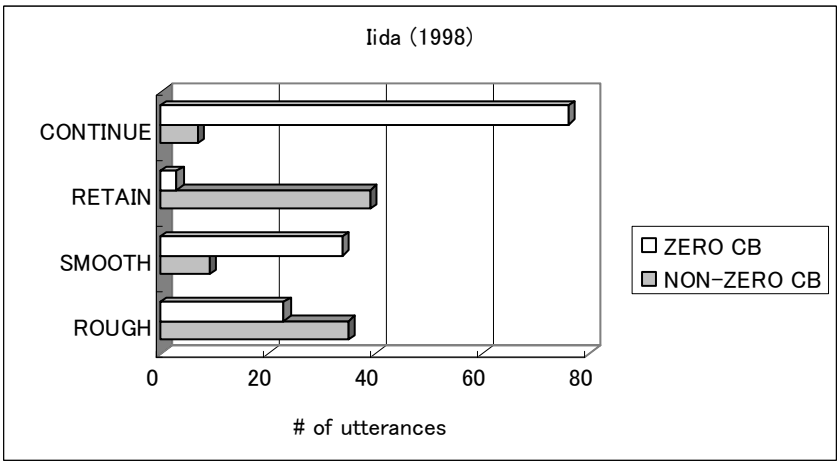


Figure 4.10: Distribution of TRANSITIONS in terms of ZERO/non-ZERO CBS in (Iida, 1998)

The high frequency of NON-ZERO CBS in RETAIN and ZERO CBS in SMOOTH-SHIFT TRANSITIONS are two major characteristics. We suspect that this is partially due to differences in the way these TRANSITIONS are defined.

Let us next examine the distribution of ZERO CBS in each TRANSITION type. The relative proportion of ZERO CBS in each TRANSITION type is given in Table 4.6 below.

	% (# of ZERO CB / # of utterances)	
CONTINUE	77.02%	(573/744)
RETAIN	52.13%	(147/282)
SMOOTH-SHIFT	58.86%	(93/158)
ROUGH-SHIFT	43.75%	(28/64)
Average	67.39%	(841/1,248)

Table 4.6: Proportion of ZERO CBs in TRANSITIONS

The most striking feature of this table is the outstandingly dominant role of ZERO CBs in CONTINUE. In our corpus, ZEROS are used 77% of the time. When we compare CONTINUE and all the other TRANSITIONS combined (see Table 4.7 below) in terms of the distribution of ZEROS/non-ZEROS, there is a significant difference ($x^2 = 77.713$, $p < .001$).

	ZERO CBs	non-ZERO CBs	ratio of ZERO CBs
CONTINUE	573	171	77%
other TRANSITIONS	268	236	53%
Total	841	407	67%

Table 4.7: Comparison of CONTINUE and other TRANSITIONS

This leads to the most well defined hypothesis concerning the interaction between CB forms and TRANSITION types, in (4.30).

(4.30) The CONTINUE hypothesis:

> ZEROS, rather than more explicit forms (e.g., full NPs, strong pronouns), are used to CONTINUE the CENTER.

Iida (1998) confirms, based on her analysis of Japanese newspaper texts, the validity of this hypothesis; ZEROS are used more than 90% of the time in CONTINUE, with a significant difference between that and the use of ZEROS in other TRANSITION types ($x^2 = 53.932$, $p < .001$). Di Eugenio (1998) presents a similar tendency in Italian; ZEROS are strongly preferred (80% of the time) in CONTINUE, but not in other TRANSITIONS, with a significant difference between the two groups ($x^2 = 9.204$, $p < .001$), which is a compatible result to our Japanese data (see Table 4.7). She claims that the usage of ZEROS for CONTINUE is seemingly "a robust cross-linguistic phenomenon (page

130)."

The tendency expressed in the CONTINUE hypothesis, however, is not clearly observed among the other three TRANSITION types ($x^2 = 4.54$, DF=2, $p < .020$); ZEROS and non-ZEROS are roughly equally used to realize the CENTERS. Rather striking is the fact that ZEROS are as frequently used as non-ZEROS in those TRANSITIONS. That is, ZEROS, as well as non-ZEROS, are used to signal a shift (RETAIN) and to make a shift (SMOOTH-SHIFT and ROUGH-SHIFT) in the CENTER. This is compatible with Iida (1998) who concludes that "full NPs are not always used to shift the CENTER, and ZEROS frequently are" (page 163).

Some researchers claim that ROUGH-SHIFT is extremely rare (2% in Hurewitz's (1998) English corpus) and it is often collapsed into other TRANSITIONS in their analyses. Our corpus, as well, exhibits ROUGH-SHIFT in only 3.34% of the utterances (see Figure 4.8 above), but the two SHIFT states (SMOOTH and ROUGH) are significantly different from each other in terms of the preference for ZERO/non-ZERO CBs ($x^2 = 4.19$, DF=1, $p < .005$). So we keep this distinction, when applicable, and abandon it, when irrelevant, in the subsequent discussion.

Although these figures present an interesting characterization concerning certain aspects of centering phenomena, a single-TRANSITION-based analysis will not best characterize the relationship among the perceived degree of coherence of a given discourse, TRANSITIONS and the use of ZEROS, as we discussed earlier. In the next section, we will move on to the TRANSITION-sequence-based analyses of the corpus.

4.4.3 Main Facts: Coherence and ZEROS

We have so far seen some fundamental facts concerning the types and distribution of ZEROS and single-TRANSITION-based centering analysis of the corpus. This section presents some further facts concerning the interrelationship between the use of ZEROS and degrees of discourse coherence that centering principles can account for, which in fact is the main part of our corpus study.

Here, we follow Di Eugenio (1998) among others, and take a TRANSITION-sequence approach to examining the distribution of ZEROS in relation to centering-predicted degrees of coherence. Di Eugenio, in analyzing the CONTINUE TRANSITION in her data, considers the possible TRANSITION states of the utterance U_{i-1} that precedes the utterance U_i in which a CONTINUE occurs, and presents three different TRANSITION sequence patterns: CON-CON, RET-CON and SHIFT-CON. Although she limited her analysis to the CONTINUE sequence group due to the small number of samples of the RETAIN and SHIFT sequences found in her corpus, we extend our analysis to the other sequence groups with fairly rich samples. As a result, we have eleven different sequence patterns: (i) CON-CON, (ii) RET-CON, (iii) SHIFT-CON, (iv) NULL-CON, (v) CON-RET, (vi) RET-RET, (vii) SHIFT-RET, (viii) NULL-RET, (ix) CON-SHIFT, (x) RET-SHIFT, and (vi) SHIFT-SHIFT, all of which we presented earlier in 3.2.3.5. One novel contribution of this corpus study is the comprehensiveness of this analysis.[14]

Perceived degrees of coherence of certain ZERO-involving discourses or the amount of inferential cost required in processing those discourses is our prime concern, and this cost can be tested through behavioral psychological experiments. Psychological studies, like those previously conducted by Gordon, Grosz, and Gillion (1993) and Brennan (1995), are outside the scope and the interest of this study, and thus, we take an empirical (corpus-based) approach.

Our fundamental assumption is that "invisible" ZERO CBs tend to appear in centering conditions that require less inferential demand, while "visible" non-ZERO CBs are used in centering conditions that require more inference cost, on the ground that texts are generally planned so that they turn out to be unambiguous. We conjecture that the analysis result of "real data" concerning the ZERO/non-ZERO CB distribution will provide an indication of relative degrees of inferential cost that certain environments impose. That is, a certain TRANSITION sequence in which more ZERO CBs appear should be less costly in terms of inference demand in interpreting a discourse containing that TRANSITION sequence.

[14] Other corpus studies that take TRANSITION-sequence approach include Turan (1995) for Turkish, Prasad (2003) for Hindi, Roh and Lee (2002) for Korean, and Poesio et al. (2002, 2004) for English, none of which explicitly present data concerning all the eleven sequence patterns. Many of these attempts, including ours, were made after (and probably in answer to) Grosz and Sidner (1998) who described the utterance-based approach to Rule 2 as one outcome of "lost intuitions and forgotten intentions" of the original centering.

Based on this assumption, we examined the distribution of ZERO/non-ZERO CBs in each sequence pattern. The result is summarized in Figure 4.1. Recall that a TRANSITION sequence involves three successive utterances, in which the label is assigned in the last utterance. Here, we see whether that last utterance contains a ZERO/non-ZERO CB (see 3.2.3.5 for detailed discussion on TRANSITION sequences).

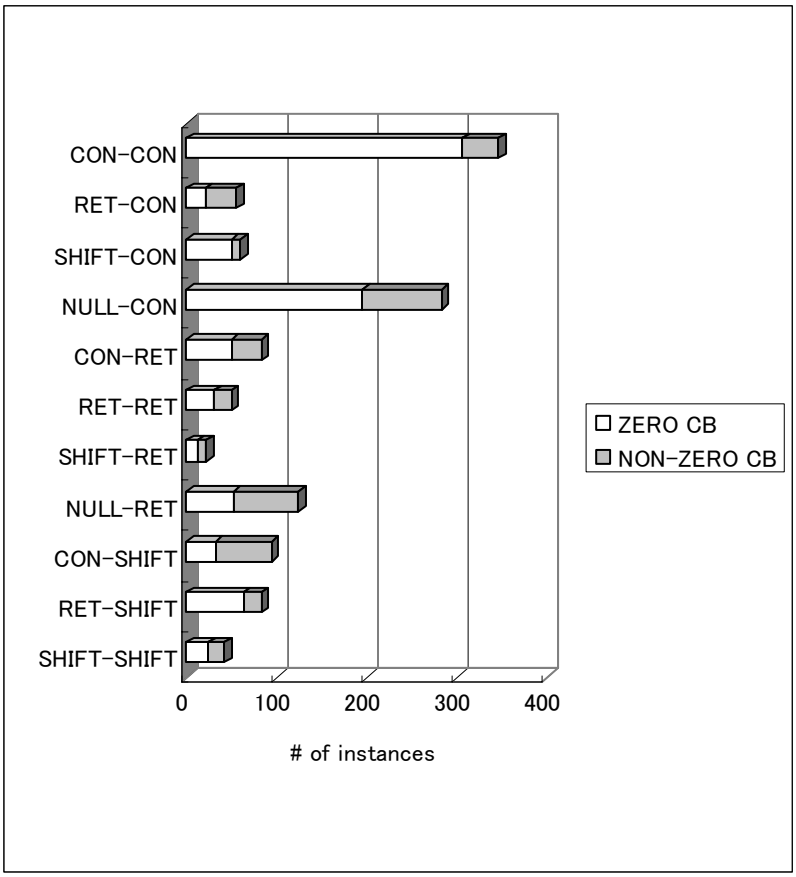


Figure 4.11: Distribution of ZERO/non-ZERO CBs in TRANSITION sequence patterns

Apparently, there is a difference in CB type distribution within the same TRANSITION sequence groups; compare, for example, RET-CON and SHIFT-CON in the CONTINUE group, and also CON-SHIFT and RET-SHIFT in the SHIFT group.

In the following subsections, we attempt to characterize each sequence pattern, both theoretically, based on centering predictions concerning the amount of inference required to process certain sequences, and empirically, based on relevant samples from our corpus. We also provide statistical evidence from the corpus, in an attempt to support those observations.

4.4.3.1 ZEROS in the CONTINUE sequence type

In Section 4.4.2.4 above, we provided suggestive evidence for the hypothesis that ZEROS are strongly preferred to CONTINUE the CENTER both from our corpus study and from some previous studies. Although the hypothesis appears to be a statistically (and cross-linguistically) valid claim, there still remains room for further investigation; whether every CONTINUE state constitutes a "preferable" environment for ZERO CBs. Here, we pay attention to the TRANSITION state of a preceding utterance, as well.

Figure 4.12 below shows the occurrences of ZERO/non-ZERO CBs in utterances in the four TRANSITION sequence patterns of the CONTINUE group.

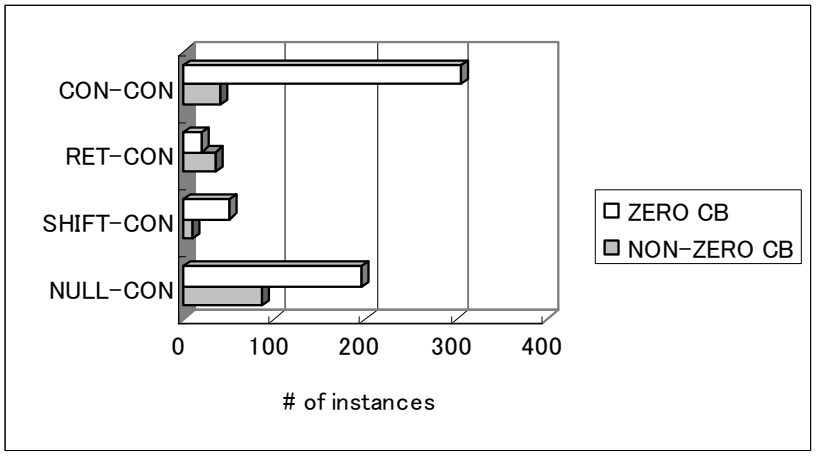


Figure 4.12: Distribution of ZERO/non-ZERO CBs in CONTINUE sequences

The figure indicates that there is a significant difference, among the four types of TRANSITION sequence type, in the tendency to realize CBs by either ZERO or non-ZERO ($x^2 = 85.60$, DF=3, $p < .001$). We will further examine each sequence with a focus on ZERO CBs.

CON-CON

The CON-CON sequence is considered to be the most coherent (GJW95). Here, an utterance in the CON-CON sequence means an utterance labeled CONTINUE that follows an utterance also labeled CONTINUE. Look at a prototypical example of this type from our corpus, in (4.31).

(4.31)	a.	トム君のお父さんは、	日本に	来る前に、
		tomu-kun-no otoosan-wa,	*nihon-ni*	*kuru-mae-ni,*
		Tom-GEN father-TOP,	Japan-to	come-before-at,

‘Before Tom’s father came to Japan,’

DSI-NULL

b. Ø アメリカで 日本語を 勉強しませんでした。
(Ø-ga) amerika-de nihongo-o benkyoo-si-mase-n-desi-ta.
(Ø-NOM) America-in Japanese-ACC studying-do-POL-NEG-PAST

‘(he) didn’t study Japanese in America.’

NULL-CON

c. Ø 日本に 来て、
(Ø-ga) nihon-ni ki-te,
(Ø-NOM) Japan-to come-and,

‘After (he) came to Japan,’

CON-CON

d. Ø 日本語を 勉強しました。
(Ø-ga) nihongo-o benkyoo-si-masi-ta.
(Ø-NOM) Japanase-ACC studying-do-POL-PAST

‘(he) studied Japanese.’

CON-CON

[*Hiroko 1*]

The use of ZEROS in the CON-CON sequences, as in utterances (c) and (d), is straightforward and far from ambiguous. This sequence is typical in beginning level JSL texts, as an introductory sample discourse that contains ZEROS.

Out of 346 examples of this sequence, 306 cases realize their CENTERS by means of ZEROS (88%). This ratio is convincingly higher than that of ZEROS in the CONTINUE group as a whole (77.02%). From this data, we conjecture that the CON-CON is a more adequate indication than the single CONTINUE TRANSITION of a preferable environment for ZEROS.

NULL-CON, SHIFT-CON and RET-CON

Recall the ‘feudal lord’ discourse segment that we presented in 4.4.2.3, which perfectly fits our purpose of examining these three sequence patterns in the CON sequence group. Let us reproduce the segment below as (4.32).

(4.32) a. 江戸時代は 藩が ありました。
edo-jidai-wa han-ga ari-masi-ta.
Edo-era-TOP feudal clan-NOM exist-POL-PAST

'In the Edo era, there were feudal clans.'

b. Ø 今の 県と だいたい 同じです。
(Ø-ga) ima-no ken-to daitai onaji-desu.
(Ø-NOM) current-GEN prefecture-to roughly equivalent-COP

'They are roughly equivalent to the current prefectures.'

c. 藩に 大名が いました。
han-ni daimyo-ga i-masi-ta.
clan-in feudal lord-NOM be-POL-PAST

'In each clan, there resided a feudal lord.'

d. 大名は 自分の 藩と 江戸に Ø うちが あって、
daimyo-wa zibun-no han-to edo-ni (Ø-no) uti-ga atte,
clan-TOP self-GEN clan-and Edo-in (Ø-GEN) home-NOM be,

'Feudal lords had (their) homes both in their clans and in Edo, and'

e. Ø Ø 藩に 1年、 江戸に 1年
(Ø-ga) (Ø-no) han-ni 1-nen, edo-ni 1-nen

(Ø-NOM)(Ø-GEN) clan-in 1-year, Edo-in 1-year

住まなければなりませんでした。
sum-anakereba-narimasen-desi-ta.
live-have-to-POL-PAST

'(they) had to live one year in (their) clans and another year in Edo.'

f. Ø 奥さんと子どもは 江戸に 住んでいました。
(Ø-no) okusan-to kodomo-wa edo-ni sunde-i-masi-ta
(Ø-GEN) wife-and children-TOP Edo-in live-be-POL-PAST

'(Their) wives and children lived in Edo.'

g. Ø 江戸まで 歩いて行かなければなりませんでしたから、
(Ø-ga) edo-made aruite-ik-anakereba-narimasen-desi-ta-kara,
(Ø-NOM)Edo-as far as walk-go-have-to-POL-PAST-because

'(They) had to walk as far as Edo, so'

h. Ø とても 大変でした。
(Ø-ga) totemo taihen-desi-ta.
(Ø-NOM) very tough-COP-PAST

'it was very tough.'

[*Minna 1*]

The CENTER structure of each utterance is also presented, this time labeled with a TRANSITION sequence type, in (4.33). The CF elements realized by ZEROS are indicated by parentheses.

(4.33)

a.	CB: none	CF: clan > Edo era	NULL
b.	CB: clan	CF: (clan) > prefecture	**NULL-CON**
c.	CB: clan	CF: feudal lord > clan	CON-RET
d.	CB: feudal lord	CF: feudal lord > home > clan > Edo	RET-SHIFT
e.	CB: feudal lord	CF: (feudal lord) > clan > Edo	**SHIFT-CON**
f.	CB: feudal lord	CF: wife/children > (feudal lord) > Edo	CON-RET
g.	CB: feudal lord	CF: (feudal lord) > Edo	**RET-CON**
h.	CB: none	CF: none	NULL

The three sequence patterns with which we are concerned here are indicated in bold. We will look at how these TRANSITION sequence types interact differently with the distribution of CB types, and attempt to explicate the reasons for that difference.

The segment starts with the NULL-CON sequence, in utterances (a) and (b). The CONTINUE in this sequence is equivalent to Kameyama's (1986) "Center Establishment."[15] This sequence is the second most frequent (283 cases) after the CON-CON, and also shows preference for ZERO CENTERS (69% of the time), but not as

[15] Walker, Iida and Cote (1994) proposed that utterances that follow an utterance without a CB should also be classified as center continuations; the idea is that even the first utterance of a segment does have a CB, but this CB is initially underspecified, and is only determined when the second utterance is processed. The idea of Kameyama (1986), on the contrary, is that center continuation and center establishment should be differentiated. Our label NULL-CON, in this sense, stands in the spirit of the latter idea.

strongly as the CON-CON (88%).

Second, the utterances (d) and (e) constitute the SHIFT-CON sequence. The SHIFT TRANSITION is a state that establishes a shift from the previous CENTER ('clan' in this example) to a new one ('feudal lord'). Therefore, shifts will naturally be "followed by a sequence of continuations characterizing another stretch of locally coherence discourse" (GJW95, page 215). Thus, the interpretation of ZEROS in this sequence is predicted not to require a lot of inferential effort. The occurrence of this sequence itself is not very frequent (60 cases), but the preference goes to ZERO CENTERS as frequently as 83% of the time.

Finally, we will turn to the RET-CON sequence that is characterized by utterances (f) and (g). RETAIN, by definition, is a state that signals a subsequent CENTER shift by realizing the CENTER in a less salient position. The reader is warned by this signal (i.e., realization of the CENTER 'feudal lord' from the previous utterance in a lower ranked position[16]), and predicts a topic change to a newly introduced entity, 'wife-and-children' in this case. This RETAIN-driven signal, however, is followed by a CONTINUE that maintains the old CENTER in this sequence. This contra-prediction sequence may cause some inferential cost in interpreting ZEROS even though the utterance alone is in the presumably most coherent TRANSITION state, i.e., CONTINUE.

In order for the ZERO in this "problematic" sequence to be accurately interpreted, additional information resources, other than centering, are necessary. In this particular case, it is inferencing from "contextual knowledge" concerning who lives in Edo and in the clan. We will later summarize potential resources of inference that supplement centering mechanisms in perceiving ZERO-containing discourse as reasonably coherent, in 4.6.3.

A clear contrast can be observed if the utterance (g) is replaced with (g') below.

(4.34') f. Ø 奥さんと子どもは 江戸に 住んでいました。
(Ø-no) okusan-to kodomo-wa edo-ni sunde-i-masi-ta
(Ø-GEN) wife-and children-TOP Edo-in live-be-POL-PAST

'(Their) wives and children lived in Edo.'

g'. Ø 藩へ 行くことは ゆるされませんでした。
(Ø-ga) han-e iku-koto-wa yuru-sare-masen-desi-ta.
(Ø-NOM) clan-to go-NOMI-TOP allow-CAUS-NEG-POL-PAST

'(They) were not allowed to go to the clan.'

[16] In our configuration of the CF ranking, zero nominal argument entities are ranked lower than their head noun entities.

Unlike the original discourse, attention is shifted to 'wife and children,' as predicted, creating a SHIFT in (g'), hence constituting a RET-SHIFT sequence in (f) and (g'). Theoretically, this sequence provides a more natural flow of CENTER management, in the sense that the prediction is fulfilled.[17] We will return to this RET-SHIFT sequence in 4.4.3.3.

Before we move on to the next sequence, let us provide another example of the RET-CON from our corpus in (4.34).

(4.34) a.

しげる君は	いたずらが好きな子	です。
Sigeru-kun-wa	*itazura-ga sukina-ko*	*desu.*
Sigeru-TOP	mischief-NOM like-kid	COP

'Sigeru is a mischievous kid.'

b.

先生が	いくら	Ø	注意しても	RET
sensei-ga	*ikura*	*(Ø-ni)*	*cyuui-site-mo*	
teacher-NOM	how-often	Ø-DAT	warning-do-though	

'No matter how often teachers may warn (him) not to,'

c.

Ø	いたずらを	します。	CON
(Ø-ga)	*itazura-o*	*si-masu.*	
(Ø-NOM)	mischief-ACC	do-POL	

'(he) keeps causing mischief.'

[*Hiroko 2*]

The CENTER 'Sigeru' is retained in (b) and a new entity *sensei* 'teacher' is introduced in a subject position, which signals a shift to this new entity. In (c), however, the old CENTER 'Sigeru' is realized by a subject ZERO, and hence the CONTINUE. If we apply the Zero Topic Assignment (ZTA) rule proposed by Walker, Iida and Cote (1990, 1994) here, this can be interpreted as a CON-CON sequence, but we assume that applying the rule also requires some, if not a great deal of, intentional or strategic inference. A number of factors, such as "contextual knowledge" from (a), "commonly-held knowledge" about who does warning and who does mischief, and the "conjunctive relation" between (b) and (c), seem to enable the interpretation of ZERO in this contra-prediction condition (see 4.6.3 for a summary).

The frequency of this RET-CON sequence is as low (56 cases and 7.51% of the

[17] Hence, this sequence is "theoretically" anticipated to be easier to process for Japanese speakers and probably for Japanese learners, but we need to wait until it is empirically verified (see Chapter 8).

CON sequence group) as that of the SHIFT-CON, but there is a significant difference between the two sequence patterns, in the way they realize CENTERS ($x^2 = 25.626$, $p < .001$). In the RET-CON sequence, ZEROS are less frequently used (37.5% of the time).

Summary of the CONTINUE group

The three different sequence patterns in the CONTINUE group have different status in terms of preference for ZERO CENTERS. This is summarized in Table 4.8, where the four sequence patterns are categorized as either "low-cost," "medium," or "high-cost"; this grouping was hypothesized earlier in Chapter 3, based on the centering prediction, defined as Rule 2, concerning inferential cost required by a certain sequence of TRANSITIONS.

centering prediction	sequence	# of ZERO CB	# of non-ZERO CB	% of ZERO CBs
"low-cost"	CON-CON	306	40	88.44%
	SHIFT-CON	50	10	83.33%
"medium"	NULL-CON	196	87	69.26%
"high-cost"	RET-CON	21	35	37.50%

Table 4.8: ZERO occurrences in CON sequences

When the three groups ("low-cost," "medium" and "high-cost") are compared, they present a significant difference in the distribution of ZERO CBs ($x^2 = 87.509$, DF=2, $p < .001$). That is, our theory-driven distinction is now supported by statistical evidence. Di Eugenio (1998) presents a similar result for Italian zero pronouns. Turan (1995) also found similar results in the comparison of null and explicit pronouns in Turkish.

4.4.3.2 ZEROS in the RETAIN sequence type

Before we examine ZEROS in RETAIN-labeled utterances, let us first clarify the environment defined as RETAIN.

What is RETAIN?

Unlike CONTINUE or SHIFT that "literally" continues or shifts CENTERS respectively, RETAIN is a state that is not as straightforward in capturing its precise function. However, the RETAIN TRANSITION plays an important role in CENTER management.

As well as the CONTINUE TRANSITION, RETAIN keeps the same CENTER from the previous utterance, but the realization of the current CENTER in a less salient position in

the utterance suggests the introduction of a potential new CENTER placed in a more salient position in the utterance. This functions as a sort of signal or warning for a subsequent CENTER shift. Therefore, capturing this signal may lead to a smoother shift of attention to another entity.

RETAIN is established by means of two conditions: (i) introduction of a potential new CENTER and (ii) allocation of a previous CENTER to a less salient position. In other words, the RETAIN state of a certain utterance (U_i) involves two entities; one is the previous CENTER, CB (U_{i-1}), that is realized in a lower-ranked position, such as OBJECT or ADNOMINAL, of U_i, and the other is the CP (U_i), which is either a totally new entity, a globally retrieved entity, or a non-CB member of CF (U_{i-1}). The realization of these two entities can be made either explicitly (via non-ZEROS) or implicitly (via ZEROS), which constitutes four possible combinations. Each combination is presented below with relevant examples from our corpus.

(i) non-ZERO CP/ non-ZERO CB

(4.35) a.

ひろこさんは	2じに	えみさんの	うちへ	いきました。
hiroko-san-wa	*2-zi-ni*	*emi-san-no*	*ie-e*	*iki-masi-ta.*
Hiroko-TOP	2-o'clock-at	Emi-GEN	house-to	go-POL-PAST

'Hiroko went to Emi's house at 2 o'clock.'

b.

えみさんは	ひろこさんの	ともだち	です。
emi-san-wa	*hiroko-san-no*	*tomodati*	*desu.*
Emi-TOP	Hiroko-GEN	friend	COP

'Emi is Hiroko's friend.'

[*Hiroko 1*]

In (b), both entities, Hiroko (CB) and Emi (CP), are realized with explicit mention of names.

(ii) non-ZERO CP/ZERO CB

(4.36) a.

船には	十分な	ボートが	なかったので、
hune-ni-wa	*zyubunna*	*booto-ga*	*nakat-ta-node,*
ship-on-TOP	enough	boat-NOM	lack-PAST-because

'As the ship lacked enough boats,'

b. まず　女の人と　子供が　Ø　乗りました。
mazu　*onnanohito-to*　*kodomo-ga*　*(Ø-ni)*　*nori-masi-ta.*
first　woman-and　child-NOM　(Ø-on)　get-in-POL-PAST

'women and children rode in the boats first.'

[*Minna 2*]

In (b), a new entity 'woman-and-child' is explicitly introduced as CP, while CB is realized as a ZERO.

(iii) ZERO CP/non-ZERO CB

(4.37) a. 初めに　パンとサラダが　たくさん　出てきた。
hazimeni　*pan-to sarada-ga*　*takusan*　*dete-ki-ta.*
first　bread-and salad-NOM　much　come-out-PAST

'First, a lot of bread and salad were served.'

b. Ø　それを　食べながら
(Ø-ga)　*sore-o*　*tabe-nagara …*
(Ø-NOM)　that-ACC　at-while

'While (they) were eating that, …"

[*Sokudoku*]

In (b), CB is realized explicitly as a demonstrative pronoun, while CP is realized as ZERO whose referent is globally located beyond the utterance (a).

(iv) ZERO CP/ZERO CB

(4.38) a. 犬も　くまも　ロボット　なので、
inu-mo　*kuma-mo*　*robotto*　*na-node,*
dog-FOC　bear-FOC　robot　COP-because

'Because those dogs and bears are robots,'

b. Ø　Ø　食べ物を　やったり、… しなくてもよい。
(Ø-ga)　*(Ø-ni)*　*tabemono-o*　*ya-ttari,･･･ si-nakute-mo-yoi*
(Ø-NOM)　(Ø-DAT)　food-ACC　give …do-not-need-to

'(They 'the owners') do not need to give (them 'robot dogs and bears') food'

[*Minna 2*]

In (b), the two entities are realized as ZEROS; the CB is a "locally" referential ZERO, whereas the CP is a situationally evoked ZERO entity.

We have seen examples for the four possible CP/CB combinations for RETAIN. Turning now to the frequency of each combination, we see an interesting tendency. CP is realized via non-ZEROS in the majority of cases (91.13% of the time: 43.62% plus 47.52% in the table), which is intuitively a reasonable choice for a signaling role. The frequency of the four types is summarized in Table 4.9.

	CP (U_i)	CB (U_i)	# (%)	%
(i)	non-ZERO	non-ZERO	123 (**43.62%**)	48.23%
(ii)	ZERO	non-ZERO	13 (4.61%)	
(iii)	non-ZERO	ZERO	134 (**47.52%**)	51.77%
(iv)	ZERO	ZERO	12 (4.26%)	
TOTAL			282 (100%)	(100%)

Table 4.9: Realization of two entities in RETAIN

CB, on the other hand, does not show any strong preference for either realization type; it is realized by non-ZEROS 48.23% of the time, and by ZEROS 51.77%. This contrasts with the result of Iida (1998) who examined a Japanese newspaper corpus. In her corpus, non-ZEROS are far more frequently used (92.86% of the time, 39 cases) than ZEROS (only 3 cases) for CBs in RETAIN. This is possibly due to the difference in the computation of RETAIN; we consider zero nominal arguments as potential RETAIN CB realizers, but Iida probably did not.

A closer look at the CENTER realization in the RETAIN condition, as presented in Figure 4.13 below, verifies this; RETAIN is created in a number of cases (103 out of 283 cases, 36.40%) by zero nominal arguments (=zero genitive) in our analysis.

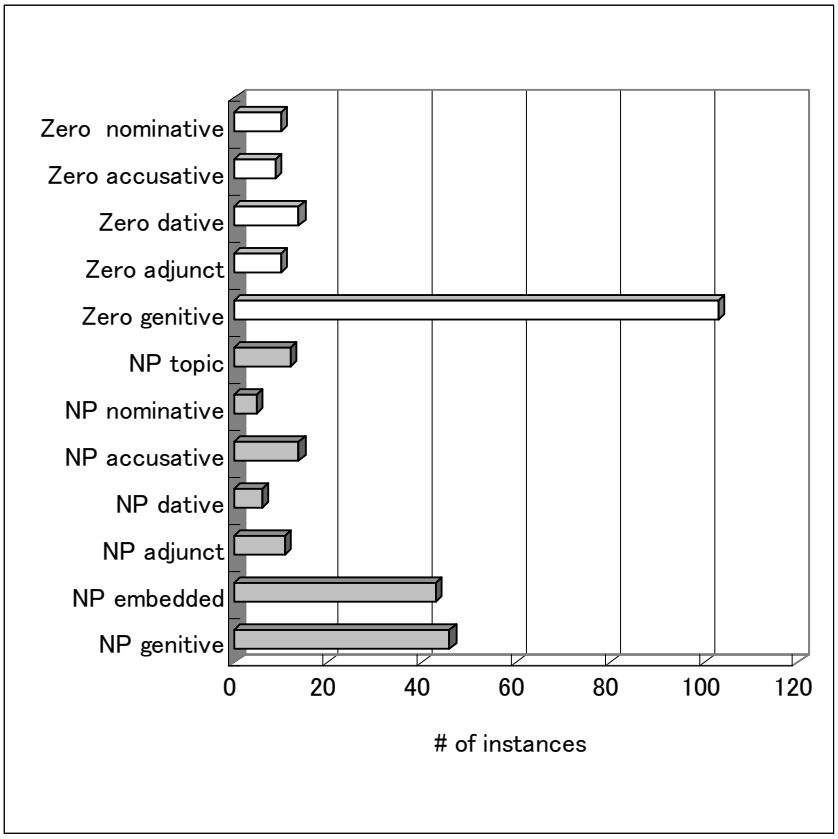


Figure 4.13: CENTER realization in RETAIN

As we discussed earlier in Chapter 3, the realization of RETAIN by zero nominal arguments matches our intuition about the perceived degree of coherence, particularly when compared to that created by CONTINUE or SHIFT. The role of zero nominal arguments in coherence establishment has just not been paid much attention to in the centering literature, which is actually an important claim of this thesis.

We have clarified the characteristics and functions of RETAIN. Their relation to ZEROS, however, has not been fully explicated; it is not as clear-cut as the CONTINUE hypothesis. In order to gain more insights concerning this TRANSITION type, we now move on to the TRANSITION-sequence-based analysis. We classify the RETAIN group into the four different sequence patterns labeled CON-RET, RET-RET, SHIFT-RET, and NULL-RET. The distribution of ZERO/non-ZERO CBs in these sequence patterns is given in Figure 4.14 below.

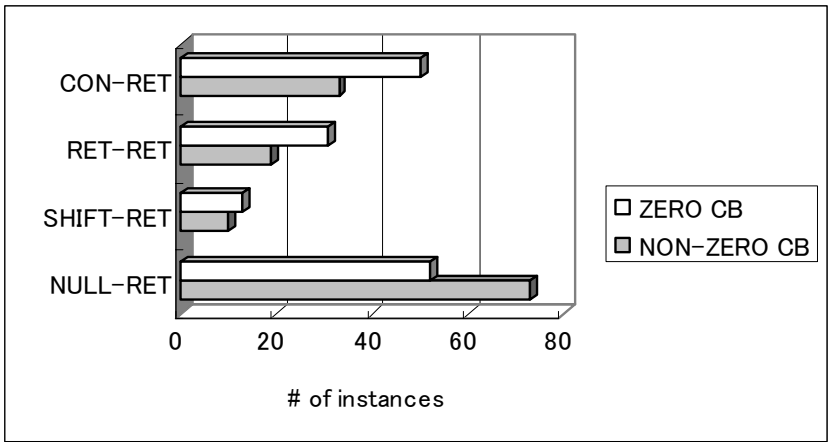


Figure 4.14: Distribution of ZERO/non-ZERO CBs in RETAIN sequences

The difference in distribution of CB forms among the four sequence types proves to be significant ($x^2 = 9.865$, DF=3, $p < .025$), but not as strongly as that in the CONTINUE group ($x^2 = 85.608$, DF=3, $p < .001$). Let us examine each pattern.

NULL-RET

In this group, the most frequent sequence turned out to be the NULL-RET (125 cases and 44% of the RET group). This sequence equals the Center Establishment of Kameyama (1986), together with the NULL-CON sequence discussed earlier. The difference between the two lies in the way in which an initially underspecified CB is realized in the current utterance, either as CP or as non-CP, as exemplified in the following sample pairs, (4.39) and (4.40), from our corpus.

(4.39) a. ジョージは、 文部省の試験に パスして、 NULL
zyooji-wa, monbusyo-no siken-ni pasu-si-te,
George-TOP, ministry-of-education-GEN exam-in pass-and,

'George passed the ME exam, and'

b. Ø 日本に 一年 留学することになった。 CON
(Ø-ga) nihon-ni 1-nen ryuugaku-suru-koto-ni nat-ta.
(Ø-NOM) Japan-in 1-year study-abroad-do-COMPL-to become-PAST

'(he) was allowed to study one year in Japan.'

[*Sokudoku*]

In this example, CB (a) 'George' is realized as ZERO in the CP (b) position, and hence

utterance (b) constitutes a CONTINUE.

(4.40) a. ジェイソンが 日本に 着いた 次の日、 NULL
Jason-ga *nihon-ni* *tui-ta* *tugi-no hi,*
Jason-NOM Japan-in arrive-PAST next day,

'The next day Jason arrived in Japan,'

b. ホストファミリーのお母さんが、
hosutofamirii-no okaasan-ga,
host-family-GEN mother-NOM,

隣の 佐藤さんの 家へ
tonari-no *Sato-san-no* *ie-e*
neighbor-GEN Mr.Sato-GEN home-to

Ø あいさつに 連れていってくれた。 RET
(Ø-o) *aisatu-ni* *turete-itte-kure-ta.*
(Ø-ACC) greeting-for take-go-EMP-PAST

'His host mother took him to their neighbor Sato for a greeting.'

[*Sokudoku*]

Here, CB (a) 'Jason' is realized as ZERO in the non-CP (b) object position, and hence utterance (b) constitutes a RETAIN, which is presumed to require a higher inference cost than the (4.39) sequence.[18]

This difference is reflected in their preference for ZERO/non-ZERO CENTERS. The NULL-RET does not favor ZERO CENTERS (41.6%), while the NULL-CON does (69.26%).

CON-RET

The CON-RET sequence comprises 83 occurrences: the second most frequent after NULL-RET in the RETAIN group. RETAIN after CONTINUE implies a warning for a shift from the previously established CENTER to a new one, and this warning is done by realizing CB in a less salient position. Recall again the 'feudal lord' discourse segment presented in 4.4.3.1. The segment is partially repeated as (4.41).

[18] In this particular example, the recognition of empathy locus or the application of ZTA will help readers perceive the discourse as more coherent, since it changes the TRANSITION state of the discourse to CONTINUE.

(4.41) a. 江戸時代は 藩が ありました。 NULL
edo-jidai-wa *han-ga* *ari-masi-ta.*
Edo-era-TOP feudal clan-NOM exist-POL-PAST

'In the Edo era, there were feudal clans.'

b. Ø 今の 県と CON
(Ø-ga) *ima-no* *ken-to*
(Ø-NOM) current-GEN prefecture-to
だいたい 同じです。
daitai *onazi-desu.*
roughly equivalent-COP

'They are roughly equivalent to the current prefectures.'

c. 藩に 大名が いました。 RET
han-ni *daimyo-ga* *i-masi-ta.*
clan-in feudal lord-NOM be-POL-PAST

'In each clan, there resided a feudal lord.'

d. 大名は 自分の 藩と 江戸に SHIFT
daimyo-wa *zibun-no* *han-to* *edo-ni*
clan-TOP self-GEN clan-and Edo-in

Ø うちが あって、
(Ø-no) uti-ga *atte,*
(Ø-GEN) home-NOM be,

'Feudal lords had (their) homes both in their clans and in Edo, and'

e. Ø Ø 藩に 1年、 江戸に 1年 CON
(Ø-ga) *(Ø-no)* *han-ni* *1-nen,* *edo-ni* *1-nen*
(Ø-NOM)(Ø-GEN) clan-in 1-year, Edo-in 1-year

住まなければなりませんでした。
sum-anakereba-narimasen-desi-ta.
live-have-to-POL-PAST

'(they) had to live one year in (their) clans and another year in Edo.'

f. Ø 奥さんとどもは 江戸に 住んでいました。 RET
(Ø-no) okusan-to kodomo-wa edo-ni sunde-i-masi-ta
(Ø-GEN) wife-and children-TOP Edo-in live-be-POL-PAST

'(Their) wives and children lived in Edo.'

[*Minna 1*]

This segment contains two examples of this sequence type, in (b)-(c) and in (e)-(f). In the former case, the CENTER is retained by a non-ZERO, a bare noun *han* 'clan,' while the latter realizes the retention of the CENTER with a zero nominal argument. This sequence prefers, though not strongly, ZERO CBs (60.24% of the time).

SHIFT-RET

The SHIFT-RET sequence has not been discussed in any centering literature, to the best of our knowledge, probably due to its rareness (only 23 cases in our corpus). A typical example from our corpus is given below.

(4.42) a. Ø むこうからくる人に
(Ø-ga) mukoo-kara kuru hito-ni
(Ø-NOM) opposite-side-from come person-into

ぶつかりそうになると、
butukari-soo-ni-naru-to,
run-be-about-to-when

'When (it 'robot') is going to run into a person coming from the opposite direction,'

b. Ø 「スミマセン、ミチヲアケテクレル？」と CON
(Ø-ga) "sumimasen, miti-o akete-kureru?"-to
(Ø-NOM) "excuse-me, way-ACC clear-EMP?" -QUO

Ø 言う。
(Ø-ni) iu.
(Ø-DAT) say

'(it) says to (her 'the person'), "Excuse me, but let me go through."

c. その人が　　道を　　あけると、　　SHIFT
sono-hito-ga　*miti-o*　*akeru-to*
that-person-NOM　way-ACC　clear-when

'When the person clears the way,'

d. Ø　　「アリガトウ、オカラダヲタイセツニネ」と　　RET
(Ø-ga)　*"arigatoo, okarada-o taisetu-ni-ne"-to*
(Ø-NOM) "thank-you, your-health careful-about-please"-QUO

Ø　　あいさつする。
(Ø-ni)　*aisatu-suru.*
(Ø-DAT)　greeting-do

'(it 'robot') greets the person, "Thank you, and take care of yourself."
[*Gendai*]

This sequence involves two entities, 'robot' and 'person (who is coming toward the robot)' who are realized in (a). The first entity 'robot' continues to be the CENTER in (b), but the second salient entity 'person' is shifted rather abruptly to the CENTER in (c), namely the CON-SHIFT sequence. In (d), the shifting of the CENTER back to the previous one 'robot' is anticipated by placing 'person' in a less salient object position. This signal for "shifting back" (in this example) or for "another shifting" is the nature of the SHIFT-RET sequence.

Describing this sequence in more intuitive terms, the point of view in this segment of discourse is not fixed, but rather is flexible. GJW95 presents a similar discourse and claims that this "flip[ping] back and forth among several different entities" (page 206) makes this sequence less coherent (or more inference-dependent[19]) than a discourse that is continuously about the same entity, i.e., the CON-CON sequence. What makes ZEROS in this discourse unproblematic for native speakers is "world knowledge;" when one person does something for another, the latter person usually expresses gratitude.

In this sequence, ZERO CBs are slightly more frequent (56.52%) than non-ZERO CBs.

RET-RET

Lastly, the RET-RET sequence makes up 50 examples in our corpus. This type is defined, in GJW95, as the second most preferred sequence after the CON-CON. New

[19] At least for native speakers of Japanese, this segment does not sound "incoherent" at all if they utilize contextual knowledge.

entities keep being introduced while maintaining the same CB. This situation is represented by an example from GJW95, in (4.43). Here, GJW assume that "the door ranks above the house in CF (b)" (page 217).

(4.43) a. The house appeared to have been burgled.
CB: none CF: house
b. The door was ajar.
CB: house CF: door > house RET
c. The furniture was in disarray.
CB: house CF: furniture > house RET

Although this discourse segment keeps introducing new entities, such as 'door' and 'furniture,' it maintains the same CB 'house.'[20] As a result, the whole segment is perceived to be "about" one entity 'the house,' but in a different way from the more coherent CON-CON sequence.

Similar samples are abundant in our corpus. Below is one such example.

(4.44) a.

ひろこさんは	けん君と	いっしょに	NULL
hiroko-san-wa	*ken-kun-to*	*issyo-ni*	
Hiroko-TOP	Ken-with	together	

トム君のうちへ	遊びに	行きました。
tomu-kun-no uti-e	*asobi-ni*	*iki-masi-ta.*
TOM-GEN house-to	visit-to	go-POL-PAST

'Hiroko went to visit Tom's house with Ken.'

b.

きれいな花が	たくさん	RET
kireina hana-ga	*takusan*	
beautiful flower-NOM	many	

Ø 庭に	植えてありました。
(Ø-no) niwa-ni	*uete-ari-masi-ta.*
(Ø-GEN) garden-in	plant-be-POL-PAST

'Many beautiful flowers were planted in the garden."

[20] For GJW, the CB 'house' is "realized, but not directly realized" (via functional relations) in (b) and (c). For us, in a corresponding Japanese discourse, the CB *ie* 'house' is a zero nominal argument, which is a directly but implicitly realized entity (see discussion in Chapter 3).

c. けん君がトム君にあげた自転車が RET
ken-kun-ga tomu-kun-ni age-ta zitensya-ga
Ken-NOM Tom-DAT give-PAST bicycle-NOM

Ø ガレージに 置いてありました。
(Ø-no) gareezi-ni *oite-ari-masi-ta*
(Ø-GEN) garage-in place-be-POL-PAST

'The bicycle that Ken gave TOM was in the garage.'

d. 大きなふじ山の絵が RET
ookina huzisan-no e-ga
Large Mt. Fuji-GEN painting-NOM

Ø 居間に かけてありました。
(Ø-no) ima-ni *kakete-ari-masi-ta.*
(Ø-GEN) living-room-in hang-be-POL-PAST

'A large painting of Mt. Fuji was hung in the living room.'
[*Hiroko 1*, slightly simplified]

In the same way as the "functional dependent" example above, while maintaining the same CENTER 'house,' this sequence keeps mentioning what's in the house, specifying its parts such as 'garden,' 'garage' and 'living room.'

This sequence type inclines toward ZERO CBs (62.00%). This figure is slightly higher than that for CON-RET (60.24%).

Summary of the RETAIN group

We have described the characteristics of RETAIN sequences. A summary of statistical data is given in Table 4.10.

centering prediction	sequence	# of ZERO CB	# of non-ZERO CB	% of ZERO CBs
"low-cost"	CON-RET	50	33	60.24%
"medium-cost"	RET-RET	31	19	62.00%
	NULL-RET	52	73	41.60%
"high-cost"	SHIFT-RET	13	10	56.52%

Table 4.10: ZERO occurrences in RETAIN sequences

The ZERO/non-ZERO CB distribution among the three "cost" groups turned out to be not significant. This is probably due to the neutral nature of the RETAIN TRANSITION itself that lies between CENTER continuation and CENTER shifting.

4.4.3.3 ZEROS in the SHIFT sequence type

The SHIFT TRANSITION state is created by discontinuing CENTERS; the previous CENTER, CB (U_{i-1}), disappears and a new CENTER, CB (U_i), is promoted from among other entities listed in CF (U_{i-1}). The newly promoted CENTER can be realized, in U_i, either in the highest ranked position, as CP (U_i), or in any lower ranked position. This distinction was first made by Brenann et al. (1987), and was named SMOOTH-SHIFT and ROUGH-SHIFT respectively, by Walker et al. (1994). Although these two SHIFT types, in our corpus, present significantly different preferences for the CB forms, either ZEROS or non-ZEROS ($x^2 = 4.194$, DF=1, $p < .005$), we combine them together here when we examine TRANSITION sequences for the sake of simplification of the presentation, and also because the ZERO use in ROUGH-SHIFT is limited to only 28 cases.

The SHIFT group consists of three sequence patterns: CON-SHIFT, RET-SHIFT and SHIFT-SHIFT. The sequence NULL-SHIFT is theoretically impossible because there is no way to compare with CB (U_i), when CB (U_{i-1}) is underspecified, to form a SHIFT TRANSITION. The distribution of ZERO/non-ZERO CENTERS in this group is provided in Figure 4.15.

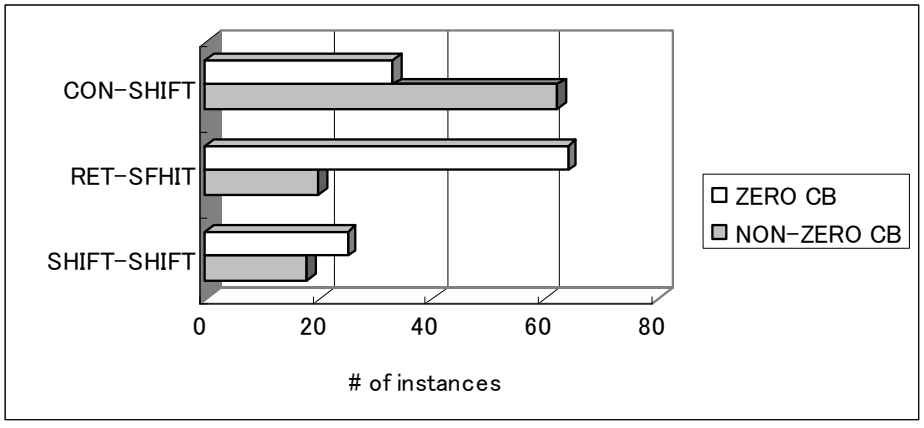


Figure 4.15: Distribution of ZERO/non-ZERO CBs in SHIFT sequences

Again, the CB type distribution among the three patterns is significant ($x^2 = 32.767$, DF=2, $p < .001$).

RET-SHIFT versus CON-SHIFT

We discussed above in 4.4.3.1 that the RET-CON sequence is contrary to the RETAIN function of signaling a subsequent shift. On the contrary, the RET-SHIFT sequence fulfills this function by completing a shift and is considered to be a natural way of CENTER management. This typical application of the ranking in Rule 2 is exemplified by a well-cited discourse segment, encoding the CON-RET-SHIFT sequence in (c)-(e), from GJW95.

(4.45)

a.	John has been having a lot of trouble arranging his vacation.	NULL
b.	He cannot find anyone to take over his responsibilities.	CON
c.	He called up Mike yesterday to work out a plan.	CON
d.	Mike has annoyed him a lot recently.	RET
e.	He called John at 5 AM on Friday last week.	SHIFT

Here, the CENTER 'John' in (c) is retained in (d) in a lower-ranked object position as 'him'; instead, a member of CF (c) 'Mike' is placed in the highest-ranked position. The newly promoted entity 'Mike' is realized by a pronoun as a new CENTER in (e), which completes a flowing CENTER shift from 'John' to 'Mike.'

The CON-SHIFT, on the other hand, poses a different story. Imagine the segment that eliminates the utterance (d), resulting in the following (c')-(e') sequence, as in (4.46).

(4.46)

c'.	He called up Mike yesterday to work out a plan.	CON
e'.	He called John at 5 AM on Friday last week.	SHIFT

There is an abrupt shift in CENTERS, i.e., without warning, between (c') and (e'). As a result, the interpretation of a pronoun 'he' becomes totally ambiguous, and requires extra inferences (although explicit mention of the other entity 'John' is of great help in this case). In this respect, the RET-SHIFT can be considered a "low-cost" sequence, while the CON-SHIFT is a "high-cost" sequence.[21]

Let us present some samples from our corpus. First, the segment (4.47) provides the RET-SHIFT sequence.

(4.47)

a.	よこはまの	おばあさんは	NULL
	yokohama-no	*obaasan-wa*	
	Yokohama-GEN	grandmother-TOP	

[21] Strube and Hahn (1999) defined the CON-(SMOOTH-)SHIFT sequence as an "expensive" TRANSITION pair, and the RET-(SMOOTH-)SHIFT sequence as a "cheap" TRANSITION pair.

りょうりを　たくさん　知っています。
ryoori-o takusan sitte-i-masu.
recipe-ACC many know-POL

'Grandma in Yokohama knows a lot of recipes.'

b. Ø いいりょうりの本を もっています。 CON
(Ø-ga) ii ryoori-no hon-o motte-i-masu.
(Ø-NOM) good recipe-GEN book-ACC own-POL

'(She) owns a good recipe book.'

c. ひろこさんのお母さんは ときどき RET
hiroko-san-no okaasan-wa tokidoki
Hiroko-GEN mother-TOP sometimes

Ø おばあさんに 電話を かけます。
(Ø-no) obaasan-ni denwa-o kake-masu.
(Ø-GEN) grandmother-DAT telephone-ACC ring-POL

'Hiroko's mother sometimes telephones (her 'Hiroko's') grandmother.'

d. そして Ø Ø SHIFT
sosite (Ø-ga) (Ø-ni)
And (Ø-NOM) (Ø-DAT)

いろいろな りょうりを 聞きます。
Iroirona ryoori-o kiki-masu.
various recipe-ACC ask-POL

'And (she 'Hiroko's mother') asks (her 'Hiroko's grandmother') for various recipes.'

[*Hiroko 1*]

A ZERO in (d) realizes the CENTER 'Hiroko's mother' which has already been introduced in a higher ranked position than the previous CENTER from (b) 'grandmother' in the utterance (c). This intervening retention creates a natural flow in CENTER shifting. Therefore, this sequence does not require consultation with other information resources even though the two entities involved share the same semantic property [+human].

Next, turn to the CON-SHIFT sequence example in (4.48).

(4.48) a. スーパーで ひろこさんは CON
suupaa-de *hiroko-san-wa*
supermarket-at Hiroko-TOP

したじきと けしごむを 買いました。
sitaziki-to *kesigomu-o* *kai-masi-ta.*
plastic-sheet-and eraser-ACC buy-POL-PAST

'At the supermarket, Hiroko bought a plastic sheet and an eraser.'

b. Ø ぜんぶで 150えんでした。 SHIFT
(Ø-ga) *zenbu-de* *150-en desi-ta.*
(Ø-NOM) in-total 150-eyn COP-PAST

'(They) were in total 150 yen.'

[*Hiroko 1*]

The CENTER in (a) is 'Hiroko' (continued from the previous utterance). In (b), however, a ZERO realizes not the previous CENTER (nor the CP), but another member of CF (a) 'sheet-and-eraser.' This results in a hasty shift of CENTERS. However, in this particular example, the "selectional restriction" for a ZERO in the utterance (b) makes this shift less problematic; 'Hiroko' cannot be '150yen.'

Likewise, in (4.49), a ZERO in (b) does not represent the CENTER in (a), 'employees,' but a lower ranked entity in CF (a), 'ideas.'

(4.49) a. Ø 新しい製品のアイデアを 考えます。 CON
(Ø-ga) *atarasii seihin-no aidea-o* *kangae-masu.*
(Ø-NOM) new product-GEN idea-ACC think-POL.

'(They 'employees') think about ideas for new products.'

b. 社長も 社長室で Ø 考えます。 SHIFT
syacho-mo *syachositu-de* *(Ø-o)* *kangae-masu.*
president-FOC president-office-in (Ø-ACC) think-POL

'The president also thinks about (it 'idea') in the president's office.'

[*Minna 1*]

These shifts are, in a sense, unexpected from a centering perspective; therefore, some overriding factors that enable these unexpected shifts should exist: "parallel structure" in this case (see 4.6.3 below).

Turning now to the statistical data, the RET-SHIFT and the CON-SHIFT pair has proven to be similar in frequency (84 and 95 cases, respectively), but different in their CB type distribution (ZEROS used 76% and 34% of the time, respectively), and this difference has proven significant ($x^2 = 32.390$, DF=1, $p < .001$). An expected shift (RET-SHIFT), rather than an unexpected one (CON-SHIFT), may impose a higher inferential cost.

SHIFT-SHIFT

The SHIFT-SHIFT sequence is the least preferred according to the ranking in Rule 2 (GJW95). Its occurrence is very limited (only 43 cases). This sequence is characterized also as "flip[ping] back and forth among several different entities" (page 206). Let us now look at the sample segment from our corpus in (4.50).

(4.50) a.

昔、	神様が	動物たちに	言った。・・・	NULL
mukasi,	*kamisama-ga*	*doobutu-tati-ni*	*it-ta.*	
long-ago,	god-NOM	animals-DAT	say-PAST	

'Long ago, God said to the animals.' …

b.

ネコは	神様の話が			RET
neko-wa	*kamisama-no hanasi-ga*			
cat-TOP	god-GEN story-NOM			
よく	聞こえなかったから、			
yoku	*kik-oe-nakat-ta-kara,*			
well	hear-able-NEG-PAST-because			

'Because the cat did not hear well what God said,'

c.

Ø	ネズミに	「いつ？」と	聞いた。	SHIFT
(Ø-ga)	*nezumi-ni*	*"itu?"-to*	*kii-ta.*	
(Ø-NOM)	mouse-DAT	"when?"-QUO	ask-PAST	

'(it 'cat') asked the mouse, "When?"'

d. ネズミは 「2日だ。」と うそを 言った。 SHIFT
nezumi-wa *“hutuka-da”-to* *uso-o* *it-ta.*
mouse-TOP “second-COP” -QUO lie-ACC say-PAST

‘The mouse told a lie saying, “On the second.”

[*Minna 2*, slightly simplified]

Right after the first established entity ‘God’ is retained and a new entity ‘cat’ is introduced in (b), the CENTER is shifted again to another entity ‘mouse’ in (d). This example involves a pair of verbs that usually have different entities for their agents: asking and answering (see 4.6.3 below).

Let us examine another example in (4.51).

(4.51) a. ジェイソンが その家に 着くと、 NULL
zyeison-ga *sono-ie-ni* *tuku-to,*
Jason-NOM the-house-at arrive-when,

‘When Jason arrived at the house,’

b. まず お母さんが 家中を RET
mazu *okaasan-ga* *ie-zyu-o*
first mother-NOM house-whole-ACC

Ø 見せてくれて、
(Ø-ni) *mise-te-kure-te,*
(Ø-DAT) show-EMP-and,

‘the host mother showed (him ‘Jason’) around the house, and’

c. Ø … 「トイレはここ」と SHIFT
(Ø-ga) *“toire-wa koko” –to*
(Ø-NOM) “toilet-TOP here”-QUO

Ø 教えてくれた。
(Ø-ni) *osiete-kure-ta.*
(Ø-DAT) teach-EMP-PAST

‘(She) showed (him), “the toilet is here.”

d. Ø … トイレは洋式だと SHIFT
(Ø-ga) toire-wa yoosiki-da-to
(Ø-NOM) toilet-TOP western-style-COP-COMPL

わかった。
wakat-ta.
learn-PAST

'(He) learned that the toilet was western style.'
[*Sokudoku*, slightly simplified]

In this example, as well, CENTERS are shifted back and forth between two entities 'Jason' and 'host mother.' This segment involves an empathy-loaded (auxiliary) verb *kureru*. We will discuss this later in 4.6.3.

In sum, in this sequence, the preference for ZERO CENTERS is not very strong (58% of the time), in comparison particularly to CON-CON (88%) and also to RET-RET (62%).

Summary of the SHIFT group
The three sequence types are summarized in Table 4.11.

centering prediction	sequence	# of ZERO CBs	# of non-ZERO CBs	% of ZERO CBs
"low-cost"	RET-SHIFT	64	20	76.19%
"high-cost"	SHIFT-SHIFT	25	18	58.14%
	CON-SHIFT	32	63	33.68%

Table 4.11: ZERO occurrences in SHIFT sequences

The difference in the ZERO/non-ZERO CB distribution between a "low-cost" sequence and the "high-cost" sequence group (SHIFT-SHIFT and CON-SHIFT combined) is significant ($x^2 = 25.627$, DF=1, $p < .001$).

4.4.3.4 Additional comparisons

CON-CON versus RET-RET versus SHIFT-SHIFT
Let us re-examine here the three sequence types explicitly defined in Rule 2 (GJW95): the CON-CON, the RET-RET and the SHIFT-SHIFT. The ZERO/non-ZERO CB frequency and distribution are summarized in Figure 4.16.

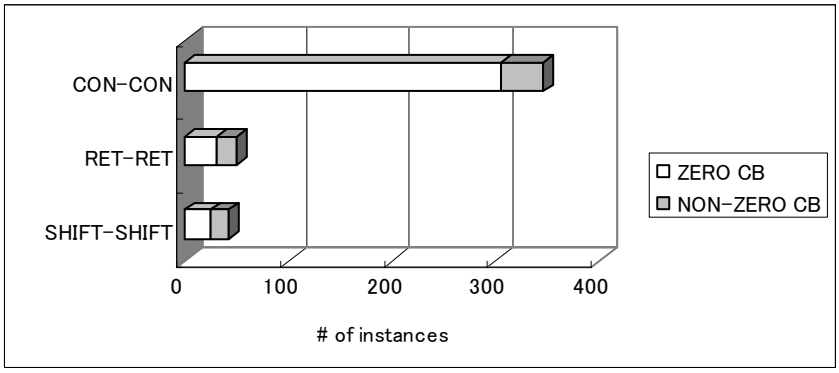


Figure 4.16: Comparison of CON-CON, RET-RET and SHIFT-SHIFT occurrences

As is clear, the frequency seen in Figure 4.16 is that predicted by the centering preference order defined in GJW95 Rule 2. The ratio of ZERO CBs is also in descending order (88.44%, 62.00%, and 58.14%). The difference between the RET-RET and the SHIFT-SHIFT, in terms of their CB type distribution, however, is not significant ($x^2 = 0.143$). This statistical result does not provide us with any evidence regarding the difference in inferential cost between the SHIFT-SHIFT and the RET-RET sequences.

RET-CON versus RET-RET versus RET-SHIFT

We have discussed these three sequence patterns separately above. Here, we will present a cross-comparison of these three to re-examine the function of RETAIN and its subsequent TRANSITION state.

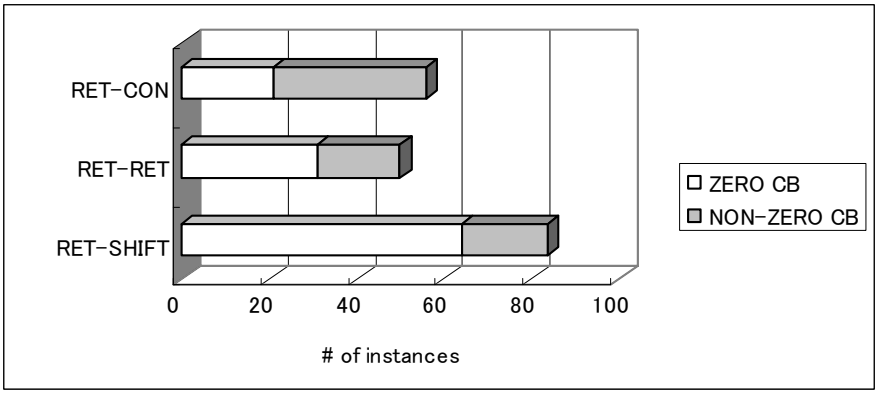


Figure 4.17: Comparison of RET-CON, RET-RET and RET-SHIFT occurrences

The frequency indicates that RETAIN is most preferably followed by SHIFT, as claimed by GJW95: RETAIN should ideally be used to introduce a following SHIFT. Karamanis (2003) argues for the adequacy of the RET-SHIFT sequence as an

entity-coherence metric for his text structuring algorithm. Our data cross-linguistically supports his claim for English.

The ZERO CB/non-ZERO CB distribution in the three sequences also indicates that RET-SHIFT is a more preferable environment for ZEROS (used 76.19% of the time) than the other two (62.00% and 37.50%).

Nominal argument in RET-SHIFT versus RET-CON

We have already examined above the RET-SHIFT and the RET-CON sequences. Here, we will pay particular attention to a subclass of these environments, i.e., when the RETAIN-encoded utterance in the sequence involves zero nominal arguments.

Zero nominal arguments constitute the construction "(A *no*) B" as a whole NP. The semantic relations between the two entities within the NP exhibit a wide variety, as presented in 2.4.1.3. Syntactically, the entity B is defined as the head of the whole NP (see 2.2.2). However, the referential properties of this complex NP are not as simple as this definition might make it seem. That is, in some cases, a head B entity is later referred to; in other cases, an implicit modifier, the (A) entity, is referred to by a subsequent referring expression, such as a ZERO. The former case constitutes a RET-SHIFT sequence, while the later is a RET-CON sequence, according to our CF ranking. Let us look at the examples in (4.52) and (4.53) respectively.

(4.52) a.

山下君は	部屋に	入りました。
Yamasita-kun-wa	*heya-ni*	*hairi-masi-ta.*
Yamasita-TOP	room-into	enter-POL-PAST

'Yamashita entered the room.'

b.

Ø 自己紹介が	終わって、	RET
(Ø-no) zikosyookai-ga	*owat-te,*	
(Ø-GEN) self-introduction-NOM	be-finished-and	

'When (his 'Yamasita's) self-introduction was finished,'

c.

Ø	手紙とプレゼントを	渡すと、	CON
(Ø-ga)	*tegami-to purezento-o*	*watasu-to,*	
(Ø-NOM)	letter-and present-ACC	hand-and	

'(He 'Yamasita') handed over the letter and present, and …'

[*Sokudoku*]

(4.53) a. くまのロボットが　　病院に　　データを　送ってくれるから、
kuma-no robotto-ga　*byooin-ni*　*deeta-o*　*okutte-kureru-kara,*
bear-GEN robot-NOM　hospital-to　data-ACC send-EMP-because

'The robot bear sends the data to the hospital, so'

b. Ø 飼い主の　　体の　　調子が　　RET
(Ø-no) kainusi-no　*karada-no*　*tyoosi-ga*
(Ø-GEN) owner-GEN body-GEN condition-NOM

とても悪いときは、
totemo warui-toki-wa,
very bad-when-TOP

'when (its 'robot's) owner's condition is very bad,'

c. 医者が　　Ø　　診に来てくれる。　　SHIFT
isya-ga　*(Ø-o)*　*mi-ni-kite-kureru.*
doctor-NOM　(Ø-ACC) see-to-come-EMP

'the doctor will come to see (him 'owner').

[*Minna 2*]

In the examples above, subsequent reference to either the A or B entity is made by means of ZEROS: a zero nominative in (4.53) and a zero accusative in (4.54). There are also cases in which later reference is made explicitly via non-ZERO expressions. Table 4.12 below summarizes the frequency of the two reference patterns that result in the two TRANSITION sequences, and their reference types.

	ZERO reference	**non-ZERO reference**	**total**
RET-SHIFT (reference to B)	11	3	14
RET-CON (reference to A)	13	19	32

Table 4.12: Frequencies of reference to A or B entity

Out of a total of 46 cases of the two sequence types, a syntactic head (B entity) is subsequently referred to, as in (4.54), in only 14 instances (43.75%). In the remaining 32 cases, an implicit modifier (A) entity, i.e., a zero nominal argument, acts as

antecedent for later ZEROS or non-ZEROS. This result contrasts somewhat with that of Yamura-Takei and Fais (ms.) who examined the A *no* B phrases and their later reference; in 57.14% of the examples that they examined, reference is made to head B entities.[22] We will not look further into this distributional difference, but at least from a cursory examination of the two results, it is clear that both A and B can act as antecedents for later reference.

The use of ZEROS in the "controversial" RET-CON sequence (see discussion in 4.4.3.1), i.e., 13 cases including the example (4.55), appears to impose a greater inferential load.

4.4.3.5 ZEROS in NULL

As we mentioned earlier, the absence of a centering TRANSITION between adjacent utterances is possible, or rather it is not rare at all in naturally-occurring utterances, no matter how strictly the parameters are set to minimize the number of such cases (Poesio et al., 2004). Those CB-lacking utterances, what we call in this thesis, the NULL utterances, are not exempt from the use of ZEROS in Japanese discourse. ZEROS do appear in the NULL labeled utterances. Iida (1998) reported that her 250-utterance corpus contained 23 such cases.

We will first examine the NULL-encoded utterances in discourse-medial positions (DSM-NULL). Our corpus includes 445 such utterances; 157 of them contain ZEROS, ten utterances of which accommodate multiple ZEROS. A total of 171 ZEROS (143 zero verbal arguments and 28 zero nominal arguments) contained in these utterances are of various referent types, summarized in Figure 4.18 below.

[22] Of the 77 A *no* B phrases that are later referred to by ZEROS, pronouns or NPs, 28 references are to A entities, 44 are to B entities, and there are also 5 unclear cases.

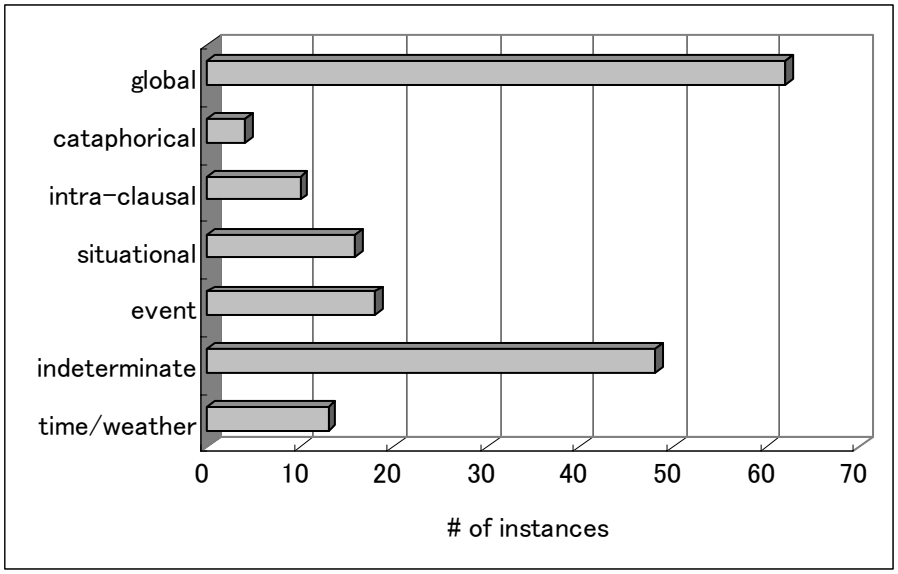


Figure 4.18: Frequencies of referent types of ZEROS in DSM-NULL

There are 62 instances of global reference, 11 of which are to antecedents beyond the DS boundary; the remaining 51 are co-referential within the same segment, in an average range of 2.76 utterances. The four cases of cataphorical reference are similar to global in that they do not create links with the previous utterance. Literally speaking, intra-clausal (10 instances) do not create any inter-clausal link, either. The remaining four reference types (situational, event, indeterminate, and time/weather), although they are not infrequent (16, 18, 48, and 13 instances, respectively), are exempt from listing in the CF, based on our decision discussed in Chapter 3. Therefore, they cannot establish proper TRANSITIONS.

Now, we turn to ZEROS in discourse-segment initial NULL (DSI-NULL) utterances. Our corpus exhibits 96 such cases.[23] The referent types of those ZEROS are indicated in Figure 4.19 below.

[23] Some discourse-segment initial utterances have more than one ZERO.

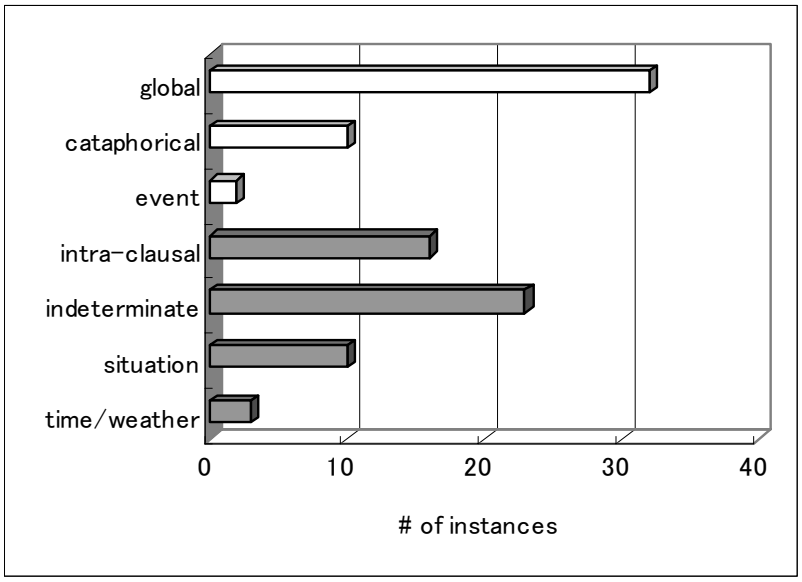


Figure 4.19: Frequencies of referent types of ZEROS in DSI-NULL

The "global" category includes those ZEROS that find their referents in any of the previous discourse segments (32 cases). The majority (31 cases) refer to entities in the adjacent segment.[24] Among them, the referents of 18 ZEROS are in the immediately preceding (but across the segment boundary) utterances.[25] Twenty-five cases refer to previous CBs, and the remaining 7 do not.

Also, there are 10 cases of cataphorical ZEROS. This means that half of the cataphorical ZEROS found in the corpus (20 in total) appear in discourse-segment initial positions.

Out of two "event" ZEROS found in the DSI position, one refers to the whole situation described in the previous segment, and the other the action described by the verbal phrases in the preceding segment. A total of 21 "event" ZEROS appear in the corpus.

[24] There is one case in which a ZERO is in the last discourse segment of the text and its referent is found in the first segment (with five intervening segments in between). The two utterances involved exhibit a parallelizing structure.

[25] This raises a fundamental question concerning what a discourse segment is, but we will not further discuss this issue in this thesis.

4.4.4 Summary

4.4.4.1 Basic facts

This corpus analysis has firstly provided us with basic facts concerning the behaviors of ZEROS, including the distribution of various ZERO types that we defined in Chapter 2 and the interrelationship between the types, and the antecedent types and locations. The result constitutes empirical evidence for the diverse nature of ZEROS, which we see as one of the potential complexities and ambiguities that Japanese language poses to the hearer and the language learner.

Secondly, we analyzed the data according to centering metrics: CENTER realization, CB types, and TRANSITION types, in an attempt to empirically validate our assumption concerning the significant role of ZEROS in the creation of local discourse coherence. Our attempt has been successfully fulfilled; ZEROS were more frequently used than non-ZEROS to conceptually link current utterances with adjacent utterances. Also, ZEROS are most commonly used to continue the CENTERS, but they also appear in CENTER-discontinuing (i.e., retaining and shifting) environments.

4.4.4.2 Main facts

In order to further investigate the environments in which ZEROS occur, we employed a TRANSITION-sequence approach to the centering analysis of the data. As a result, a number of insightful findings were drawn from the analysis. Here, we will discuss how we interpret the figures.

The TRANSITION-sequence-based approach to the CB type distribution has revealed that the distribution is not as simple as it might look if characterized by a single-TRANSITION approach. This is clear from the ranking of sequence types, presented in Table 4.13, according to the ratio of ZERO CBs (in descending order).

Rank	Sequence type	Ratio of ZERO CB (%)
1	CON-CON	88.44
2	SHIFT-CON	83.33
3	RET-SHIFT	76.19
4	NULL-CON	69.26
5	RET-RET	62.00
6	CON-RET	60.24
7	SHIFT-SHIFT	58.14
8	SHIFT-RET	56.52
9	NULL-RET	41.60
10	RET-CON	37.50
11	CON-SHIFT	33.68
	Average	60.63

Table 4.13: Ranking of TRANSITION sequence types according to the ZERO CB ratios

Take the CONTINUE group, for instance; the four types within the group range from first to tenth in the ranking. The same is true of the SHIFT groups, ranging from third to eleventh. The range of the RETAIN group is somewhat squeezed into the middle of the ranking, from fifth to ninth.

Here, we assume that this ranking serves as an approximate indicator that reflects the degree of coherence, and hence the amount of inference cost that each sequence imposes, on the ground that texts are generally planned so that they turn out to be unambiguous. Thus, we incorporated this ranking in the refining of our cost-based classification, a tentative version of which we presented in Chapter 3. The plan for the refinement is given in Table 4.14.

cost	type	ZERO CB	non-ZERO CB
Low-cost	CON-CON	306	40
	SHIFT-CON	50	10
	RET-SHIFT	64	20
	Low-cost total	**420**	**70**
Medium-cost	NULL-CON	196	87
	RET-RET	31	19
	CON-RET (↓)	50	33
	Medium-cost total	**277**	**139**
High-cost	SHIFT-SHIFT (↓)	25	18
	SHIFT-RET	13	10
	NULL-RET (↓)	52	73
	RET-CON	21	35
	CON-SHIFT	32	63
	High-cost total	**143**	**199**

Table 4.14: Cost-based classification of TRANSITION sequences

This grouping was made so that the difference in the CB type distribution among the three groups might be the greatest ($x^2 = 174.479$, DF=2, $p < .001$) of any possible groupings. The symbols (↑) and (↓) indicate that that sequence type is classified as less costly or more costly, respectively, than was initially defined in the tentative version. The resulting revised version is presented in Table 4.15.

"low-cost" sequence types	"medium-cost" sequence types	"high-cost" sequence types
CON-CON, SHIFT-CON RET-SHIFT	RET-RET, NULL-CON CON-RET	SHIFT-SHIFT, SHIFT-RET, NULL-RET, RET-CON, CON-SHIFT

Table 4.15: Inference cost-based classifications of sequence patterns (revised)

4.5 Centering predictions and human intuition

We have discussed that preference for CB types, i.e., ZERO or non-ZERO, can be explained by the centering rules for CB realization (Rule 1) and TRANSITION preference (Rule 2). Particularly, we have focused the interaction of ZERO use in a certain utterance and perceived degree of coherence predicted by a TRANSITION sequence type in which that utterance occurs.

This subsection provides some empirical evidence on how such centering predictions match human intuition on the "naturalness" of ZERO use. We use JSL learners' writing samples that were judged by JSL teachers on their use of ellipsis, in order to present how their judgments are interrelated with the centering-based analysis and discussion in the previous section.

The samples consist of two sets of narrative texts, which describe the story of a movie "Shall We Dance," written by two upper-intermediate JSL learners (whose first language is English). Some quantitative information concerning this learner corpus is given below.

# of texts	2
# of paragraphs (discourse segments)	11
# of sentences	37
# of clauses (utterances)	52

Table 4.16: Quantitative information for the JSL corpus

The centering analysis of the corpus is provided in Table 4.17.

	ZERO-CB	non-ZERO CB	TOTAL
CONTINUE	20	6	26
RETAIN	0	5	5
SHIFT	3	4	7
TOTAL	23	15	38

Table 4.17: Distribution of CB types for single TRANSITIONS in the JSL corpus

The distribution is approximately equivalent to that of our corpus, and both texts are, as a whole, perceived to be reasonably "coherent," although they exhibit more or less unnatural flow. The distribution of CB types for TRANSITION sequences, on which we base our analysis, is also given below, in Table 4.18.

centering prediction	sequence type	ZERO CB	non-ZERO CB
low-cost	CON-CON	13	**2**
	RET-SHIFT	2	**1**
	SHIFT-CON	2	0
medium-cost	NULL-CON	5	3
	CON-RET	0	3
high-cost	SHIFT-SHIFT	**1**	0
	NULL-RET	0	2
	RET-CON	0	1
	CON-SHIFT	0	3
TOTAL		23	15

Table 4.18: Distribution of CB types for TRANSITION sequence types in the JSL corpus[26]

Our assumption is that in low-cost sequences, ZERO CBs are a reasonable choice in terms of CENTER management, and a safer option to avoid redundancy; whilst in high-cost sequences, non-ZERO CBs are a less risky choice to eliminate unnecessary ambiguity. In other words, the choice of CB type highlighted in the table is considered to be potentially illegal or unnatural usage that is subject to revision. We will see how this assumption is reflected in human intuitive judgments on the choice of CB types.

Our human judges were ten JSL instructors at tertiary institutions in Japan, Singapore and the U.S., who have extensive JSL teaching experience, but none of them had prior knowledge of centering mechanisms. Given the writing samples with ZEROS specified, the judges were instructed to mark (i) NPs that they would advise students to elide in order to avoid redundancy, and (ii) ZEROS that they would advise students to overtly express in order to avoid ambiguity. They were asked to do the marking based on their intuitive judgment on the naturalness of the discourses. Their marking was interpreted in this way: if at least nine judges, out of ten, agreed on a certain usage (ZERO or non-ZERO), that usage was regarded as "approved," while if eight or fewer judges agreed, the usage was labeled "disapproved." In other words, if two or more human judges decided to revise a certain usage, the usage was considered somewhat problematic.

[26] The data does not include the RET-RET and the SHIFT-RET sequences.

The result is as follows. Three "potential redundancy inducing" cases of non-ZERO CB in "low-cost" sequences were all disapproved by human judges.[27] Look at one such example in (4.54).

(4.54) a. 杉山さんは 会社員で 、 NULL
sugiyama-san-wa *kaisyain-de,*
Sugiyama-TOP office worker-COP

'Mr. Sugiyama is an office worker, and'

b. Ø いつも 仕事のあとで ダンスの看板を CON
(Ø-ga) *itumo* *sigoto-no ato-de* *dansu-no kanban-o*
(Ø-NOM) always work-GEN after dance-GEN sign-ACC

見ていました。
mite-i-masi-ta.
look-be-POL-PAST

'on his way back from work, (he) always looks at the sign of a dancing school.'

c. <u>杉山さんは</u> 電車の中で 女の人を CON
<u>*sugiyama-san-wa*</u> *densya-no-naka-de* *onna-no-hito-o*
Sugiyama-TOP train-GEN-inside-in woman-ACC

窓から 見ていました。
mado-kara *mite-i-masi-ta*.
window-from look-be-POL-PAST

'Mr. Sugiyama looks at a woman from the window of the train.'

The half (five out of ten) of judge teachers claimed that the topic NP CB (underlined) in the CON-CON sequence utterance (c) should be ZERO-pronominalized.

One "risky" case of ZERO CB in "high-cost" sequence was also disapproved. This case is presented in (4.55).

[27] There were varying degrees of disapproval: from 20% to 50%. We will not look into the reasons for each case here, but the possible causes seem to be found both in the text (e.g., the linguistic environment) and in the judge (e.g., knowledge, tolerance for ambiguity). Also, some judges commented, after the experiment, that their decision might change depending on the target level.

(4.55) a.

Ø	Ø	Ø	聞くのはこわかった。	SHIFT
(Ø-ga)	*(Ø-ni)*	*(Ø-o)*	*kiku-no-wa kowakat-ta.*	
(Ø-NOM)	(Ø-DAT)	(Ø-ACC)	ask-NOMI-TOP afraid-PAST	

'(His wife) was afraid to ask (him) (about the reason).'

b.

Ø	うわきを	しているかもしれない。	SHIFT
(Ø-ga)	*uwaki-o*	*site-iru-kamo-sirenai*	
(Ø-NOM)	affair-ACC	do-is-may	

'(He) might be having an affair.'

Half of the judges disfavored the ZERO use for the CB in the subject position of the utterance (b) in the SHIFT-SHIFT environment.[28]

On the other hand, out of 17 cases of ZERO CB in "low-cost" sequences, 14 were approved; the remaining three involved multiple ZEROS, which we believe affected human judges in their decisions. No cases of non-ZERO CB in "high-cost" sequences were disapproved.

This proves that centering predictions concerning the choice of CB types undoubtedly match human intuition on the naturalness and coherence each type creates in a certain environment.

4.6 Pedagogical implications

In this section, we will discuss what significance the findings from our corpus study have for JSL teachers.

4.6.1 ZERO occurrences and types

Our fundamental assumption about ZEROS is that some ZEROS are easier to process than others. Which ZEROS are easier to process, and for whom, is a crucial empirical question that requires a well thought-out and planned experiment on a considerable number of subjects, which is beyond the scope of this study, but the knowledge of a wide variety of ZERO types and their distribution is helpful. This is what our corpus study first provides us, as we stated earlier in 4.4.4.1.

Let us compare two texts from the same JSL textbook. There are two expository texts, both of which consist of four paragraphs: one 24-clause text exhibits 15 ZEROS

[28] The other half probably regard this ZERO as unambiguous enough because of contextual and world knowledge about 'who is afraid' and 'who is having an affair.'

and the other, with 28 clauses, contains 14 ZEROS. The two texts are similar number-wise, but when we look into the referent types of ZEROS contained, they show totally different characteristics. Look at Table 4.19.

	local	global	event	situational	indeterminate	total
Text 1	10	4	1	0	0	15
Text 2	2	1	1	1	9	14

Table 4.19: Frequency of referent types in two different texts

Text 1 contains only the textually retrievable ZEROS, i.e., ZEROS whose referents can be found in the discourse. Text 2, on the other hand, includes many ZEROS (10 out of 14 total) that are not contextually evoked. This difference is something that JSL teachers should be aware of in the instruction of ZERO-containing discourse. We will discuss this issue further in Chapter 7.

4.6.2 ZEROS and coherence

The relationship between ZEROS and coherence has been verified in our corpus study. The four important points that we would like to emphasize are as follows.

(i) ZEROS play a significant role in creating coherence;

(ii) the role of less-recognized zero nominal arguments in coherence creation has proven significant;

(iii) ZEROS are used in a variety of environments with differing degrees of inferential cost; and

(iv) the distribution of ZERO types and ZERO-occurring environments varies from text to text, and predicts inference level costs as defined by both a TRANSITION sequence analysis and native speaker intuitions.

Keen awareness of these facts and critical analysis of teaching materials with these points in mind are helpful in predicting potential difficulties that learners may encounter. We will discuss these points further in Chapter 7.

4.6.3 Resources for making inferences

By analyzing ZEROS and their textual/contextual environments in so-called "high-cost" sequence utterances, we attempt to extract potential resources of information required to make inferences in interpreting ZEROS and in comprehending a discourse. Listing these, we believe, would be beneficial for effective instruction of ZEROS and for understanding the coherence created by ZEROS. The list includes:

(i) empathy,
(ii) selectional restrictions,
(iii) pair verbs (e.g., ask-answer),
(iv) parallelism,
(iii) topicalization (grammatical and zero),
(iv) word order (scrambling),
(v) conjunctive relations,
(vi) contextual knowledge, and
(vii) world knowledge.

These factors sometimes (but not always) override centering principles, as exemplified in several discourses presented above, such as (4.33), in which a ZERO in a RET-CON sequence is made acceptable by the "contextual knowledge" involved, and (4.49), in which a ZERO in a CON-SHIFT sequence is perceived as reasonably unambiguous because of the "parallel structure" of the two adjacent utterances. A single factor or a combination of several factors enables the use of ZERO CBs in a high-cost sequence discourse.

We assume that these factors support the strategic and intentional inference skills that native speakers are usually equipped with and that non-native learners need to learn. The mastery levels of these factors will affect perception of coherence and understanding of the discourse. Looking further into each factor is an interesting issue to explore, but we will leave this for future research. [29]

4.7 Summary

In this chapter, we conducted an extensive corpus study and two major sets of results were presented. The first set offered some basic facts about the corpus concerning the distribution of various ZERO types, as well as a preliminary centering analysis. The second set provided findings regarding the interrelationship between the distribution of

[29] Kameyama (1996) discussed "grammatical parallelism preference" and "commonsense preference" among others, in her account of pronoun interpretation.

ZEROS and the degree of discourse coherence that was predicted by the centering rule. In addition, the centering predictions on ZERO use, drawn from the analysis results on JSL data, were proven to match human intuition about the appropriate use of ZEROS. Finally, we briefly discussed the pedagogical implications of the results.

The significant role and diverse distribution of ZEROS in Japanese discourse proven in this chapter will serve as an impetus for the development of a ZERO-detecting tool that will be presented in Chapter 6 and its pedagogical application that we discuss in Chapter 7.

Part II

Technology and Pedagogy

In Part I, we have given the definition and typology of ZEROS that this thesis is concerned with, and discussed the role of these ZEROS in Japanese discourse in a particular relation to discourse coherence. Our analysis, in the centering framework, has provided theoretical assumptions concerning the significant contribution of ZEROS to coherence establishment, along with introspective and statistical evidence from our corpus. This raises two questions: (i) how much trouble native speakers or learners of Japanese have in recognizing entities evoked by ZEROS in discourse; and (ii) how conscious native speakers or learners of Japanese are of entities evoked by ZEROS when processing discourse that includes them. Answering these questions is beyond the scope of this thesis, but the questions have led us to a "what-if." What if these invisible ZEROS are made visible? Is it technologically possible? Is it of any help to those who teach a ZERO-prone language or to those who learn it? Chapter 6 is an attempt at answering the first question. The second question will be answered in Chapter 7. Chapter 5, beforehand, discusses some background on the use of technology for educational purposes, especially for language learning.

Contents

Chapter 5

Educational and Language Technologies

5.1 Educational technology and CALL

Educational technology (henceforth, ET), as the term implies, involves both “education” and “technology,” and aims for their congenial integration. That is, the goal of ET is to use technology to support education, or more precisely, to use technology effectively as a tool to enhance the learning and teaching processes.

The use of ET can be characterized in terms of three defining facets: space, target and technology. The first facet is the space or environment in which technology is put into use and practice. Much of the ET research and practice is currently focusing on “e-learning” or “online education” that considers so-called “cyberspace” or “virtual classrooms” as its educational environment, where course materials are delivered via the Internet and/or learners are collaborating using computer-mediated communication (CMC) tools. In fact, “e-learning” and “distance learning” are the new buzzwords in the community of education in Japan and in many other countries worldwide. Still, ET can also be used in “actual space” or “traditional classrooms.” The availability of document processing software in place of manual writing, and presentation software and a digital screen in place of a traditional blackboard and printed materials has been changing the classroom instruction drastically.

The second facet concerns for whom ET is intended in order in enhancing their learning process. The target age groups vary from K-12 (kindergarten, elementary, middle and high school pupils) to adult (e.g., university students and adults in so-called adult education and job training). The target subject areas also vary: math, science, computer, art, music, social studies, language, and even anger management, to name a few. The subject area that we aim at is language learning, and technology-enhanced language learning has traditionally been called computer-assisted language learning, or CALL for short. Its origin can be traced back to the 1960s when the PLATO project

was first featured.[1]

Technologies currently available for educational use also show a wide variety, most of which are useful for any subject area, although some are domain-specific. Such technologies range from basic computer capabilities to multimedia devices, and to web/network technology and speech/language technology. CALL systems are often categorized according to the technologies they deploy. Categories depend, for example, on whether the system does or does not use speech technology, web technology, or NLP technology. We will leave the discussion of the first two types of technology to other work, and focus on the use of NLP in this thesis. In the next section, we will overview NLP with regard to methodology and application.

To sum up, our focus will be on the exploitation of NLP technology for language learning in a real classroom environment. Our primary target group consists of university students, i.e., adults rather than children, who study Japanese as a "foreign" (rather than "second") language.

5.2 NLP: Methodology and application

NLP, by definition, is the process of computer analysis of input provided in a human language (natural language) and the conversion of this input into a useful form of representation. The general aim of NLP is two-fold; it is primarily concerned with helping us come to a better understanding of human languages as a system of computational representations and processes, and is secondarily concerned with getting computers to perform useful and interesting tasks with human languages, utilizing such representations, as summarized by Webber (2001). She classifies work having to do with the former concern as Computational Linguistics (CL), and the latter as Applied Natural Language Processing (ANLP), Natural Language Engineering (NLE), or Language Technology (LT). Our interest is not only in the NLE or LT aspect of NLP that enables us to embody the development of our intended program, but also in the CL aspect that models the underlying human processes.

In this section, we will overview NLP in terms of methods, processes, and applications. The discussion here is heavily drawn from the two recent "bibles" in Natural Language Processing (Dale, Moisl, and Somers, 2000) and Computational Linguistics (Mitkov, 2003). In so doing, we will clarify our stance toward the use of NLP in CALL.

[1] A comprehensive review of CALL history can be found at http://www.history-of-call.org/.

5.2.1 Methods

Natural Language Processing (NLP), as a discipline, has its own history and rationale. Dale, Moisl, and Somers (2000) propose three main strands of approaches to NLP according to its historical development: the symbolic approach, the empirical approach, and the artificial neural network approach.

Firstly, **linguistic-based approaches** have their origins in generative linguistics, which concerns itself with the formal and syntactic description of linguistic phenomena, primarily along the lines proposed by a highly influential generativist, Noam Chomsky and his successors. This symbolic approach is often contrasted with empirical approaches that are based on statistical and other data-driven analyses of raw data in the form of text corpora. The **corpus-based approach**, instantiated as statistical and machine-learning methods, has gained speed as the availability of computer technology has made the analysis of reasonably large corpora increasingly viable, although it was initially criticized by Chomsky and his followers, who were strongly opposed to empirical methods in linguistics. The most recent approach is the artificial **neural network-based approach**, which is based on an analogy with the physical structure of biological brains, and hence orients itself toward cognitive modeling and simulation.

More recently, an integrated approach is sometimes taken, mainly in an attempt to supplement limitations of one approach with strengths of another (e.g., Iida, Inui, Takamura, and Matsumoto, 2003).

The approach that we take for this study is purely linguistic-based. It can, however, be considered empirical in the sense that our linguistic-based heuristics are partly drawn from the results of a corpus analysis. Our motives for this choice are closely related to and largely influenced by our intention of applying NLP to language learning. As we stated earlier, the CL aspect of NLP concerns modeling human understanding and generation of language. For this purpose, the linguistic-based approach is the most reasonable choice among the three, as it provides a more transparent (“glass box”) language model in which rules and principles are articulated, and thus provides us with direct implications for language teaching.

5.2.2 Processes

As presented in Mitkov (2003), linguistic levels of processing that NLP is responsible for typically range from word segmentation, which presents a substantial challenge in non-segmented oriental languages (including Japanese), to morphological analysis, which assigns a part-of-speech tag to each morpheme, and to syntactic analysis, which parses a string of words into larger chunks and often presents their phrase structure or dependency relations. In the area of semantics, word-sense disambiguation is an important task, given the fact that many words, such as ‘right’ in English and ‘*hasi*’ in

Japanese, have multiple meanings. Disambiguation is also required at syntactic and discourse levels, as well. Anaphora resolution, as a process of disambiguation of referential relations, is one crucial aspect of discourse processing that is usually constructed "on top of" morphological, syntactic and semantic analyses.

Our focus will be on the detection of the presence of invisible referential expressions, which requires lexical, syntactic, and semantic interpretations of the input, as well as some pragmatic factors.

5.2.3 Applications

Natural Language Processing (NLP) is a fascinating area of research and an emerging technology with a variety of real-world applications. The most familiar applications found in our daily life include the grammar checking, spell checking and spelling correction that many word processing packages are equipped with. Machine translation (MT) is one of the earliest practical applications of NLP techniques, dating back to the 1950's, and still is an active area of research.[2] Other areas include information retrieval, information extraction, question answering, and text summarization, to name a few from the extensive coverage in Mitkov (2003). Also listed in this volume is computer-assisted language learning (Nerbonne, 2003), in which our interest lies, and which will be discussed in more detail in what follows.

5.3 NLP in language teaching/learning

Computer-Assisted Language Learning (CALL) is one promising area that NLP techniques can contribute to. The emerging discipline that seeks to apply NLP to the problems of language learning and language learning research is called "intelligent computer-assisted language learning" or simply ICALL. This term is used, on one hand, to refer exclusively to parser-based CALL programs (e.g., Holland, Maisano, Alderks, and Martin, 1993); on the other hand, it is used in a broader sense to cover CALL systems equipped with any AI techniques (such as inferencing, learning from interactions, and updating knowledge), and is also known as intelligent tutoring systems (ITS), a subfield of AI (e.g., Hamburger, Schoelles, and Reeder, 1999). In this thesis, we treat the term in a neutral sense to indicate CALL programs that deploy NLP techniques of various kinds, and use the terms ICALL and NLP-based CALL (or NLP-enhanced CALL and some other varieties) interchangeably.

[2] The use of MT for language learning has also been discussed in the CALL literature (e.g., Anderson, 1995).

Since the rise of this discipline,[3] there has been a debate concerning the relationship between CALL and NLP and the two communities they belong to, as well as the pros and cons of NLP-based CALL (e.g., Swartz and Yazdani, 1992; Holland, 1995; Hamburger et al., 1999; Tschichold, 2000; Borin, 2002a, b; Nerbonne, 2003). On the "pessimistic" side of those debates, Holland grieves for "the neglect of ICALL." Borin metaphorically describes the relationship as "oil and water." Tschichold raises a question whether or not they are "unwilling partners."

Among the pessimistic views on NLP-based CALL is the observation that many CALL programs have been successful without NLP technology, which has tended to turn the eyes of CALL researchers away from NLP. NLP does not seem to be indispensable to CALL, at least to traditional CALL that emphasizes drill and practice, and to multimedia CALL and web-based CALL that value communicative activities.

Pessimism may also stem from the distance between the two communities, as Borin (2002) pointed out, including different cultures and misunderstanding about the other discipline, namely, humanistic CALL versus engineering NLP.

Despite all this pessimism, the efficacy of NLP-inspired CALL is still promising and worth pursuing, with a "milk and honey" (Borin, 2002) or "bread and butter" view of the collaboration between the two disciplines. Gamper and Knapp (2002) provided a comprehensive review of ICALL systems as a fruitful result of such collaboration.

5.4 Previous NLP-in-CALL work

Successful "milk and honey" or "bread and butter" collaboration through a "willing partnership" between CALL and NLP has been realized in numerous research efforts in the form of NLP-enhanced CALL programs. This section reviews those existing programs, which range widely in their linguistic levels of analysis, from lexeme to discourse. The aim of this review is not necessarily to be exhaustive, but rather to present a summary of what has been done in order to enable a comparison to what we are attempting to do. We will first review ICALL programs developed for English and other European languages, and then introduce some Japanese ICALL work.

ICALL programs for English and other European languages

Concordancing programs, or simply concordancers, also called KWIC (key word in context) are among most basic language processing programs. Quite a few concordancers are available on the market: *MonoConc* designed for monolingual corpus

[3] Earlier NLP-based CALL work was done in the 1980s (e.g., Pulman, 1984; Zock and Alviset, 1986). The 1990s witnessed numerous works in CALL from an NLP perspective. For example, COLING (International Conference on Computational Linguistics) organized a panel on the use of NLP and CL in CALL in 1996.

and *ParaConc* for parallel corpora (Athelstan), *Wordsmith* (Oxford University Press), and *MicroConcord* (Oxford University Press), and so on. There are also a number of concordancers currently available on the web. Edict Virtual Language Centre in Hong Kong, [4] for example, provides an online "resource assisted learning system" that includes a word frequency text profiler, dictionary reference and concordancer in the spirit of "data-driven learning (DDL)."[5] *Idiom Concordancer* is in a similar vein such that it aims to assist writing by providing idiomatic expressions in authentic contexts; it locates idioms in the research paper corpus (Morishita, Nanba, and Aizawa, 2003).

Morphological processing has reached a reasonably sufficient maturity (Nerbonne, 2003), and it has been applied to a considerable number of programs that aim to support language learners with glossed text. *PC-KIMMO*, a morphological parser, is used for glossing text (Antworth, 1993). Another example is *GLOSSER*, which provides assistance for French learners in the form of morphological information for a lemma, dictionary entry for the lemma, and examples from corpora (Nerbonne, Dokter, and Smit, 1998).

Even more ICALL work has been done at the syntactic level, with parsers for syntax checkers. Falling in this category is the *ALICE* system by Levin, Evans, and Gates (1991) and the *LINGER* system by Yazdani (1991). Loritz (1995) developed the *GPARS* system, which utilizes a parsing technology to classify the constructions used by learners and to indicate not only where errors are made, but also what constructions are avoided or overused by learners. Furthermore, Loritz, DeSmedt, Aoki, Yamura-Takei, and Chen (1998) suggest that "competency analysis," as well as "error analysis," is what parser-based grammar checkers are capable of, and that such checkers are even good enough to outperform human teachers.

Attempts to go "beyond syntax" can be found in work by Dorr, Hendler, Blanksteen, and Migdaloff (1995), who utilize lexical semantics for free response questions in their *MILT* system.

ICALL programs for Japanese

A respectable number of CALL programs intended for JSL/JFL have also been implemented and some are freely accessible to the intended users and researchers. These programs are roughly divided into three groups: (i) acquisition support type, (ii) comprehension support type, and (iii) production support type.

Sawaya (2002) developed a *Web-Concordancer* for Japanese language learners, which is presently incorporated into the *Asunaro* system (see below). He reported that it had been shown to have a positive effect on learners' vocabulary acquisition and that it received a high evaluation from teachers for its benefits in the area of material

[4] http://www.edict.com.hk/

[5] DDL will be discussed in detail in Chapter 7.

preparation and self-study. Yang and Akahori (1997) implemented a CALL program that aims at the acquisition of passive voice in Japanese. It contains morphological and syntactic analyzers, as well as error analysis and feedback generating components.

There are quite a few reading support systems. *JGloss* analyzes Japanese text and appends the readings and meanings of words. Similar reading support can be obtained at *Rikai.com*. *Reading Tutor* is a reading tutorial system to improve the reading skills of English/German-speaking learners of Japanese (e.g., Kawamura, Kitamura and Hobara, 2000), accessible online.[6] It is equipped by morphological processing (by *ChaSen*) with on-demand dictionary look-ups (in *EDR Dictionary* for English and *Woerterbuch-Daten* for German). It also contains vocabulary/kanji level checkers that provide a difficulty level analysis results, in which the levels correspond to the four levels defined in the Japanese Language Proficiency Test (JLPT). *Asunaro* is an integrated reading support program freely accessible online.[7] It utilizes *JUMAN* (morphological analyzer) and *KNP* (syntactic analyzer) and provides, in addition to support on a morphological level, syntactic structures of the input text in four different formats: *KNP* output, tree structure, nesting box structure, and click-on dependency structure.

There are also some programs that aim to support sentence production of learners. *ALICE-chan* also exploits morphological and syntactic analyses, and provides feedback concerning errors detected by those analyses in students' responses to exercises (Levin and Evans, 1995). Likewise, Kakegawa, Kanda, Fujioka, Itami, and Ito (2000) developed a parser-based system for diagnostic processing that is capable of detecting errors in students' input sentences to given exercises. *BANZAI* is an intelligent language tutor that is designed to improve learners' grammatical and sentence production skills (Nagata, 2002a, b). It utilizes morphological/syntactic analyses and provides diagnostic feedback on errors detected.

We have reviewed NLP-based CALL systems both for English (and some other European languages) and for Japanese. As you can see, all these systems aim at the lexical and syntactic level problems that ESL/JSL learners might encounter in their comprehension and/or production. Work that focuses on discourse level phenomena is practically non-existent, to the best of our knowledge.[8] This is probably due to the immaturity of automatic discourse level processing, in contrast to well-developed morphological and syntactic level analyses, and also due to the lower level of interest in or emphasis on discourse (as opposed to sentence grammar) in language teaching in general. It is also worth noting that many of the reading aids reviewed above take

[6] http://language.tiu.ac.jp/ (maintained at Tokyo International University).

[7] http://hinoki.ryu.titech.ac.jp/ (maintained at Tokyo Institute of Technology).

[8] One exception that we are aware of is work by Suri and McCoy (1993a), who attempt to detect discourse-level errors concerning the use of definite and indefinite articles.

authentic texts as input, i.e., the users (teachers and learners) can choose such texts from the world as are interesting and informative to them to be analyzed by these tools. This will be an important base for data-driven learning (DDL). We will return to this issue in Chapter 7.

Given the review of previous work, our work will be innovative in that it aims at a discourse-level phenomenon and attempts to enhance instruction and acquisition of the phenomenon, with data-driven or corpus-based learning methodology and principles as its pedagogical backbone.

5.5 Summary

In this chapter, we first reviewed educational technology and in particular, NLP techniques and applications. More specifically, we discussed the pros and cons of the use of NLP in language teaching and learning. We also presented some previous work on NLP enhanced language teaching/learning aids.

A schematic summary of those reviews and discussions is provided in Figure 5.1 below. Our perspective and stance in the development of *ZD* are indicated by highlighting in the figure.

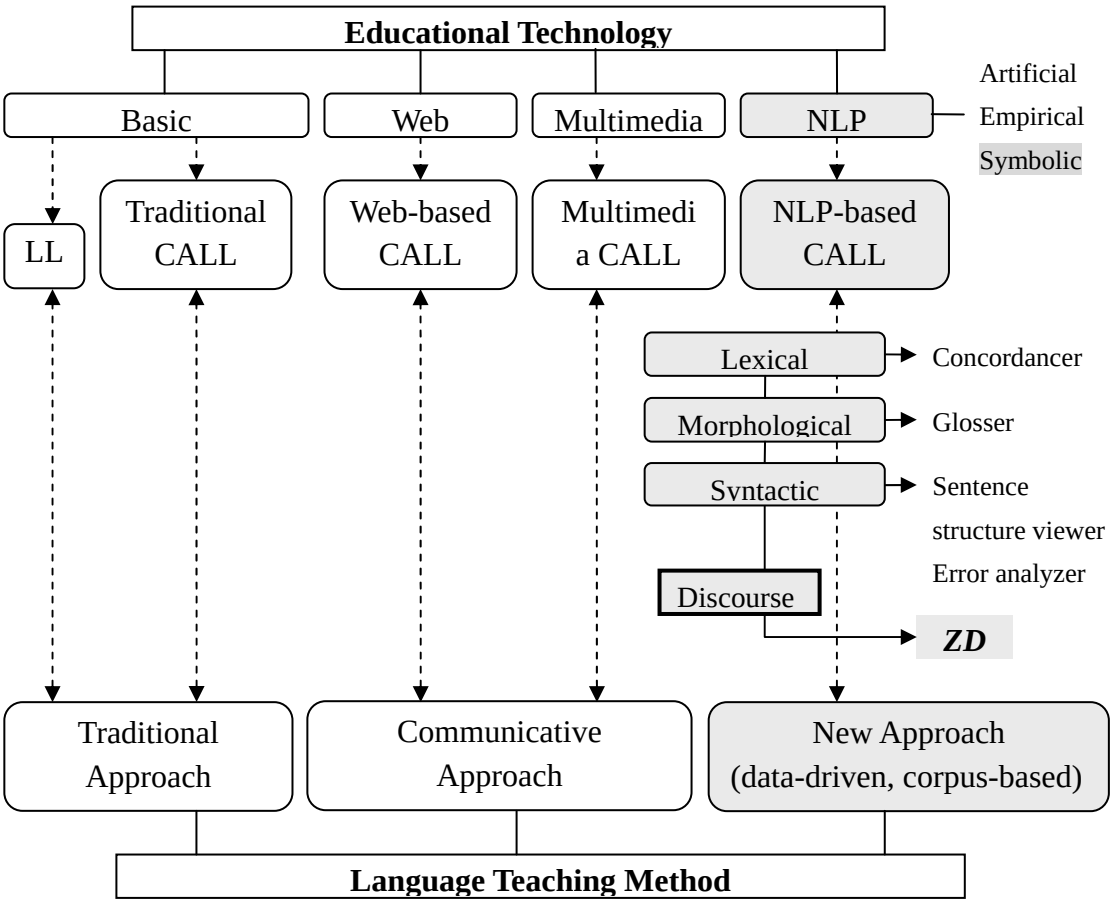


Figure 5.1: Overview of the relations between ET and language teaching methodology

Our focus is on the use of ET as it contributes to language learning, i.e., NLP technology and its embodiment as NLP-based CALL. We take a purely linguistic (symbolic) approach to explicate a discourse-level phenomenon, fully utilizing lexical, morphological, and syntactic analyses that underlie that phenomenon. Our major goal is to relate technology to pedagogy in a theoretically and empirically feasible way. We will demonstrate how important a role NLP-based CALL plays in what we tentatively call a "new approach" to language teaching later in Chapter 7.

Although not included in the figure, the intended users are teachers and learners in university level JSL courses, excluding K-12. The program is intended for use in a traditional classroom (in the sense of "not virtual" or "not long-distance", thus including computer-equipped classrooms). The intended mode is teacher-planned rather than total self-study at the present time.

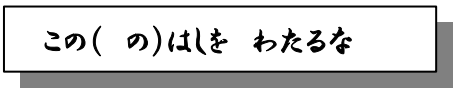
Chapter 6

Technology and *Zero Detector*

6.1 Impetus for developing *ZD*

Zero Detector (hereafter *ZD*) is a linguistic analysis tool that is intended to serve as a basis for pedagogical purposes (which we will discuss later in Chapter 7). The primary function of this program is to make invisible ZEROS visible, by detecting the existence of ZEROS in a given input discourse and explicitly marking them in the output.

Recall the Ikkyu anecdote that we introduced in Chapter 1, in which we assumed that he saved himself from being punished by recognizing the presence of a single ZERO, in the warning sign placed in front of the bridge that he needed to cross. One motivation for the development of this tool derives from our hypothesis that it would save more people if the sign read like this:



(6.1)	この	(の)	はしを	わたるな
	kono	*(no)*	*hasi-o*	*wataru-na*
	this	(GEN)	edge/bridge-ACC	cross-NEG

We conjecture that recognition of ZEROS is harder for "some people" (see below for discussion), especially for those unfamiliar with or unaware of this peculiar linguistic phenomenon in Japanese, which may lead to a failure in the recognition of a unique interpretation like (6.1), or more generally, to misinterpretation, and hence to a failure in a reasonable degree of perception of coherence in a ZERO-containing discourse. By "reasonable" we mean native-like. Establishing native-like perception of coherence created by ZEROS may be enhanced by the visual marking of the invisible; this is our

fundamental motive for the development of *ZD*.

By "some people" we mean two groups of people: (i) native Japanese speaking teachers of the Japanese language, and (ii) Japanese language learners whose native language (e.g., English) does not exhibit a similar phenomenon to Japanese ZEROS.

Firstly, native speakers of Japanese are supposedly so unconscious of the presence of ZEROS in the discourse they are processing that the interpretation of ZEROS and/or of a discourse that contains them is largely automatic; hence, the recognition of ZEROS may require conscious effort and intensive attention to the language, and also some linguistic expertise concerning the phenomenon.

This supposition was verified by an experiment that we conducted on ten native speakers of Japanese who are more or less language-conscious (as they are a group of people in the NLP community); half of them were more familiar with the phenomenon of ZEROS than the other half. Given a brief definition and some examples of ZEROS in discourse, they were asked to identify the presence of ZEROS in three sets of text consisting of 30, 25 and 23 utterances respectively. Their results were compared to the one provided by one subject whom we regard as an expert on ZEROS.[1] The expert detected a total of 48 ZEROS. ZEROS detected by our ten subjects showed drastic variation in their number, ranging from 16 to 52 (35.4 on average). Interestingly, the number of ZEROS detected by the less-ZERO-familiar group was much smaller (22.6 average) than by the more-ZERO-knowledgeable group (48.2 average). This may first imply that all native speakers of Japanese are not equally conscious of ZEROS, and may secondarily suggest that the recognition of ZEROS largely depends on how much speakers are acquainted with these invisibles as a phenomenon.

This supposition may also be applicable to Japanese language teachers; some teachers are more conscious of ZEROS than others. Teachers do know that Japanese is an "elliptic" language, but they do not necessarily spot every single example of the ellipsis phenomenon that occurs in discourse. Moreover, even though they are conscious and well-enough acquainted with the phenomenon, the detection of ZEROS is a tedious and time-consuming task. Computerization of the manual process would be a great advantage since it would release teachers from having to spend enormous amounts of time on the tedious work of analyzing educational materials that they intend to use in class. It would also have advantages over error-prone and often inconsistent manual analysis.

The same supposition would be true of Japanese language learners. Learners understand that Japanese is elliptic, but knowing precisely "where ellipsis occurs" and "what is elided" is a different story (Obana, 2000). To Japanese language learners, however, the recognition of ZEROS alone does not mean much. It probably does not have a direct impact on their comprehension of ZERO-containing discourses, but the

[1] The subject has an extensive experience on ZERO research from linguistic and pedagogical perspectives.

recognition of ZEROS could lead naturally to the recognition of coherence relations in a discourse, and hence to a better understanding of the discourse. The perceived degree of coherence would vary from learner to learner, depending on how well they recognize ZERO-creating coherence. Accurate interpretation of ZEROS also varies greatly amongst learners, as was indicated by the performance assessed by the experiment that we presented in 2.6.1. All these differences derive from the recognition of ZEROS in the first place; that is our rationale for making invisible ZEROS visible.

We have discussed so far why we want to make ZEROS visible for teachers and learners, and hence why we want to develop *ZD*. We will discuss later, in Chapter 7, how these two groups of people would educationally benefit from using *ZD*.

6.2 Methodological principles

Here, we will present our overall stance toward the development of *ZD*. We aim to re-use existing NLP technologies and resources that are sufficiently mature and "portable" where possible, rather than building a system from scratch.[2] *ZD* integrates two existing natural language analysis tools and an electronic dictionary, none of which were intended for language teaching/learning purposes, into its architecture, attempting to make the best possible use of their capabilities for our purpose. Morphological analysis is done by *ChaSen* 2.2.8 (developed at NAIST; e.g., Matsumoto, Kitauchi, Yamashita, Hirano, Matsuda, Takaoka, and Asahara, 2000), and dependency structure analysis by *CaboCha* 0.21 (also developed at NAIST; e.g., Kudo and Matsumoto, 2000, 2001). *Goi-Taikei: A Japanese Lexicon* (Ikehara, Miyazaki, Shirai, Yokoo, Nakaiwa, Ogura, Oyama, and Hayashi, 1997) is used as a source of verbal argument structure (or valency pattern) search in the zero verbal argument recognition components and also as a source of nominal syntactic/semantic categorization in the zero nominal argument recognition modules.

The biggest advantage of reusing existing tools and database is to release system developers from making every single component from scratch, which saves a tremendous amount of time and effort. Disadvantages are, on the other hand, that the existing tools and database may not fully suit the new purpose; it is inevitable that the intended goals of the developers and the users do not always match in a perfect manner. We attempt to correct this disadvantage with necessary adjustments.

ZD utilizes syntactic and lexical semantic information from the surface realization of the input text. *ZD* employs a rule-based approach for its architecture, with theoretically sound heuristics. *ZD* deals with two types of ZEROS, as we presented in

[2] Several NLP-in-CALL projects follow the same principle, e.g., the ICALL groups at the University of Geneva (Vandeventer, 2000) and at Dublin City University (Greene, Keogh, Koller, Wagner, Ward, and van Genabith, 2004), and the aforementioned programs for Japanese, *Reading Tutor* and *Asunaro*.

Chapter 2, zero verbal arguments and zero nominal arguments, which are distinct from each other in their syntactic representation. Hence, the two types naturally need two different sets of heuristics. We will outline the theoretical assumptions from which our heuristics are drawn and present the algorithms for the recognition of these ZEROS, in two separate sections, 6.4 and 6.5 respectively, after a brief discussion of the notions common to both types of ZEROS and a description of the database that we employed in Section 6.3.

6.3 Argument structure versus valency

6.3.1 Definition

Argument structure, as we discussed in 2.2.1, defines the range and nature of syntactic elements usually required by a head verb, noun or other lexical unit (referred to as "predicate"). So does "valency," a term introduced by the French linguist, Lucien Tesnière, by analogy with the chemistry of atoms. In this thesis, we use the terms "argument structure" and "valency," and "argument" and "valent" interchangeably.

6.3.2 Lexicon

Central to the task of understanding a natural language text is determining its argument structure or valency, i.e., the "who did what to whom" and/or "of what/whom" information about the text, which is also a key component for the recognition of ZEROS in the system of *ZD*. Such information is found in a so-called "lexicon," or "(valency) dictionary," which usually contains data for each entry (lemma) at various linguistic levels: phonology, morphosyntax, syntax and semantics, as well as possible linking between the entries for various lexical and semantic relations. The availability of electronic lexicons for an increasing number of natural languages has made such dictionaries among the most indispensable language resources for those involved in all aspects of NLP research.

From among several electronic lexicons available for Japanese, we decided to use *Goi-Taikei: A Japanese Lexicon*. *Goi-Taikei* is a semantic and valency dictionary; it is commercially available both in an electronic version (CD-ROM) and in a print version comprising five volumes (Ikehara et al., 1997). The major attraction of *Goi-Taikei* is its size and coverage, containing 300,000 word entries.

Each word entry in *Goi-Taikei* specifies syntactic information (part-of-speech) and a set of semantic classes. The semantic classes are taken from a hierarchical semantic ontology that is made up of three separate ontological trees: each one containing 2,710 nodes for nouns, 130 nodes for proper nouns, and 36 for predicates (i.e., verbs,

adjectives and nominal adjectives).

For example, for the search for a word はし *hasi*, *Goi-Taikei* returns entries as in (6.2).[3]

(6.2) a. 橋（はし） ［名］ 420 橋
hasi (ha-si) [noun] 420 bridge

b. 端（はし） ［名］ 2658 端 2659 先(場) 2667 ふち …
hasi (ha-si) [noun] 2658 edge 2659 tip (place) 2667 rim

c. 箸,はし,ハシ(はし) ［名］ 913 箸・さじ
hasi (ha-si) [noun] 913 chopsticks/spoon

The primary entry for the word *hasi* is syntactically categorized as a "common noun" and is semantically classified as a member of the "bridge" group (#420) which is under the "place" node (#388) in the "concrete" noun group. It is secondarily classified in the same syntactic category, but as a member of the "edge" semantic group (#2658) which is under the "location" node (#2610) in the "abstract" noun group. In the third sense, it belongs to the "tableware" node.

In addition, *Goi-Taikei* contains valency patterns for 6,000 predicates; a total of 14,000 patterns are listed, with an average of 2.3 patterns for each predicate. These patterns, in fact, correspond to those for English; they are intended to be used for transfer-based machine translation applications. Each predicate sense in the dictionary is associated with one or more argument slots, which are labeled N1, N2, etc. Each argument slot contains information, such as its grammatical function, indicated by case marking particles and selectional restrictions. The search for a verb 渡る *wataru* returns the basic information as in (6.3).

(6.3) 渡る（わたる）［自動］
wataru (wa-ta-ru) [intransitive]

Also, its valency patterns, along with their corresponding English expressions, are provided with ten different listings. The first two listings are presented in (6.4).

(6.4) a. 15 natural phenomenon (action; passivization not allowed)
N1-*ga* N2-*o wataru* N1 blow across N2
[N1(2373 wind) N2(511 land)]

[3] The first three listings, out of the eight entries for *ha-si*, are presented here.

b. 18 physical movement (action; passivization not allowed)
N1-*ga* N2-*o wataru* N1 cross N2
[N1(3 agent 535 animal 986 vehicle) N2(388 place 2610 location)]

Recall the Ikkyu example. According to the *Goi-Taikei* semantic and valency definitions in the (b) sense, both the Ikkyu interpretation "cross the edge" and the normal interpretation "cross the bridge" are possible.

6.4 Zero Verbal Argument Recognition

6.4.1 Verbal argument structure

6.4.1.1 Related work

Verbal argument structure or valency is significant in its own right. The central role that it plays in analyzing clause units makes it an inevitable lexical resource for many NLP applications. There have been several electronic valency dictionaries developed and made available mainly to the research community. They include the 260,000-word *EDR Dictionary* (EDR, 1996) and the 2,000-word *IPAL Lexicon* (IPA, 1987, 1990, 1996), besides the aforementioned *Goi-Taikei*. More recently, *Valence Data on Japanese Verbs* (Ogino, Kobayashi, and Isahara, 2003), a successor of *EDR*, has joined the electronic resource pool.

Even before the age of electronic publishing, verbal valency attracted attention in a variety of theoretical frameworks that share the common idea that verbs are the core of sentence structures. Such theories include dependency grammar (proposed by Tesnière for French in 1959, or by Hays for English), valency grammar (by Helbig and Schenkel, Engel and Schumacher for German), case grammar (by Fillmore), lexical functional grammar or LFG (by Kaplan and Bresnan) and generative grammar (by Chomsky), among others.[4] In generative frameworks, such as Government and Binding (GB), for example, a "subcategorization frame" is defined to specify the range of sister constituents within the verb phrase, namely whether or not the verb permits a following NP object, and "selectional restrictions" specify the inherent semantic features permitted (or required) on the constituents. More traditionally, syntactic patterns for English verbs have been extensively studied by Fries (1952) and Hornby (1954), both of whom are influential in EFL/ESL pedagogy.

Influenced by these studies, work on Japanese valency patterns, as well, has a long history. Though electronically unavailable, there are also a few research efforts on

[4] We have benefited a great deal from Ishiwata and Ogino (1983) for this summary.

constructing a verbal valency (or syntactic pattern) dictionary (e.g., Ishiwata and Ogino, 1983, Ishiwata, 1999; Koizumi, Funakoshi, Honda, Nitta, and Tsukamono, 1989).

6.4.1.2 Our approach

Our approach is eclectic and relatively theory-neutral; it does not strictly adhere to any specific grammatical framework reviewed above, but rather simply adopts the general idea that a clause consists of a head predicate and its arguments; a predicate takes (or requires) a set of arguments, and the arguments are syntactically dependent on the head predicate. Thus, "predicate" and "argument" are two key concepts in our approach (see Chapter 2).

Predicate

The predicates that constitute clauses in Japanese include verbs, adjectives, nominal adjectives and the copula. Each predicate word does not usually occur by itself, but rather co-occurs with some auxiliary elements, including modal and other supporting verb types that follow the core predicate (in bold), as illustrated in (6.5).

(6.5)	a.	verb	***nageyoo**-to-si-ta*	[core: *nageru* 'throw']
	b.	adjective	***atarasi**-katta*	[core: *atarasii* 'new']
	c.	nominal adjective	***sizuka**-ni-naru*	[core: *sizuka* 'quiet']
	d.	copula	***da**-tta*	[core: *da* 'be']

The whole predicate in (6.5a), for example, is morphologically analyzed into several elements, as in (6.6).

(6.6) ***nageyoo**-to-**si**-ta*
throw-COML-**do**-PAST

This predicate unit contains two verbs *nageru* 'throw' and *suru* 'do,' but the valency should be checked for the core predicate, 'throw' in this case. We will discuss this point more concretely later in section 6.4.3.

The verb *nageru*, for example, usually requires two arguments: the one who does the act of throwing and the one that is thrown. Most adjectives and nominal adjectives are one-place predicates. Two nominal arguments or one nominal and one adjectival argument are obligatory for clauses containing a copula.

We use the term verbal arguments[5] for all four cases in (6.5), simply because verbs

[5] In Yamura-Takei and Fujiwara (2004), we used the term "zero predicate-argument," which is avoided here because of the confusing usage of the term "predicate."

are the major type of clausal predicate and there is no appropriate (and non-confusing) term to cover all these predicate types. Therefore, when we use the term verbal arguments, we also include the adjectival and copula arguments, for the rest of the thesis.

Argument PPs

Arguments normally take the form of PPs, i.e., NPs that are headed by (case-assigning or topic/focus marking) particles, often coded as NP-*ga* or N-*ga*. We classify arguments into three groups according to their head particle types: Topic PPs, headed by a topic marking particle *wa*, Focus PPs, headed by focus marking particles *mo*, *koso*, *dake*, *sae*, *sika*, etc., and Case PPs,[6] headed by case marking particles *ga*, *o*, *ni*, *e*, *to*, *yori*, *de*, *kara* and *made*, out of which *ga*, *o*, and *ni* represent the surface realization of grammatical case (see 2.2.3). We regard adjuncts as non-particle-accompanied phrases, such as *sono hi*, 'that day.' Look at the next example.

(6.7)	太郎は	そのとき	かべに	卵を	投げようとした
	Taro-wa	*sono-toki*	*kabe-ni*	*tamago-o*	*nageyoo-to-si-ta*
	Taro-TOP	that-time	wall-at	egg-ACC	throw-to-do-PAST

'At that moment, Taro tried to throw an egg at the wall.'

This clause contains a core predicate (*nageru* 'throw') and one adjunct (*sono toki* 'then') and three arguments: one Topic PP (*Taro-wa*) and two Case PPs (*kabe-ni* and *tamago-o*).

We defined ZEROS as the unexpressed "obligatory" arguments of a core predicate. What qualifies as "obligatory" is an open issue, and there is no agreement among linguists on its definition. Somers (1984) proposed, in denying a simply binary distinction (i.e., obligatory/non-obligatory), a six-level scale of valency binding that reflects the degree of closeness of an argument to the predicate. The levels are (i) integral complements, (ii) obligatory complements, (iii) optional complements, (iv) middles, (v) adjuncts, and (vi) extraperipherals.

Ishiwata (1999) suggests that in Japanese, members of group (i) are often treated as parts of idioms and are not omissible; Japanese nominative *-ga* and accusative *-o* fall into the category (ii), while dative *-ni* belongs to (iii). In light of this, we assume that obligatory arguments are phrases accompanied by the nominative-case particle *ga*, and accusative *o*. Dative *ni* in an indirect object position requires special handling. Whilst it is true that it is often optional, there are some cases (e.g., *tutaeru* "tell," *watasu* "hand") in which the presence of the dative phrase is obligatory. If the argument is

[6] In Yamura-Takei et al. (2002), we use the term "Kase Phrase (KP)", but we replace it with "Case Particle Phrase (Case PP)" in this thesis.

unexpressed in these cases, we identify it as a zero argument as well. In addition, we take *ni*-marked subject/object and *ga*-marked object (as discussed in 2.2.3) into consideration.

In sum, we consider argument PPs that are headed by "grammatical" case markers as "obligatory" elements and exclude PPs headed by "semantic" case markers from our ZERO candidates. Therefore, among the three arguments contained in (6.7) above, *Hanako-ni* is not considered as an "obligatory" argument PP. If the argument is unexpressed in these cases, we identify it as a zero argument.

Look at the sample clause in (6.8).

(6.8)	昨日	カレーライスを	食べた
	kino	*kareeraisu-o*	*tabe-ta.*
	Yesterday	curry-and-rice-ACC	eat-PAST

The valency pattern of the predicate *taberu* 'eat' requires a nominative argument as well as an accusative argument. This implies the presence of a ZERO "*Ø-*(*ga*)" in the sentence (6.8), as in (6.8'). We call this ZERO type the "zero verbal argument."

(6.8')	*kino*	(*Ø-ga*)	*kareeraisu-o*	*tabe-ta.*
	Yesterday	(Ø-NOM)	curry-and-rice-ACC	eat-PAST

'Yesterday, Ø ate curry and rice.'

This definition of ZEROS provides the following three basic valency patterns for verbs and potential ZEROS.

(6.9)				
	a.	NOM + V	*Ø-ga tomaru*.	'Ø stops.'
	b.	NOM + ACC + V	*Ø-ga Ø-o tomeru*.	'Ø stops Ø.'
	c.	NOM + DAT + ACC + V	*Ø-ga Ø-ni Ø-o osieru*.	'Ø teaches Ø Ø.'

6.4.2 Verbal valency dictionary

As a lexical database that *ZD* accesses in search of the valency for a given verb, *Goi-Takei* is employed (see 6.3.2 above for detailed description of *Goi-Taikei*). The biggest advantage of the *Goi-Taikei* verbal valency dictionary is its size and coverage; it contains 6,000 predicates.

In addition to *Goi-Taikei*, we also use a small lexicon that was constructed from the hand-tabulated valency listing provided by Ishiwata and Ogino (1983) and Ishiwata (1999). The list contains valency patterns for 1,154 predicates (including verbs, adjectives, and nominal adjectives), with semantic features for each valent specified.

Valents (coded N) are accompanied by one of nine case particles, *ga*, *o*, *ni*, *to*, *e*, *kara*, *yori*, *made* and *de*, each of which is assigned one and only semantic feature (labeled in French), from among "abstrait," "action," "animal," "concret," "divers," "humain," "localite," "number," "matière," "temps," and "s(entence)," as an example in (6.10) shows.

(6.10) *arau* 'wash' N [hum] *ga* + N [con] *o* + V

A predicate and its valency pattern, in most cases, correspond on a one-to-one basis. In the case of multiple patterns, the patterns are listed from a fewer-valent pattern to a more-valent pattern.

In constructing our lexicon from this list, we first selected 334 predicates that are listed in the vocabulary for the Japanese-Language Proficiency Test (JLPT) levels 3 and 4 (distributed by the Japan Foundation and Japan Educational Exchange Services, in 1994 and revised in 2002), reexamined the valency patterns, and made some slight modifications when necessary.[7] We call this valency dictionary *JLPT3/4*, and use it as a resource for *ZD*, in addition to *Goi-Taikei*.

These two sets of lexicons, distinct from each other in their size, coverage and original intention, are incorporated into two versions of the zero verbal argument component of *ZD*.

6.4.3 Algorithm

The recognition of zero verbal arguments is subjected to the following procedures. We will use the following utterance as an example input string to illustrate the ZERO detecting processes.

(6.11)

困った太郎は	さっそく	論文を
komatta taroo-wa	*sassoku*	*ronbun-o*
troubled Taro-TOP	immediately	paper-ACC

調べさせることにした。
sirabe-saseru-koto-ni-si-ta.
look-in-CAUS-NOMI-to-do-PAST

'Troubled Taro, immediately tried to have (someone) look in the paper.'

[7] This is done solely for the purpose of using *ZD* for the instruction of intermediate JSL learners. Modifications were made, according to suggestions from a JSL teaching expert, in order to provide as canonical and basic a valency pattern as is appropriate for those learners.

The input is first analyzed morphologically by *ChaSen*, and passed on to the next step.

Clause splitting and labeling

The identification of clause boundaries is vital for many NLP tasks (Orasen, 2000). It is an initial step that is required for our task, as well, because the basic unit for the ZERO detecting operation is a clause that consists of one and only head predicate and its arguments. Thus, the input text that is previously morphologically analyzed is next split into a set of clauses.

Clause splitting, in our method, is initiated by searching for an element morphologically defined as a type of predicate (i.e., verb, adjective, or nominal adjective). Here, some complication lies in the fact that some predicates are simplex, as in (6.12a) below, while others are complex, involving multiple predicates, as in (6.12b). The example (b) contains two elements that are morphologically analyzed as verbs (underlined): a core predicate, *taberu* 'eat' and a supporting verb, *aru* 'have.'

(6.12) a. *tabe-ta*
eat-PAST
'ate'

b. *tabe-ta-koto-ga-aru*
eat-PAST-NOMI-NOM-have
'have eaten'

These complex predicate patterns are predefined as simplex to avoid excessive clause splitting. The predefined rules comprise a total of 15, which are grouped into the following four patterns in (6.13).

(6.13)

a.	verb + verb	(11 rules)
b.	adjective + verb	(1 rule)
c.	verb + adjective	(2 rules)
d.	verb + nominal predicate	(1 rule)

One of the rules above is applied to the complex predicate in the sample clause, *sirabe-saseru-koto-ni-si-ta*, which contains two verbs (underlined), and it is consequently analyzed as one predicate.

Then, the clauses are labeled with their clause types: independent (main), dependent (coordinated/subordinated) or embedded (relative/nominal/quoted). A clause serves as the basic unit for the zero detecting operation. In this study, embedded clauses are excluded from this operation and are left within their

superordinate clauses.[8] An example output is given in (6.14).

(6.14) 困った EC(RC)] 太郎は さっそく 論文を
komatta EC(RC)] *Taro-wa* *sassoku* *ronbun-o*

調べさせることにした IC]
sirabe-saseru-koto-ni-si-ta IC]

Here, we use the acronyms: IC for Independent Clause, EC for Embedded Clause and RC for Relative Clause.

Dependency analysis

Once the text is split into clauses, each clause is analyzed for its dependency structure and then converted into its clause structure frame. The argument PPs that depend on the verb are extracted, and then classified into phrase types (Topic PP, Focus PP and Case PP) according to their head particles. An example of this frame is given in Figure 6.1.

[8] This treatment is identical to that of the CENTER-updating unit for our centering analysis (see .3.2.3).

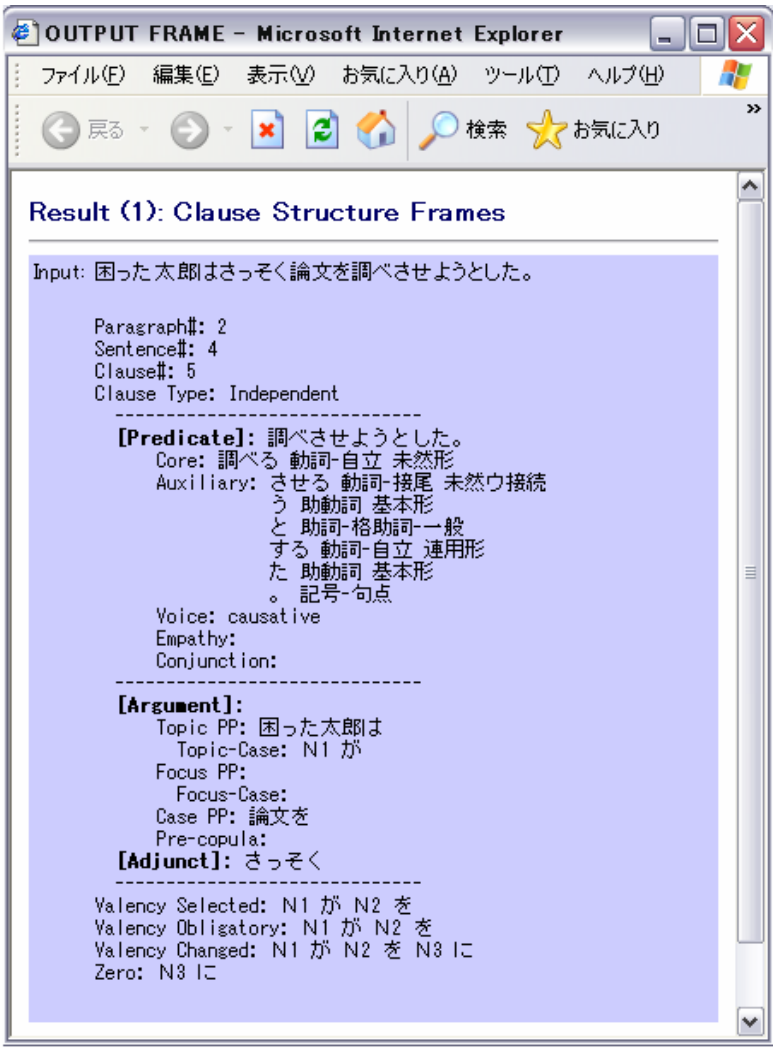


Figure 6.1: Sample clause structure frame

This frame indicates that this utterance, labeled clause #5 in the fourth sentence in the second paragraph in the input text, is a clause of "Independent" type, with a relative clause (RC) embedded in it.

The core predicate is a verb *siraberu* 'investigate' whose valency is later checked against a valency dictionary. The verb is accompanied by a causative verb, *saseru*, followed by a past marking auxiliary verb *-ta*. The "voice" slot is, hence, marked as "causative," which is later referred to at the stage of valency changing operations. The utterance contains two arguments: one Topic PP whose canonical case is restored, at the case restoring operation phase (see below), as nominative (marked N1-*ga*) and one Case PP. It also includes one adjunct, i.e., an adverb.

Valency checking

Given the clause structure frame, a core predicate is checked against *Goi-Taikei* to search for its valency pattern(s). *Goi-Taikei* has a semantic valency dictionary, originally designed for transfer-based Japanese-to-English machine translation, so it includes as many valency pattern entries for each predicate as are necessary for effective transfer. The entries are ordered according to the expected frequency of occurrence. We took the naïve approach of selecting the first-ranking entry from the listing for each core predicate. The valency selected for the verb *siraberu* is shown in (6.15).

(6.15) Valency Selected: N1 *ga* N2 *o*

The next step is to apply the definition of "obligatoriness" described in 6.4.1.2. In order to refine the selected valency pattern, the following modification is made; if non-*ga*, -*o*, or -*ni* cases are within the first three slots of the selected valency pattern, they are removed. The resulting valency for (6.15) is given in (6.16).

(6.16) Valency Obligatory: N1 *ga* N2 *o*

If a *ni*-case still remains in the third slot, it is also deleted. These operations leave us two valency patterns: (i) N1-*ga* N2-*o*, and (ii) N1-*ga* N2-*ni*, in most cases.

Valency changing operation

Then, a valency changing operation is done in the case of causatives or passives. When an auxiliary verb is added to the core predicate in the causative or passive construction, the verb then requires three arguments. In the causative case, there are a *ga*-marked causer, an *o*-marked object and a *ni*-marked causee. The valency changing operation adds the valent, N3 *ni*, as in (6.17) because the voice slot is marked as causative in Figure 6.1 above.

(6.17) Valency Changed: N1 *ga* N2 *o* N3 *ni*

Case restoring operation

Case-less elements, such as Topic PP and Focus PP, need to have their canonical case markers restored. This is done, in a parallel fashion with the ZERO identification, by assigning the first remaining valent(s) to Topic PP and/or Focus PP. Let us review the rationale for this operation.

In Topic PPs and Focus PPs, topic/focus marking particles replace the nominative case marker -*ga* or the accusative case marker-*o*. This replacement of case particles sometimes causes ambiguities, as example (6.18) shows.

(6.18) ネコは Ø つかまえた。
neko-wa Ø *tukamae-ta.*
cat-TOP Ø catch-PAST

This utterance alone is ambiguous because two derivations for the structure (6.18) are theoretically possible, as in (6.19).

(6.19) a. *neko-wa* (*ga*) *Ø-o* *tukamae-ta.*
cat-TOP(NOM) Ø-ACC catch-PAST

'The cat caught (something).'

b. *neko-wa(o)* *Ø-ga* *tukamae-ta.*
cat-TOP (ACC) Ø-NOM catch-PAST

'The cat, (someone) caught.'

Empirically, however, (a) is a highly dominant case, as we saw in the evidence provided from our corpus in 3.2.3.3 (see Table 3.2). We examined all the PPs marked by a topic marking particle *wa* and a focus marking particle *mo* in our corpus, and found that the vast majority of topic PPs are canonically of nominative case.

Other case marking particles, such as dative case marker *ni*, and other semantic particles, such as *made* and *kara*, in contrast, are preserved when PPs are topicalized or focused, and topic/focus marking particles are simply added to them, as illustrated in (6.20).

(6.20) a. ネコにには むずかしい。
neko-ni-wa *muzukasii.*

Ø-ga *neko-ni* *muzukasii.*
Ø-NOM cat-for difficult

'Ø is difficult for cats.'

b. ネコからも 話を 聞いた。
neko-kara-mo *hanasi-o* *kii-ta.*

Ø-ga *neko-kara-mo* *hanasi-o* *kii-ta.*
Ø-NOM cat-from-FOC story-ACC hear-PAST

'Ø heard a story also from the cat.'

These cases are not problematic for the case-restoring operation; canonical cases (underlined) are explicitly maintained.

Returning now to example (6.14), Topic PP, *Taro-wa*, is assigned *ga* case and the Topic-case slot is marked with N1-*ga*, in Figure 6.1. In this way, all the case-less phrases are assigned cases.[9]

ZERO identification

Now that the valency pattern for the given predicate is assigned, it is checked against overt arguments listed in the frame. The valent N2 is matched with the overt argument *ronbun-o* and removed from the ZERO candidate list, as shown in (6.21) where the case slot N1-*ga* assigned to a Topic PP, *Taro-wa* is also deleted.

(6.21) Valency Changed: ~~N1 *ga*~~ ~~N2 *o*~~ N3 *ni*

Finally the remaining valent, if any, is assumed to be a ZERO, i.e., N3 *ni*, in this example.

ZERO insertion

Once ZEROS are identified, *ZD* decides where to insert the identified ZEROS in the original text, by keeping canonical ordering as listed in the valency pattern. An example of the verbal (obligatory) argument structure from Figure 6.1, with the identified ZERO, is presented in 6.22. Here, the predicate-argument structure is arranged horizontally, and the restored case-marking particle, *ga* in this case, is presented in parentheses.

(6.22) * *komatta Taro-wa* (*ga*)
* *ronbun-o*
* [*ni*]
* *sirabe-sasyo-o-to-si-ta*

Finally, the original series of clauses with ZEROS inserted in the most plausible positions, along with adjuncts, is provided, as in (6.23).

(6.23) (previous utterance)… *komatta Taro-wa(ga) sassoku ronbun-o* [*ni*]

[9] Torisawa (2001b) proposed an unsupervised learning method for what he calls canonicalization of non-case marking particles. This approach utilizes case frames and semantic word classifications, which guarantees a semantic compatibility in a given verb-noun pair that our approach fails to assure. However, it risks the possibility of assigning to a given noun a case that is already used for another noun within a clause, which will not happen in our method.

sirabe-saseyoo-to-si-ta. … (next utterance)

To sum up, the flow diagram of the ZERO detecting processes that have been described above (highlighted) is illustrated in Figure 6.2.

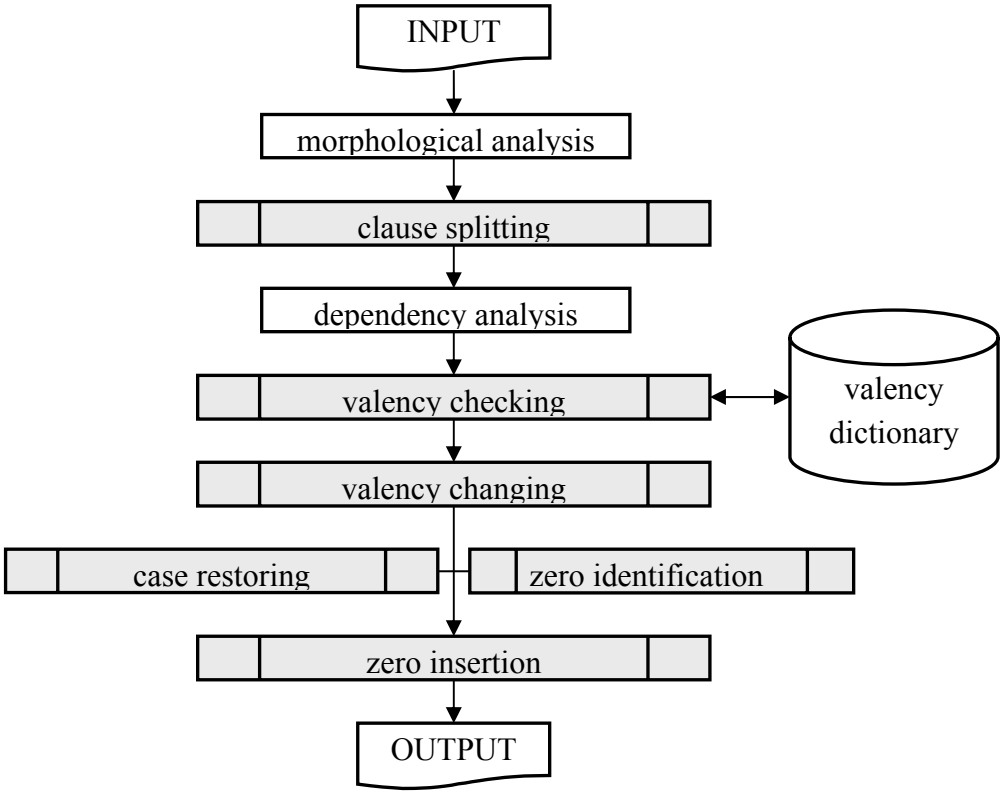


Figure 6.2: Flow diagram of zero verbal argument detecting processes

6.4.4 Other methods

There has been little work that focuses on the detection of ZEROS, compared to the interpretation of ZEROS. Among the few researchers dealing with this topic, Nakaiwa (1997) utilizes aligned English and Japanese sentence pairs to identify zero pronouns (and also their antecedents). Seki, Fujii and Ishikawa (2001) take a similar approach to ours,[10] in the zero pronoun identification phase of their probabilistic model for ZERO resolution. Kawahara et al. (2002, 2004) also take a case-frame approach that utilizes the automatically constructed case frames from a tagged corpus. All this work, however, sees ZERO identification as a prerequisite for the subsequent resolution of the antecedents; none provides any evaluation of the performance of the identification

[10] They use the IPAL Lexicon as a case frame dictionary.

phase alone. Also, many other papers on zero anaphora resolution use manually ZERO-detected corpora for their experiments or do not explicitly describe their detecting processes.

This negligible amount of work on detection is an impetus for developing *ZD*; detection itself could be an important NLP task, given an appropriate application area, in the same way that concordancers find any particular lexical unit on the user's demand.

6.5 Zero Nominal Argument Recognition

6.5.1 Nominal argument structure

6.5.1.1 Related work

Verbal argument structure or valency has been extensively studied and placed in the core of a variety of syntactic theories, as we presented in 6.4.1.1. Nominal argument structure or valency, as well, has been discussed in the literature, mostly on semantic grounds.

Partee (1987) suggests that NPs can be interpreted either as individual (type e), predicate (type <e,t>), or as generalized quantifiers (type <<e,t>,t>). Furthermore, Partee and Borschev (1998, 2000, 2003) argue for "argument-modifier distinction" of possessive constructions in NP, with regard to sortal nouns (plain one-place predicates) versus relational nouns (or "transitive" nouns), and type shifting.

The study of "definiteness" of nouns also concerns nominal arguments. Löbner (1985, 1991) argues that some nouns are "definite" simply because they are semantically so. He proposes that many definites in discourse are in fact "semantic definites." Semantic definites, i.e., nouns with functional concepts, inherently bear arguments which can be expressed either explicitly or implicitly. Fraurud (1996) expresses a similar view. She examined a Finnish corpus and found that many of the so-called first mention definites are actually semantic "functionals" that can be identified indirectly through their semantic arguments.

Grimshaw (1990) also assumes that not all nouns have an argument structure and calls those that do so "argument-taking nominals," which, in her definition, are "process" and complex event nominals.

In Japanese work, Nishiyama (2003, 2004) defines what he calls "unsaturated nouns" as nouns that are semantically incomplete and require a "parameter" to fill the gap.

6.5.1.2 Our approach

Our approach to zero nominal arguments largely depends on the idea that underlies the studies presented in the previous section. We conjecture that some nouns inherently do require arguments, or less firmly put, that some nouns are more likely to take arguments than others in certain contexts, and that those arguments can either be overtly expressed or unexpressed at the level of surface realization. We refer to the cases in which arguments required by their head nouns are implicitly realized, as our definition of zero nominal arguments.

Look at example (6.24), assuming that it occurs in a certain discourse context.

(6.24) 身長は　　50センチだ。
sintyo-wa　*50 senti da.*
height-TOP　50-centimeters COP

Utterance (6.24) does not contain a "zero verbal argument." The utterance satisfies the valency requirements of the predicate: the copula verb *da* appears with a topicalized subject and a pre-copula nominal, both of which are overt. Therefore, utterance (6.24) contains no "zero verbal argument." However, this utterance alone is semantically incomplete, although it is syntactically well formed. The noun *sintyo* 'height' calls readers' attention to "of-what/whom" information and readers recover that information in the flow of text. In this sense, this noun is categorized as Löbner's "semantic definite," being a noun of functional concept. Then, the missing information can usually be supplied by an NP ('the robot,' for example) followed by an adnominal particle *no*, as in (6.24').

(6.24') (*Ø-no*)　*sintyo-wa*　*50 senti da.*
(Ø-GEN)　height-TOP　50-centimeters COP

'(The robot's) height is 50 centimeters.'

We assume that argument structures of nouns are realized in the form of this adnominal construction and regard this unexpressed 'NP *no*' in the NP *no* NP (a.k.a., A *no* B) construction as the other type of ZERO.

It can be said that zero nominal arguments are "semantic ellipsis" triggered by semantic incompleteness, in contrast to zero verbal arguments, which are "syntactic ellipsis" inferred from syntactic requirements. In other words, the search for zero nominal arguments is equivalent to seeking nouns that semantically require arguments in the context in which they appear. We call these nouns "argument-taking nouns (ATNs)," which are roughly equivalent to the aforementioned concepts: Partee and Borschev's "relational nouns," Löbner's "semantic definites," Grimshaw's

"argument-taking nominals," and Nishiyama's "unsaturated nouns."

Consequently, we take a lexico-semantic approach to zero nominal argument recognition, in contrast to the syntactic approach we employ for the zero verbal argument recognition, and we will explicate it in the following section.

6.5.2 Nominal valency dictionary

6.5.2.1 Alternative: Nominal semantic dictionary

Nominal valency has been studied for English and some other European languages, and several attempts have been made to construct a nominal lexicon. For example, *NOMLEX* (NOMinalization Lexicon) is a computational lexicon of derived nominals in English (e.g., Macleod, Meyers, Grishman, Barrett, and Reeves, 1997). Another example is the *STO* project, the on-going computational lexicon project which is an attempt to morphologically, syntactically and semantically encode nouns in Danish (e.g., Olsen, 2002). Both provide information about the syntactic/semantic behaviors of the nominals they concern. In addition, *FrameNet* provides frame-semantic descriptions of English lexical items, including frame-bearing nouns (e.g., Baker, Fillmore, and Lowe, 1998).

Several broad-coverage resources of this type are available for Japanese verbs, as we listed in 6.4.1.1. For nouns, however, there is no comparably rich resource yet. The Japanese *FrameNet* project is currently on-going (Ohara, Fujii, Ohori, Suzuki, Saito, and Ishizaki, 2004). Several other attempts have been made to construct a nominal case frame dictionary using A *no* B phases in corpora (Kurohashi, Murata, Yata and Shimada, 1998; Kawahara, Sasano and Kurohashi, 2004), to construct a tagged corpus that contains information of relations between nouns (Kawahara, Kurohashi and Hasida, 2002), and to automatically construct nominal case frames (Kawahara and Kurohashi, 2004).

The lack of availability of an accessible electronic nominal valency dictionary for Japanese has directed our attention to an alternative, i.e., the use of a semantic dictionary. In what follows, we will discuss how this alternative is made possible and successful.

6.5.2.2 Preliminary corpus analysis

Zero verbal arguments are unexpressed elements that are predictable from the argument structure of the head verb or other predicate. Zero nominal arguments, analogously, are missing elements that can be inferred from some properties specified by their head nouns, i.e., the argument structures of the nouns. We conjecture that certain nouns are more likely to take (zero) nominal arguments than others, and that the head nouns that

take zero nominal arguments, extracted from our corpus, are representative samples of this particular group of nouns. Thus, we carried out a corpus-based analysis of our target construction, i.e. (A *no*) B, with the following procedures.

A no B classification

Our first approach was to use an existing A *no* B classification scheme. The scheme we adopted is a classification proposed by Shimazu, Naito and Nomura (1985, 1986a, 1986b, and 1987, henceforth SNN). Based on their corpus study, they classified the A *no* B phrases into five main groups according to the semantic dependency relations between the elements of the phrase. Their classification and a description of each group with some examples were given in Chapter 2.

Distribution of (A no) B examples

Given these A *no* B categories, our next step was to examine our corpus and to locate, based on the native speaker intuitions and the linguistic expertise of the author, a total of 320 zero nominal arguments (unexpressed A nouns) that are associated with B nouns. Locating unexpressed "A *no*" was not problematic because lexical and contextual information reveal to a native speaker's introspection that something is missing from the surface, in most cases. Several rounds of annotation and occasional consultation with another native-speaking linguist, we assume, have achieved a reasonably feasible result.

We then classified these located (A *no*) B examples into groups, modeled on the SNN A *no* B classification scheme. The distribution of the examples from each group is presented in Table 6.1 (next page); the definitions are repeated from Table 2.4 (in Chapter 2). Also, the examples found in our corpus are listed.

Group	Definition	Examples from our corpus	# (%)
I	A: argument	*inu-no-sampo*	33
	B: nominalized verbal element	'dog-*no*-walk'	(10.31%)
II	A: noun denoting an entity	*kao-no-yoko*	23
	B: abstract relational noun	'face-*no*-side'	(7.19%)
III	A: noun denoting an entity	*kodomo-no-kazu*	35
	B: abstract attribute noun	'children-*no*-number'	(10.94%)
IV	A: nominalized verbal element	*hitori-gurasi-no-hito*	0
	B: argument	'living-alone-*no*-person'	(0.00%)
V	A: noun expressing attribute	*kaisya-no-syokudo*	229
	B: noun denoting an entity	'company-*no*-cafeteria'	(71.56%)
Total			320 (100%)

Table 6.1: Distribution of (A *no*) B types

Group V comprised the vast majority, while approximately the same percentage of examples was included in Groups I, II and III. There were no Group IV examples.

For comparison, we also examined the A *no* B samples (with explicit nominal arguments) in the same corpus. This is summarized in Table 6.2, along with the data from the SNN corpus (scientific journal articles) and from a Japanese email corpus.[11]

Group	Our corpus implicit	Our corpus explicit	SNN corpus explicit	Email corpus explicit
I	33 (10.31%)	76 (8.67%)	1247 (20.99%)	217 (32.88%)
II	23 (7.19%)	146 (16.65%)	725 (12.20%)	147 (22.27%)
III	35 (10.94%)	71 (8.10%)	371 (6.24%)	15 (2.27%)
IV	0 (0.00%)	2 (0.23%)	271 (4.56%)	27 (4.09%)
V	229 (71.56%)	582 (66.36%)	3328 (56.01%)	254 (38.48%)
Total	320 (100%)	877 (100%)	5942 (100%)	639 (100%)

Table 6.2: Comparison of A *no* B group distribution in three different corpora

[11] This is the corpus used in Fais and Yamura-Takei (2003) in which a discussion of the nature of the corpus can also be found. Yamura-Takei and Fais (ms.) examined the whole corpus for A *no* B phrases in terms of the relative salience of each element, A and B.

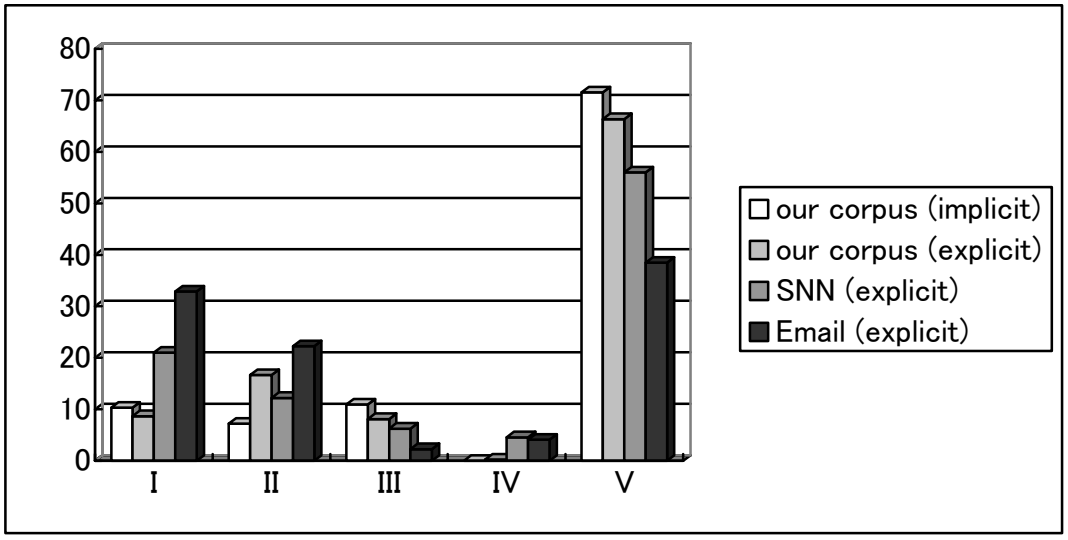


Figure 6.3: Comparison of A *no* B group distribution in three different corpora

The distributions of the types, as you can see in Figure 6.3, are roughly similar for our corpus and the corpus of SNN; however, the email corpus is relatively unique compared to the other two corpora.

Comparing the (A *no*) B and the A *no* B phrases in our corpus, there isn't any striking contrast, though group II nouns seem to have a tendency to appear with explicit arguments. This is probably because group II nouns have less semantic substance and some of them hardly ever or never appear alone.

Goi-Taikei: A Japanese Lexicon

Before we move on to the next stage, let us describe the lexicon that we utilize, as a resource, for the characterization of B nouns. The lexicon that we use is *Goi-Taikei* (see 6.3.2 above for its general description). Among the ontological semantic trees that the *Goi-Taikei* provides, we use the common noun ontology that defines approximately 300,000 nouns based on an ontological hierarchy of 2,715 semantic attributes, in a maximum of 12 level-tree structures. The top four levels of the hierarchy are depicted in Figure 6.4 (next page).

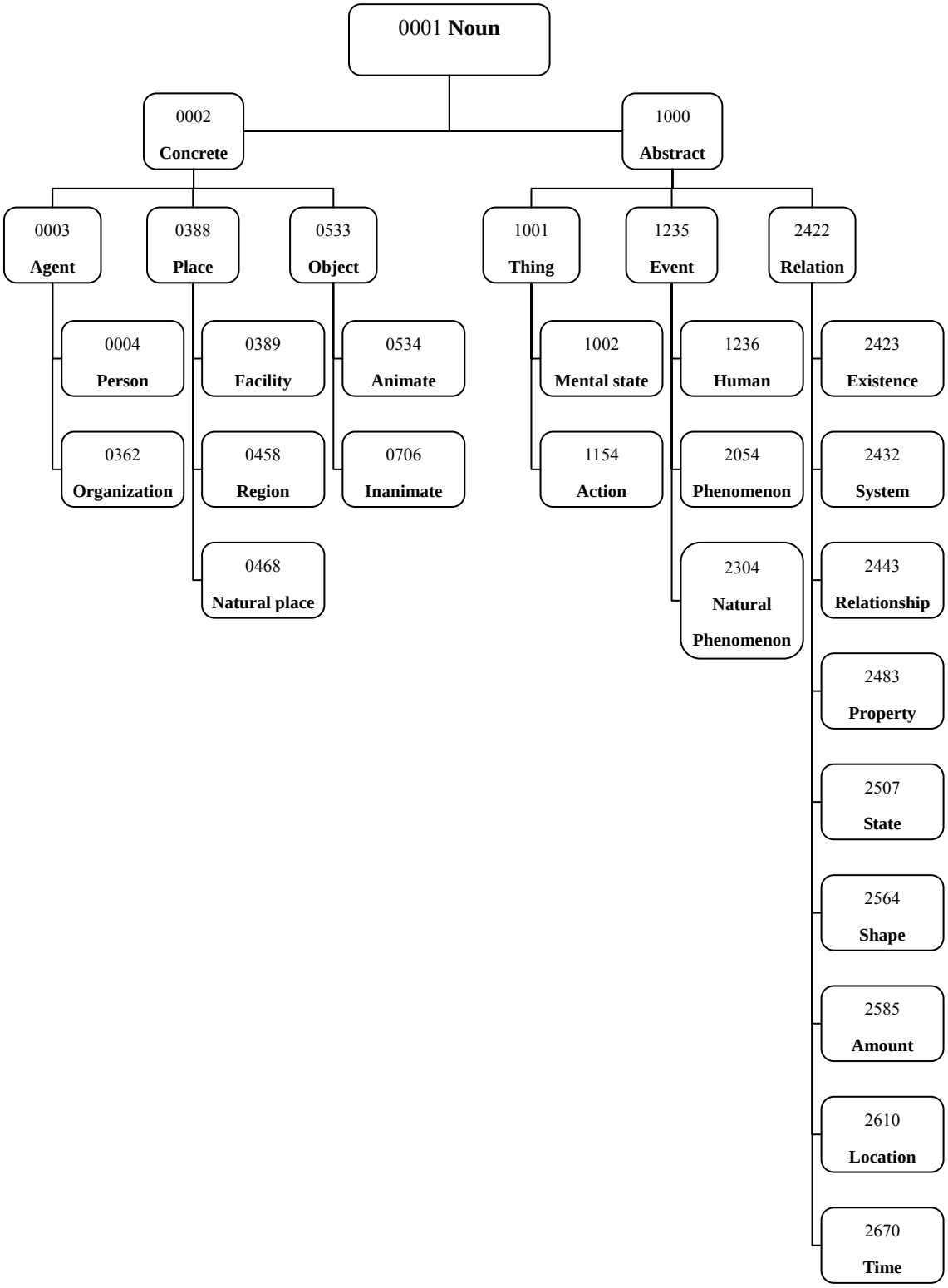


Figure 6.4: The top four levels of the semantic hierarchy for nouns

Each node in the tree represents a semantic class, and is numbered. For instance, the lexical entry *yane* 'roof' is categorized as a member of the roof group (#0875) that belongs to the housing part group (#0866), which ascends through the tree by the following chain: building (#0836) < inanimate (#0706) < object (#0533) < concrete (#0002), under the root node of noun.

Goi-Taikei also provides syntactic properties of nouns, using the following nine part-of-speech (POS) codes.

POS code				Example
1	Common noun		名	*ie* 'house'
2	Nominalized verbal		サ変	*ryoori* 'cooking'
3	Adjectival noun		名（形動）	*yuui* 'dominance'
4	Derivational noun	Derived from verb	名（転成）	*naosi* 'revision'
		Derived from adjective		*sirosa* 'whiteness'
5	Temporal noun		時詞	*gogo* 'afternoon'
6	Numeral noun		数詞	*hyaku* 'hundred'
7	Formal noun		名（形式）	*naka* 'inside'
8	Proper noun		固	*tookyoo* 'Tokyo'
9	pronoun		代名	*mina* 'everybody'

Table 6.3: POS codes for nouns in *Goi-Taikei*

Characterization of B nouns

We conjecture that certain nouns are more likely to take zero nominal arguments than others, and that the head nouns that take zero arguments, extracted from our corpus, are representative samples of this particular group of nouns. We call them "argument-taking nouns (ATNs)." ATNs syntactically require arguments and are semantically dependent on their arguments. We use the term ATN only to refer to a particular group of nouns that take implicit arguments (i.e., zero nominal arguments).[12]

We closely examined the 127 different ATN nouns from among the 320 cases of zero nominal arguments and classified them into the four types that correspond to Groups I, II, and III and V, as presented in Table 6.4 below.

[12] Recall that we mentioned earlier that some nouns never occur with implicit arguments, such as *ken* "matter" and *hoo* "direction," They are excluded from this category.

Type	Syntactic properties	Semantic properties	#	Examples
I	**Nominalized verbals**, **de-verbal nouns**, common nouns	Human activity	21	*zikosyokai* 'self-introduction'
		Phenomenon	3	*entyo* 'extension'
II	**Formal nouns**, common nouns	**Location**	**13**	*mae* 'front'
		Time	1	*yokuzitu* 'next day'
III	**De-verbal nouns**, **De-adjectival nouns** suffix nouns, common nouns	**Amount**	**9**	*sintyo* 'height'
		Value	2	*nedan* 'price'
		Emotion	1	*kimoti* 'feeling'
		Material phenomenon	1	*nioi* 'smell'
		Name	1	*namae* 'name'
		Order	1	*itiban* 'first'
V	Common nouns	**Human (kinship)**	**14**	*haha* 'mother'
		Animate (body-part)	**14**	*atama* 'head'
		Organization	**7**	*kaisya* 'company'
		Housing (part)	**7**	*doa* 'door'
		Human (profession)	**4**	*sensei* 'teacher'
		Human (role)	**4**	*dokusya* 'reader'
		Human (relationship)	**3**	*dooryoo* 'colleague'
		Clothing	**3**	*kutu* 'shoes'
		Tool	2	*saihu* 'purse'
		Human (biological feature)	2	*zyosei* 'woman'
		Man-made	2	*kuruma* 'car'
		Facility	1	*byoin* 'hospital'
		Building	1	*niwa* 'garden'
		Housing (body)	1	*gareeji* 'garage'
		Housing (attachment)	1	*doa* 'door'
		Creative work	1	*sakuhin* 'work'
		Substance	1	*kuuki* 'air'
		Language	1	*nihongo* 'Japanese'
		Document	1	*pasupooto* 'passport'
		Chart	1	*tizu* 'map'
		Animal	1	*petto* 'pet'
		? (Unregistered)	2	*hoomusutei* 'homestay'
	Total		127	

Table 6.4: Syntactic/semantic properties of B nouns

The table also lists the syntactic/semantic characterizations of the nouns in each type and the number of examples in the corpus. The syntactic properties are represented by the POS codes for nouns in the *Goi-Taikei* (see above). The semantic properties are represented by the various (fourth to eighth) level nodes in the semantic feature hierarchy tree. Assigning the syntactic and semantic properties to these nouns was manually done, first by searching *Goi-Taikei* for the entries, and then by selecting the most appropriate one, when there were multiple candidates, using contextual information. The characteristic properties are indicated in bold, and will be discussed later.

When we examine these four types, we see that they partially overlap with some particular types of nouns studied theoretically in the literature. Teramura (1991) subcategorizes locative relational nouns like *mae* 'front,' *naka* 'inside,' and *migi* 'right' as "incomplete nouns" that require elements to complete their meanings; these are a subset of Type II. Iori (1997) argues that certain nouns are categorized as "one-place nouns," in contrast to "zero-place nouns," in which he seems to include Type I and some of Type V nouns. Kojima (1992) examines so-called "low-independence nouns" and categorizes them into three types, according to their syntactic behaviors in Japanese copula expressions. These cover subsets of Type I, II, III and V. In computational work, Bond, Ogura, and Ikehara (1995) extracted 205 "trigger nouns" from a corpus aligned with English. These nouns trigger the use of possessive pronouns when they are machine-translated into English. They seem to correspond mostly to our Type V nouns. Our results appear to offer comprehensive coverage that subsumes all of the types of nouns discussed in these previous accounts.

Next, let us look more closely at the properties expressed by our samples. The most prevalent ATNs (21 in number) are **nominalized verbals** in the semantic category of **human activity**. The next most common are **kinship** nouns (14 in number) and **body-part** nouns (14), both in the common noun category; location nouns (13), either in the common noun or **formal noun** category; and nouns that express **amount** (9) whose syntactic category is either common or **de-adjectival**. The others include some "**human**" subcategories, as well as organization (for belong-to), housing (part) for whole-part, clothing (for possession).

The part-of-speech subcategory, "nominalized verbal (*sahen-meisi*)" is a reasonably accurate indicator of Type I nouns. So is "formal noun (*keihiki-meisi*)" for Type II, although this does not offer a full coverage of this type. Numeral noun compounds with a counter suffix, such as '70%,' also represent a major subset of Type III.

Semantic properties, on the other hand, seem helpful for extracting certain groups such as location (Type II), amount (Type III), kinship, body-part, organization, and some human subcategories (Type V). But other low-frequency ATN samples are problematic for determining an appropriate level of categorization in *Goi-Taikei*'s semantic hierarchy tree.

This observation from the results of our corpus analysis will be the base for the zero nominal argument recognition algorithm presented in the next section.

6.5.3 Algorithms

Our goal is to build a system that can identify the presence of zero nominal arguments. As we mentioned earlier, zero nominal argument recognition is equivalent, in our approach, to ATN (Argument-Taking Noun) recognition. The algorithm consists of a set of lexicon-based heuristics, drawn from the observations in 6.2.3, with some additional filtering rules. The algorithm takes morphologically analyzed text as input and provides ATNs as output.

6.5.3.1 Preliminary version

We started with the implementation of a preliminary version of the algorithm initially proposed in Yamura-Takei (2003), which consists of the following three basic processes:

[1] ATN candidate (bare noun) extraction, with idiom filtering,
[2] syntactic category (part-of-speech) checking of the given candidates from [1], and
[3] semantic category checking of the remaining candidates from [2].

Bare noun extraction

The observation that zero nominal arguments usually co-occur with "bare nouns" is both theoretically motivated (see Chapter 2) and empirically verified; more than 90% of manually detected zero nominal arguments appear with bare nouns. Bare nouns are often simplex as in (6.25a), and sometimes are compound (e.g., numeral noun + counter suffix noun) as in (6.25b). These are immediately followed by case-marking, topic/focus-marking or other particles (e.g., *ga*, *o*, *ni*, *wa*, *mo*) to form PPs.

(6.25) a. *atama-ga* head-NOM
b. *70-paasento-o* 70-percent-ACC

The extracted nouns under this definition are initial candidates for ATNs.

Idiom filtering

Once bare nouns are identified, they first go through idiom filtering. Our preliminary evaluation revealed that there are some problematic cases in which ATN candidate nouns are contained in verbal idiomatic expressions, as example (6.26) shows.

(6.26) *me-o-samasu* eye-ACC-wake 'wake up'

Although *me* 'eye' is a strong ATN candidate, as listed in Table 6.4, case (6.26) should be treated as part of an idiomatic expression rather than as a zero nominal argument expression. Recall that we previously stated in Chapter 2 that Vieira and Poesio (2000) also list "idiom" as one use of definite descriptions (the English equivalent to Japanese bare nouns in terms of their behaviors), along with same head/associative anaphora, etc. Thus, we decided to add an idiom filtering operation before we apply syntactic/semantic checking.

Idiom filtering consists of two components: general rules and an idiom dictionary. There are two general rules to filter out ATN-involving idiomatic expressions:

(i) nominalized verbal + *o* | *ni* + verb, and
(ii) noun + *ni* + *iku* | *kuru*.[13]

If a nominalized verbal, a syntactically defined ATN candidate, is followed by a particle *o* or *ni*, and any verb, the verbal will not go into further checking. This rule eliminates VPs such as *benkyo-o-suru* 'studying-ACC-do' and *suimin-o-toru* 'sleeping-ACC-take.' Secondly, if any noun is followed by a particle *ni* and either verb *iku* 'go' or *kuru* 'come,' the noun will be dropped from the candidate list. This rule excludes VPs like *tasuke-ni-kuru* 'rescuing-for-come' and *kankoo-ni-iku* 'sightseeing-for-go.'

Other idiomatic expressions, which are hard to generalize, are listed one-by-one in the idiom dictionary.

Syntactic/semantic checking

The syntactic/semantic properties used to sort ATNs in the processes [1] and [2] are informed by the results of the preliminary analysis presented in Table 6.4 above. For syntactic filtering, we defined the following five POSs and POS sequences:

(i) nominalized verbal,
(ii) derived noun,
(iii) formal noun,
(iv) numeral noun + suffix (e.g., *iti-bu* 'one part'), and
(v) verbal adjective + suffix (e.g., *kiken-sei* 'dangerous property').

For semantic filtering, we decided to use the noun groups of high frequency (more than two nouns categorized in the same group; indicated in bold) to minimize a risk of over-generalization. As a result, we defined the following nine nodes (at the

[13] Here, '|' indicates 'or.'

fourth-eighth levels) in the *Goi-Taikei* semantic hierarchy, as the semantic category for ATN nouns:

(i)	human <kinship>	#72~110,
(ii)	human <relationship>	#111~149,
(iii)	human <role>	#333~361,
(iv)	organization	#362~387,
(v)	animate <part>	#552~670,
(vi)	clothing	#813~837,
(vii)	housing <part>	#866~882,
(viii)	amount	#2585~2609, and
(ix)	location	#2610~2669.

These include a total of 378 deepest-level nodes.

The preliminary version, which consists of these three processes, has been tested against five sets of corpus materials in order to make further refinements and extensions. The training corpus used for the tests comprises *Hiroko 1*, *Hiroko 2*, *Minna 1*, *Minna 2* and *Gendai*, from our whole corpus. These sets were used to determine what other heuristics should be employed and to evaluate whether newly employed heuristics drawn from the result on one set of corpus materials work as well in another set of materials.

6.5.3.2 Enhanced version

The final configuration of the system, i.e., an enhanced version of the zero nominal argument recognition algorithm, was completed on the basis of an extensive evaluation of the heuristics using the corpus listed above. As a result, the following enhancement and addition of new rules were made.

Refinement of semantic category

Originally, we defined nine semantic properties, including 378 nodes in the hierarchy tree. The definition was simple; all the nodes under a defined category were unconditionally included. This often caused over-detection and hence, the need for further subdivision and refinement of categories arose. Also, evaluation on the training corpus revealed some cases of under-detection, which led to the addition of newly defined categories.

As a consequence of the refinement and addition of the ATN semantic properties, we now have a total of 393 nodes; the whole list is provided in Appendix B. This number does not indicate a simple addition of 15 nodes to the original 378, but is a

synergetic result of adding and subtracting.

Enhancement of idiom filtering

The idiom dictionary was enlarged by adding mainly body-part expressions. This addition resulted in the inclusion of a total of 1,003 entries in the dictionary.

Addition of indefinite description filtering

ATNs, as the term implies, take (explicit or implicit) arguments that are linked with other entities in the previous discourse or in the situation. Therefore, ATNs are specific and definite in nature. In other words, ATNs are definite descriptions, and indefinite descriptions should be excluded from our ATN candidates. This is what we call "indefinite description filtering."

How to eliminate indefinite descriptions is not as straightforward as in English, which has a binary (definite vs. indefinite) article system. Definite/indefinite descriptions in Japanese often share the same surface realization, bare nouns, as we mentioned earlier (Chapter 2), so definiteness marking as in English does not work for Japanese. Instead, the distinction is normally inferred from surface level information concerning the sentences in which those descriptions appear. Trenkić (2000) calls this "definiteness inferring."

Murata (1996) investigated the rules that determine (in)definiteness of Japanese nouns, utilizing clues from surface expressions. Bond (2001) proposes an algorithm with a tractable set of semantic features to represent the definiteness of NPs, to be used in a Japanese-to-English MT system. Given insights from these works, we defined seven indefinite description filtering rules as in (6.27).

(6.27)

(i)	noun + *ga* | *wa* + *aru* | *nai*	
	e.g., *kutu-ga aru*	shoe-NOM is 'there is a shoe'
(ii)	noun + *yoo* | *muki*	
	e.g., *ryokoo-yoo-no baggu*	traveling-for-GEN-bag 'a bag for traveling'
(iii)	noun + *to-iu*	
	e.g., *ryuugaku-to-iu-no-wa*	studying-abroad-QUO-call 'so-called studying abroad'
(iv)	noun + *to* + *wa*	
	e.g., *ninki-to-wa*	polularity-QUO-TOP 'what is popularity'

(v) noun + *de* + *wa* + *nai*
e.g., *atama-de-wa-naku* head-COP-TOP-NEG
'… is not a head'

(vi) noun + *ga* | *o* | *mo* + numeral
e.g., *ie-o 2-ken tateru* house-ACC 2-counter build
'…build two houses'

(vii) noun + *ga* | *wa* + amount expression[14]
e.g., *mado-ga ooi* window-NOM many
'…has many windows'

When nouns appear in these expressions, those nouns are pre-excluded from the ATN candidate list. However, nouns with semantic properties of "kinship" and "body part" are exempt from these rules because those nouns are inherently ATNs regardless of the context in which they occur.

Supplementary checking

There are some nouns that are non-ATNs in most usages, but function as ATNs in specific cases. Listing these nouns as ATNs creates a high risk of over-detection. Instead, we constructed a special-expression dictionary that lists expressions that include such examples, one of which is presented in (6.28).

(6.28) *kuni-ni kaeru* country-to return

The noun *kuni* 'country' is usually treated as non-ATN, but it is marked as ATN only when it appears in the expression in (6.28), which usually means 'return to one's own (or native) country.' The dictionary contains nine such expressions.

Also, there are cases in which the noun group in a certain *Goi-Taikei* node designated as non-ATN contains only a few ATNs, but ones that are quite frequent. Leaving such nouns there causes under-detection. We constructed a supplementary dictionary, which lists such nouns so that they are always treated as ATNs. The listing includes nouns, such as *deguti* 'exit' and *zyuusyo* 'address.'

As a result of these four types of enhancement, the accuracy testing on the training corpus significantly improved from 58% to 85% (F-value, see below), which indicates that the modifications we made are valid.

In sum, the whole process consists of four modules: [1] preprocessing module, [2] ATN candidate extraction module, [3] ATN extraction module, and [4] ZERO insertion module. Let us provide the flow diagram of zero nominal argument detecting processes in Figure 6.5 (next page). Enhanced components are highlighted.

[14] This includes *ippai*, *takusan*, *ooku*, *taryoo*, *tairyoo* 'many/much' and *sukosi*, *tyotto*, *syooryoo* 'few/little.'

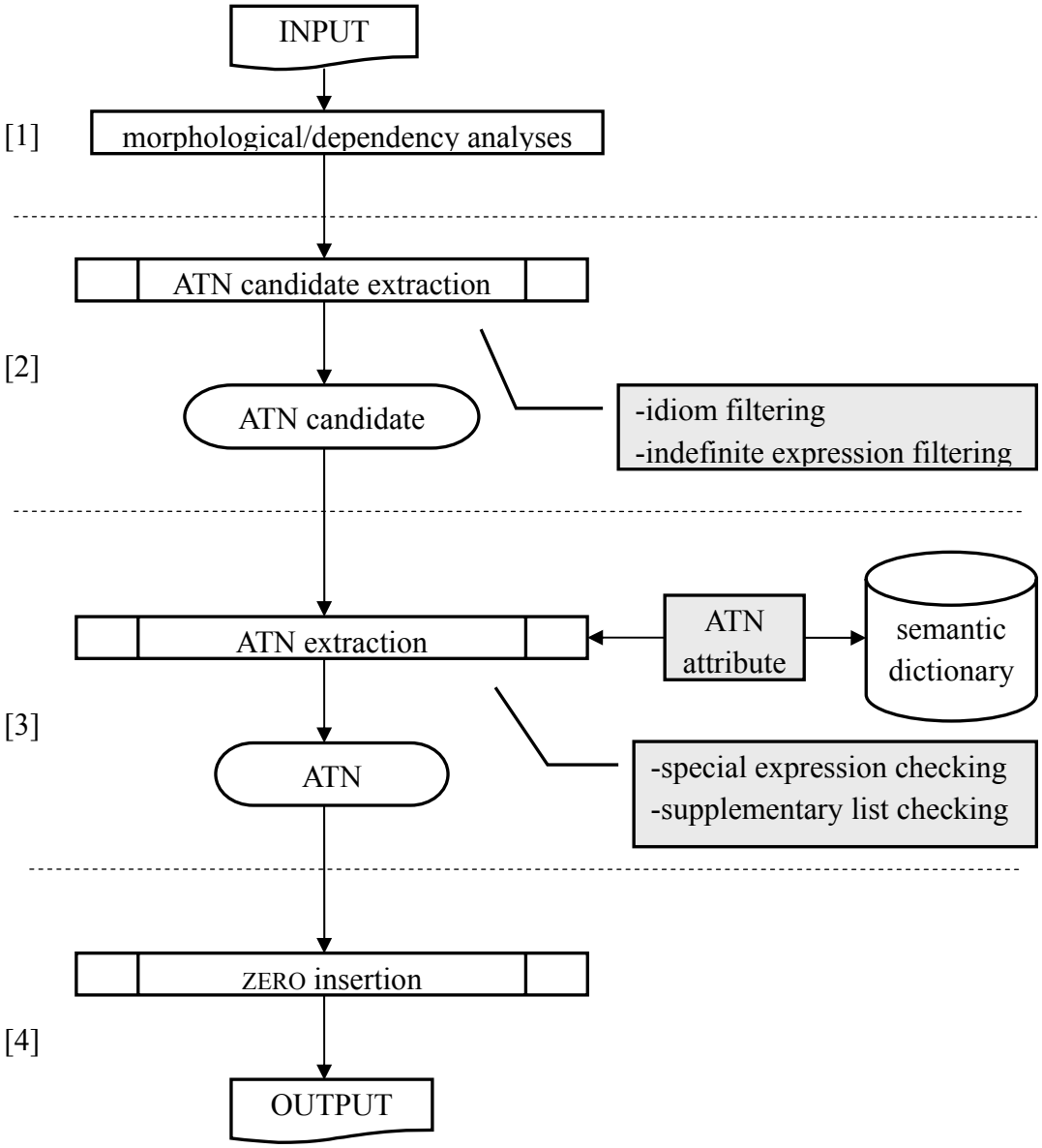


Figure 6.5: Flow diagram of zero nominal argument detecting processes

In the preprocessing module in [1], input text goes through morphological and dependency analyses, which is a prerequisite for the following bare noun extraction. In module [2], bare nouns, as a prime condition of ATN candidates, are extracted, with some filtering processes. Module [3] extracts ATNs according to our definition, while checking some specific cases. Finally in module [4], ZEROS are inserted in the pre-ATN positions in the output.

6.6 System Architecture

ZD was implemented in TurboLinux. All sources relied heavily on analysis and data searching and matching techniques, which were implemented in the programming language C. Other modules, including the user interface and communication were implemented in the CGI scripting language. The architecture is overviewed in Figure 6.6.

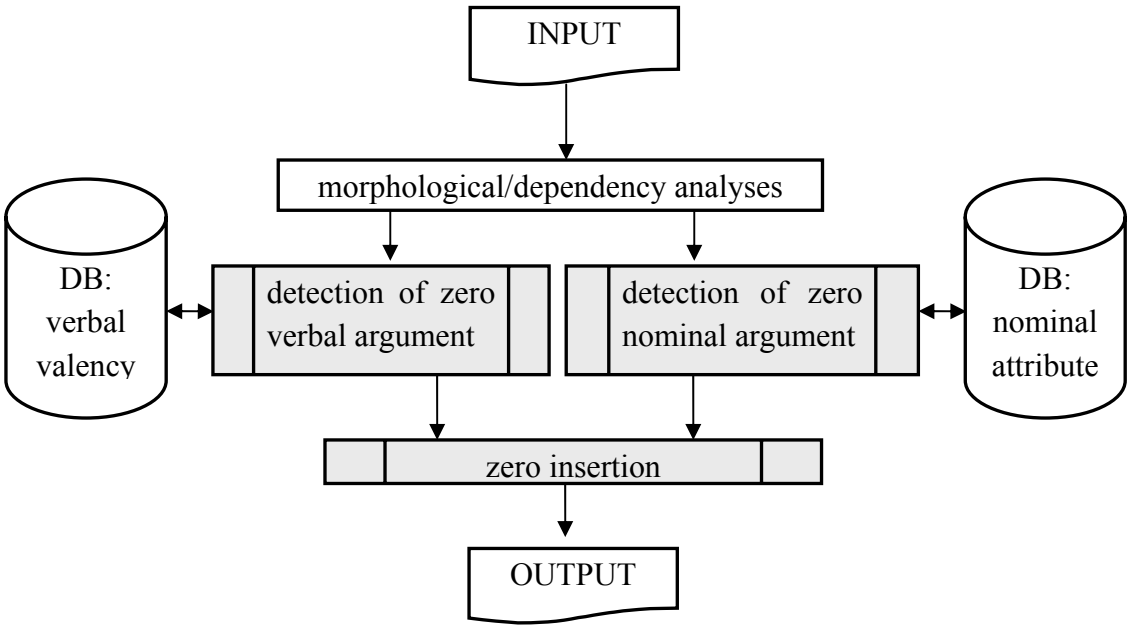


Figure 6.6: Overview of system architecture

Currently, we have two versions of the zero verbal argument detection modules, each of which has access either to *Goi-Taikei* or to *JLPT3/4* for verbal valency search.

6.7 Evaluation

6.7.1 Corpus and method

The performance of *ZD* was evaluated against two new sets of corpus materials: (i) 15 expository texts, from an intermediate JSL textbook, that contain a total of 57 paragraphs, 225 sentences, and 368 clauses, (ii) one narrative text, a short novel by Shinichi Hoshi, which contains a total of 34 paragraphs, 105 sentences, and 160

clauses.[15] The evaluation corpus was manually examined for the presence of ZEROS, in the same way that we did for the corpus analysis presented in Chapter 4. The *ZD*-detected ZEROS were checked against these manually detected ZEROS, which we consider as "correct." We indicate the result with recall (R) and precision (P) metrics, defined as follows:

(6.29) a. Recall (R): the ratio of ZEROS correctly detected by *ZD* over all correctly identified ZEROS,
b. Precision (P): the ratio of ZEROS correctly detected by *ZD* over all *ZD*-detected ZEROS.

To paraphrase, a recall of less than 100% indicates that *ZD* missed some of the desired ZEROS, i.e., under-detection, while a precision of less than 100% indicates that *ZD* detected something that is not regarded as a correct result, i.e., over-detection. We also employ F-value (F), as defined in (6.30), which reflects an average effect of recall and precision.

(6.30) F-value (F): the figure computed by the formula, $(b^2+1) * P * R / b * P+R$, where b corresponds to relative importance of precision (P) and recall (R).

Here, we set b to 1 since we equally value precision and recall.

Evaluation was done on the performance of the zero verbal argument recognition component and the zero nominal argument recognition component separately because the two components are based on totally different heuristics, and they are in a sense two different systems. For zero verbal argument, the two valency dictionaries that we integrate into the system, *Goi-Taikei* and *JLPT3/4* were compared for their functions as lexical sources.

6.7.2 Result

The results of the experimental runs are presented in the tables below. First, Table 6.5 (next page) presents the result obtained by testing the process on expository texts that contain 197 zero verbal arguments and 99 zero nominal arguments, which are "correct."

[15] We exclude, from the original text, (i) direct quotations (because they are dialogic in nature) and (ii) utterances with "substantive ending," i.e., verb-less clauses (because our zero verbal argument recognition heuristics presume the existence of a verbal or adjectival predicate or a copula.

		R	P	F
Zero verbal argument	*Goi-Taikei*	80.71%	57.82%	67.37%
	JLPT3/4	82.74%	78.74%	80.69%
Zero nominal argument		73.74%	70.19%	71.92%

Table 6.5: Evaluation of *ZD* performance on expository texts

In the case of zero verbal argument recognition, the *JLPT3/4* version apparently outperformed the *Goi-Taikei* version, which has a tendency toward over-detection. This is probably because the entries of the *JLPT3/4* valency dictionary (designed especially for JSL learning purposes) better fit the intermediate level sentence structures.

Secondly, Table 6.6 presents the results of testing on narrative texts (with 340 zero verbal arguments and 149 zero nominal arguments).

		R	P	F
Zero verbal argument	*Goi-Taikei*	82.06%	63.70%	71.72%
	JLPT3/4	80.29%	76.26%	78.22%
Zero nominal argument		69.80%	71.72%	70.75%

Table 6.6: Evaluation of *ZD* performance on narrative texts

In this corpus, the performance of the two versions (*Goi-Taikei* and *JLPT3/4*) is compelling. The *Goi-Taikei* version still tends to over-detect, but its recall rate is better than that of the JLPT3/4 version. For more "authentic" and "uncontrolled" texts like novels, a wider coverage, as realized in *Goi-Taikei*, seems to have an advantage.

As for zero nominal argument recognition, accuracy has been achieved at roughly equal rates in both types of corpus at a little over 70%.

6.7.3 Discussion

Overall, the current *ZD* has achieved an accuracy of 79.00% (*JLPT3/4*), 71.43% (*Goi-Taikei*), and 70.29% (nominal), all indicated by average F-value figures. These roughly represent the figures that are considered to be the limit for NLP systems with rule-based shallow processing that does not deploy rich world and semantic knowledge (cf., Tetreault and Allen, 2004). In this regard, *ZD* has achieved near-maximum accuracy, as a system in its intended design scheme.

6.7.3.1 Possible further enhancement

The current achievement of *ZD* has also indicated areas for further improvement. The tractable areas that the error analysis has revealed include:

(i) integration of semantic, pragmatic and discourse factors in the ATN selection,
(ii) treatment of ATN candidates with modifiers, and
(iii) refinement of ATN properties.

Of all the under-/over-detection errors, more than about 90% are due to our purely syntactic/lexical approach, i.e., due to error type (i). Look at the following examples.

(6.31) a.

しげおくんは	いたずらが	好きな子です。
sigeo-kun-wa	*itazura-ga*	*sukina-ko-desu.*
Shigeo-TOP	mischief-NOM	like-kid-COP

'Shigeo is a mischievous kid.'

b.

先生が	いくら	注意しても	いたずらします。
sensei-ga	*ikura*	*tyuui-site-mo*	*itazura-si-masu.*
teacher-NOM	how often	warn-do-though	mischief-do-POL

'However often (his) teacher warns him not to, he never stops.'

(6.32) a.

丸山先生は	教え方が	上手で
maruyama-sensei-wa	*osiekata-ga*	*jyoozu-de*
Maruyama-TOP	teaching-NOM	good-COP

'Ms. Maruyama is good at teaching'

b. ….(skipping a few utterances)

c.

先生は	ちょっと驚いた顔で …
sensei-wa	*tyotto odoroita kao-de ...*
teacher-TOP	little surprised look with

'She looked a little surprised…'

A bare noun, *sensei* 'teacher,' appears in the two contexts above (underlined). In (6.31), the noun is most plausibly interpreted as an ATN to denote Shigeo's (home

room) teacher. In (6.32), on the contrary, the same bare noun should rather be considered to be an NP reference to *Maruyama-sensei* in (a). This distinction can be made by looking at an NP history list within the discourse, which the current algorithm does not employ.

A few errors (2% of all errors) are related to our definition of ATNs as bare nouns. Currently, all nouns with modifiers or dependents are excluded from the ATN candidate list. This works in most cases, but sometimes causes under-detection in a case like (6.33).

(6.33)	親しい友人が	車に	乗って
	sitasii yuujin-ga	*kuruma-ni*	*notte*
	close friend-NOM	car-in	ride

'(Someone's) close friend rides in a car'

There are also a few errors that are caused by the current configuration of the ATN semantic property list: errors of both over-detection and under-detection. Further refinement of the list would be desirable.

These suggestions for enhancement are on the assumption that an existing lexicon like *Goi-Taikei* is used. On the other hand, there is another total alternative, which will be discussed in the next subsection.

6.7.3.2 Possible alternative approach

Our approach makes use of syntactic and semantic properties listed in an existing lexicon, as "approximate" indicators of a certain group of nouns that we intend to extract. This approach has its limitations, as is pointed out by Kurohashi and Sakai (1999). One limitation can be illustrated by the pair of Japanese nouns, *sakusha* 'author' and *sakka* 'writer,' which falls under the same semantic property group (at the deepest level).[16] These nouns have an intuitively different status as far as their valency requirements are concerned; the former requires "of-what work" information, while the latter does not.[17] We risk over- or under-generalization when we designate certain semantic properties, no matter fine-grained they might be. This risk is inevitable when we use a lexicon that was not designed specifically for our intended purpose.

One possible approach to compensate for this risk is a hand-tabulation of nominal valency, such as *JLPT3/4* verbal lexicon that we constructed for zero verbal argument recognition. However, this method is not realistic for zero nominal arguments because

[16] This example pair is taken from Iori (1997).

[17] This intuition was verified by an informal poll conducted on seven native speakers of Japanese.

the size of the lexicon for nouns is incomparably larger; *Goi-Taikei*, for instance, lists 76,082 nouns (excluding proper nouns and pronouns) and 20,781 verbs and adjectives. *IPAL Lexicon* selects only 1,081 nouns according to the syntactic and semantic features to be fully described.

Also, there are two critical issues in constructing a nominal lexicon. One is the notoriously hard-to-define argument-adjunct distinction for nouns, which is closely related to the distinction between ATNs and non-ATNs. We experimentally tested seven native-speaking subjects in distinguishing these two. We presented 26 nouns in the same *Goi-Taikei* semantic category (at the deepest level): "persons who write." There were six nouns that all the subjects agreed on categorizing as ATNs, including *sakusya* 'author.' Five nouns, including *sakka* 'writer,' on the other hand, were judged as non-ATNs by all the subjects. For the remaining 15 nouns, however, the judgments varied widely. As Somers (1984) suggest for verbs, a binary distinction does not work well for nouns, either. There may also be a line (although it may be very thin) between nouns that take explicit arguments and those that take implicit arguments (i.e., zero nominal arguments). The most clear-cut examples fall in the category of *keisiki-meisi* 'formal noun' in *Goi-Taikei*. Among the 40 nouns listed under that part-of-speech code, there are several nouns that can never occur alone, i.e., they always take explicit arguments, such as *baai* 'case' and *koto* 'matter.' These correspond to Somers' first type in his six-level scale of valency binding that reflects the degree of closeness of an argument to its head.

The second issue concerns the semantic features used to describe arguments of nouns. Another pair of nouns, *sensei* 'teacher' and *kyoosi* 'teaching professional,' again in the same *Goi-Taikei* category, are both multi-valent, but in different ways; sensei calls for "of-what subject," "of-what organization," and "of-whom" elements, while *kyoosi* does not take an "of-whom" complement: *John no kyoosi* 'John's teaching professional' sounds unnatural. The semantic description for each argument is also essential in referent resolution and is an interesting issue for further investigation, but it is beyond the scope of this thesis, focusing as it does on zero argument detection.

As discussed, constructing a so-called nominal valency dictionary involves many critical issues and costly labor, which is actually the primary reason for the choice of our approach, that is, to re-use existing resources, as we stated at the beginning of the chapter. However, our ATN semantic property list (in Appendix B), created as a result of the corpus analysis and evaluation done on this project, might serve as a starting point for the future construction of such a nominal lexicon for Japanese, and in cross-linguistic attempts, as well.

6.8 Output

6.8.1 General aims

Basically, *ZD* provides "ZERO-made-visible" text as output. In addition, the zero verbal argument recognition component delivers some other information, such as the underlying structure of the input clause and valency patterns, depending on users' needs. Figure 6.7 shows the user selection interface. Here, the clause splitting result can be manually corrected, when necessary, before it is sent to the ZERO detection processes.

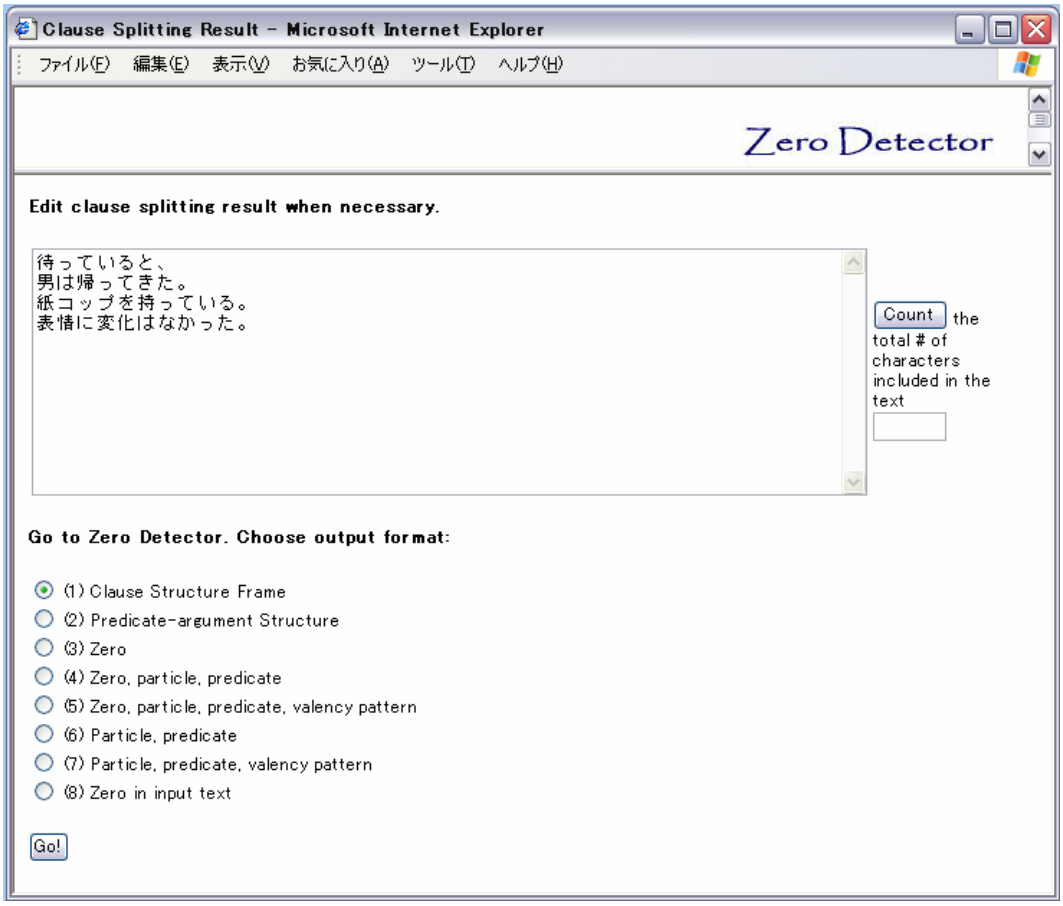


Figure 6.7: *ZD* output selection interface

This diverse output aims to inform the users (i.e., teachers) of various types of information about the input clause that they can use as a reference or as material for instructing students on the mechanisms of ZEROS. The output is supplied in the following eight formats:

(i) clause structure frame,
(ii) argument structure frame,
(iii) enhanced case-marking,
(iv) enhanced case-marking with valency information,
(v) ZERO-specified clause,
(vi) ZERO-specified clause with enhanced case-marking
(vii) ZERO-specified clause with enhanced case-marking and valency information, and (viii) ZERO-specified text.

The interface and the output utilize CGI scripting, which enables a wide variety of presentation styles, including enhancement by color, style, and font, by means of HTML, advantage of which will also be discussed in Chapter 7.

6.8.2 Various output formats

We will present some output formats by using the four-utterance discourse in (6.34) below as input.[18]

(6.34) 待っていると、男は帰ってきた。手に紙コップを持っている。表情に変化はない。

Its surface-level English translation is given in (6.35).

(6.35) Waiting, and man returned. Carrying paper cup. Facial expression had no change.

This is a typical example of a ZERO-containing "unambiguous" Japanese discourse given the context in which it occurs. By "unambiguous," we mean that Japanese speakers find no difficulty in interpreting the discourse even though there seems to be no surface level indication of, for example, who is carrying the paper cup and whose facial expression is being talked about.

Clause structure frame
This is a preliminary analysis step for subsequent ZERO identification process, but its output might also be of help to the user in order to understand the underlying structure and processes of ZERO detection. The frame output of an example clause is given in Figure 6.8 (next page).

[18] This is an excerpt from a short novel by Shinichi Hoshi, "Syanai-no Jiken (It Happened on a Train)."

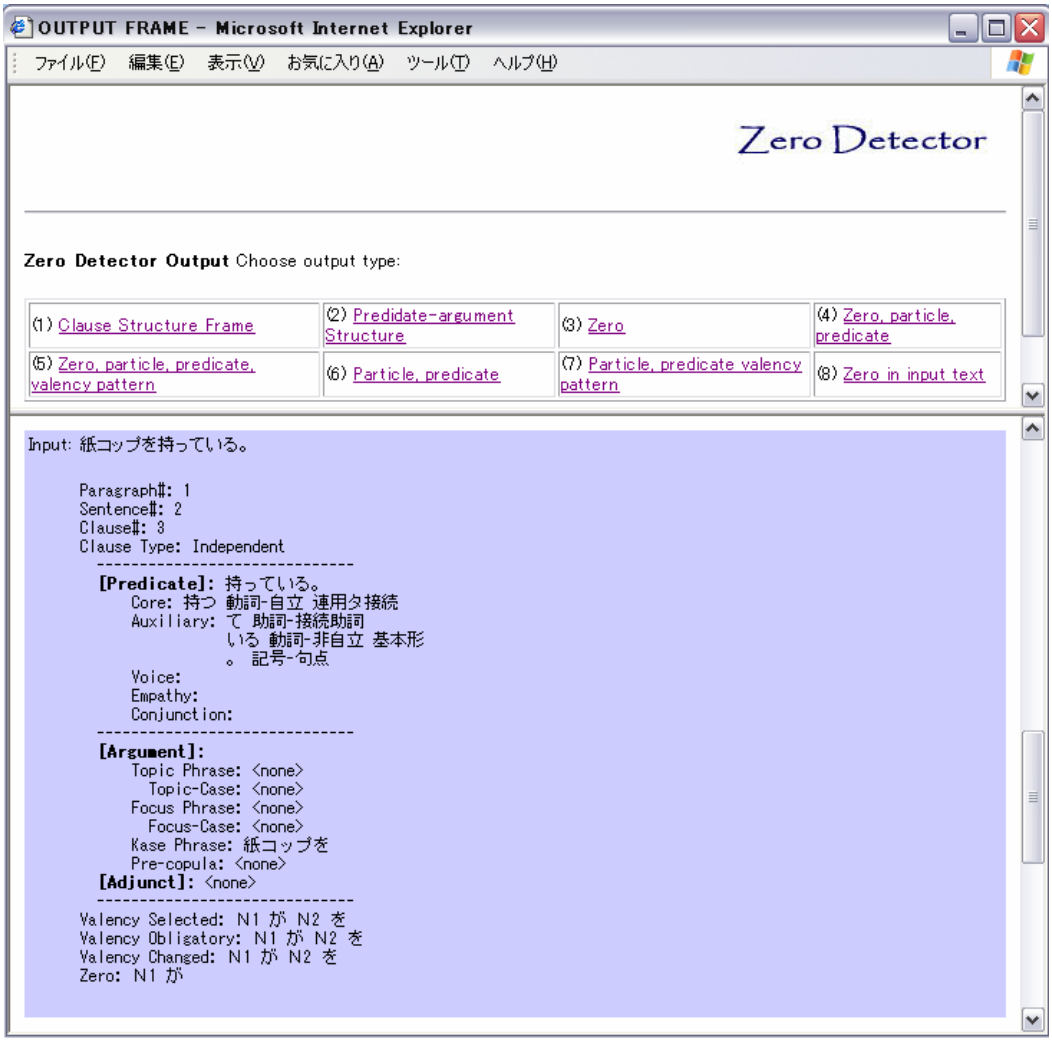


Figure 6.8: Clause structure frame output

Clause #3 in the input text is analyzed into predicate and argument structure, and one ZERO (N1-ga) is detected as a result of valency matching and is indicated at the bottom of the output. From here, the users can choose any output type they want to see next.

Argument structure frame

This format provides the predicate-argument structure of a given clause. Thus, it simply presents core (explicit and implicit) elements of the clause, excluding any adjuncts. The frames of the first three clauses are given in Figure 6.9.

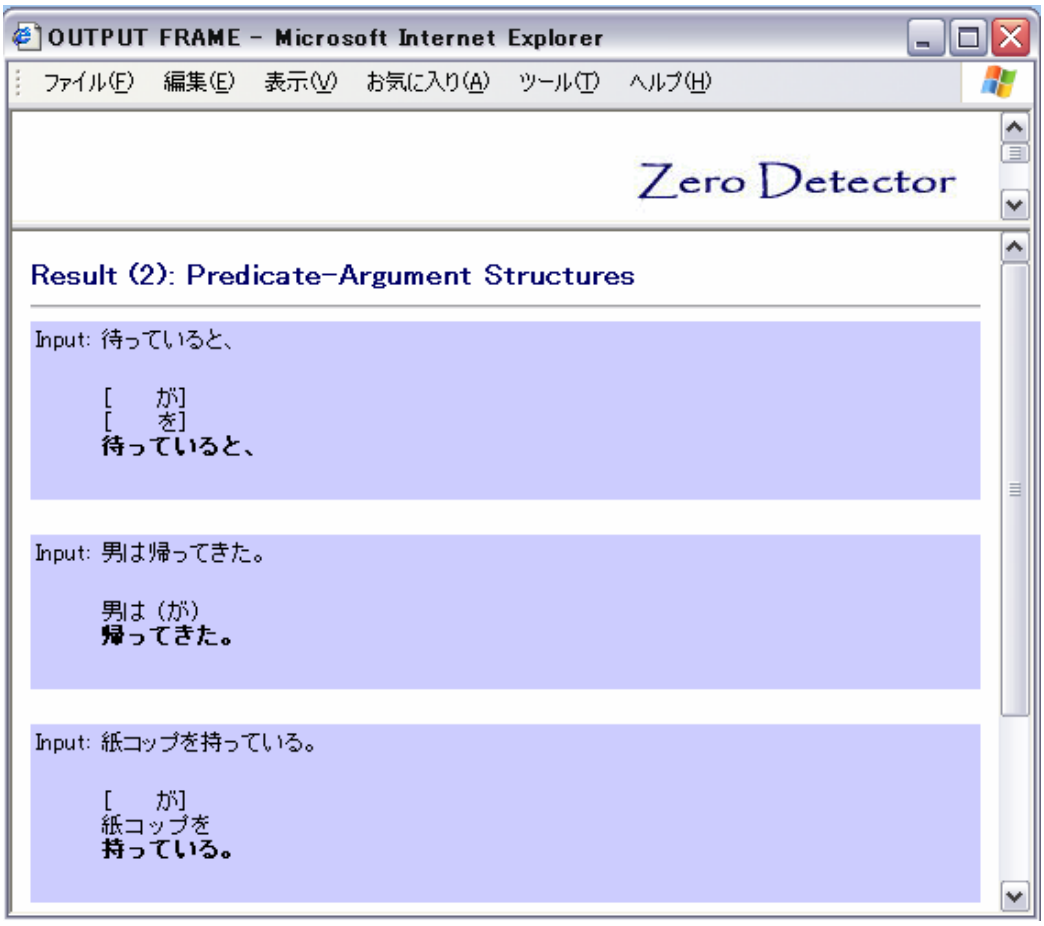


Figure 6.9: Argument structure frame

Here, overt topic markers and focus markers are accompanied by their restored cases indicated in parentheses, here, (ga), in the second clause. We assume that it gives a clear picture of the basic clause structure and promotes awareness of the structure.

Enhanced case-marking with/without valency information

As we discussed in Chapter 2, ZERO candidates are defined as arguments in the form of PPs. Therefore, case particles play an important role in the recognition of the argument structure, and hence of the presence of ZEROS. Identifying the overt PPs thus leads to the confirmation of the presence of ZEROS, by matching them against the valency information of the given predicate. The example output is given in Figure 6.10.

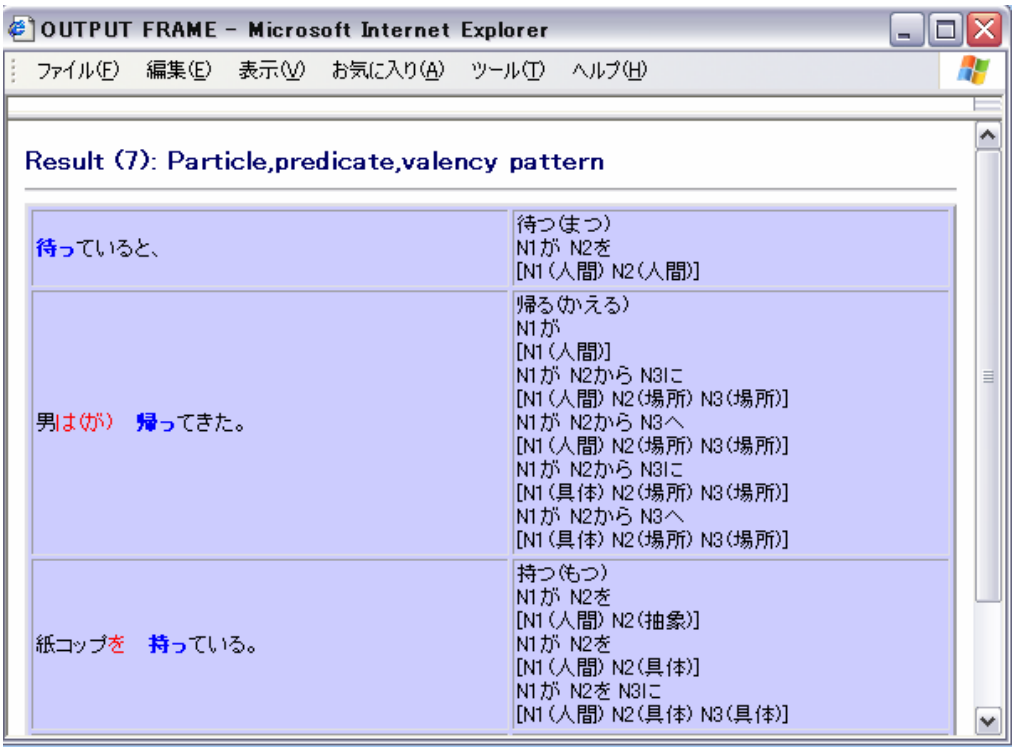


Figure 6.10: Enhanced case-marking and valency information

As you can see, this format does not locate ZEROS. This aims to provide materials for the overt PP-valency matching exercises.

ZERO-specified clauses with additional information

In this format, detected ZEROS are indicated by brackets, with accompanying case particles. Here, we insert ZEROS, maintaining canonical ordering of predicate-arguments: nominative *ga*, followed by accusative *o* and dative *ni*. Also, we avoid using a topic marker *wa* in order to adhere to the canonical valency patterns of the predicates, as defined in the valency dictionary. The sample output is given in Figure 6.11.

Figure 6.11: ZERO-specified clause output

ZERO-specified text

Finally, the ZERO-inserted original input text is provided; it aims to give a quick view of ZERO distribution in the text.

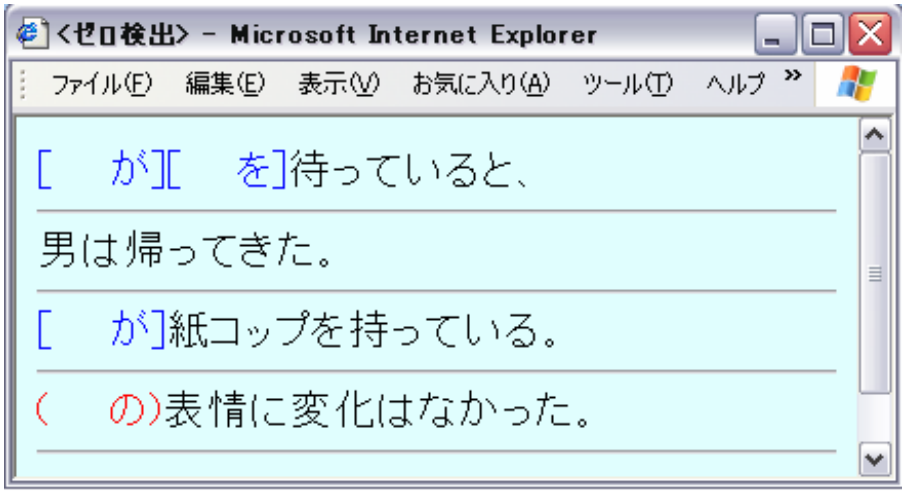


Figure 6.12: ZERO-specified text

Clause-by-clause parallel arrangement of the text is intended to promote the recognition of coherence chains created by ZEROS (see Chapter 7 for further discussion of the pedagogical validity of this move).

6.9 Summary

We have presented how "making the invisible visible" has been blueprinted theoretically and made possible technologically. The embodiment of *ZD* was made possible where "theory" meets "technology."

Specifically, we explicated how the system was built upon existing NLP technologies and resources, and how it was harmonized with two sets of theoretically and empirically sound heuristics. This attempt has proven to be successful, as can be seen in the performance results yielded by the evaluation the system underwent, results that meet the standards of NLP research. In addition, spelling out the linguistic rules for the system has clarified the underlying (hypothetical) human processes of understanding ZERO phenomena processes whose implications for the teaching of ZEROS in the JSL context we wish to explore.[19] Integration of these implications into the system is beyond the scope of the present development of *ZD*, but they will be an invaluable resource for the future expansion of any CALL program that is built around the capability and potential of *ZD*.

In the following chapter, we will discuss the issues that arise where "technology" meets "pedagogy."

[19] This is actually one of our aims in this project, focusing on the CL aspect of NLP, as discussed in Webber (2001); see Section 5.2.

Chapter 7

Pedagogy and *Zero Detector*

As any CALL system ought to be, *Zero Detector* is pedagogy-driven, as well as pedagogy-oriented.[1] The Research Policy Statement drafted by EUROCALL states that progress in CALL research "often begins with pedagogical practice or learner needs driving the development of technology-based materials, techniques, or environments."[2] The development of *ZD* also began with a pedagogical discrepancy, i.e., the lack of availability of good teaching materials and techniques for explicating ZEROS, an area that poses a challenge for many Japanese language learners (see Section 2.6 for fuller discussion). In this section, we will discuss in what pedagogical frameworks and for what pedagogical purposes *ZD* can be useful and propitious for both teachers and learners.

The majority of the previous and related work cited in this chapter is from L1 (first language) or L2 (second language) research conducted for English as the best-studied language in the literature of pedagogy (and in linguistics in general). Many of the principles discussed here, however, hold for L2 pedagogy in Japanese as well, and we will apply them to our discussion here with careful modification and elaboration.

7.1 Enhancing teaching

In the first section of this chapter, we will discuss how *Zero Detector* can promote effective instruction by JSL teachers of ZEROS themselves and of discourses that contain them. In this respect, we regard teachers as primary users of the program and aim to help them utilize *ZD* output in order to enhance their instruction of text with ZEROS. As our emphasis will be placed on instructing reading comprehension, rather than

[1] It is a common criticism that some CALL software is largely technology-driven and is remote from being pedagogically sound (e.g., Levy, 1997b; Oxford, 1995).

[2] The statement is available at http://www.eurocall-languages.org/research/research_policy.htm (retrieved in September, 2004).

teaching writing, we will begin in the next subsection with an overview of the reading process. Hatasa (2003) argues briefly, after an overview of the past and present of CALL for Japanese, that the future agenda includes the development of reading-support systems that present effective reading strategies rooted in reading process research (e.g., Chikamatsu, 2003). This is exactly the issue toward which we direct our discussion.

7.1.1 Reading processes

Reading comprehension is a complex cognitive process that involves text-based "bottom-up" processing and knowledge-based "top-down" processing, interacting simultaneously. Recent second language research views the reader as an active processor who decodes linguistic information from a text (bottom-up processing) and applies his/her non-linguistic background knowledge (top-down processing), while fully utilizing his/her inference skills, in order to construct a coherent representation of the text. This view is known as the interactive model of reading (McCormick, 1988). Figure 7.1 below illustrates the model, following Celce-Murcia and Olshtain (2000) among others.

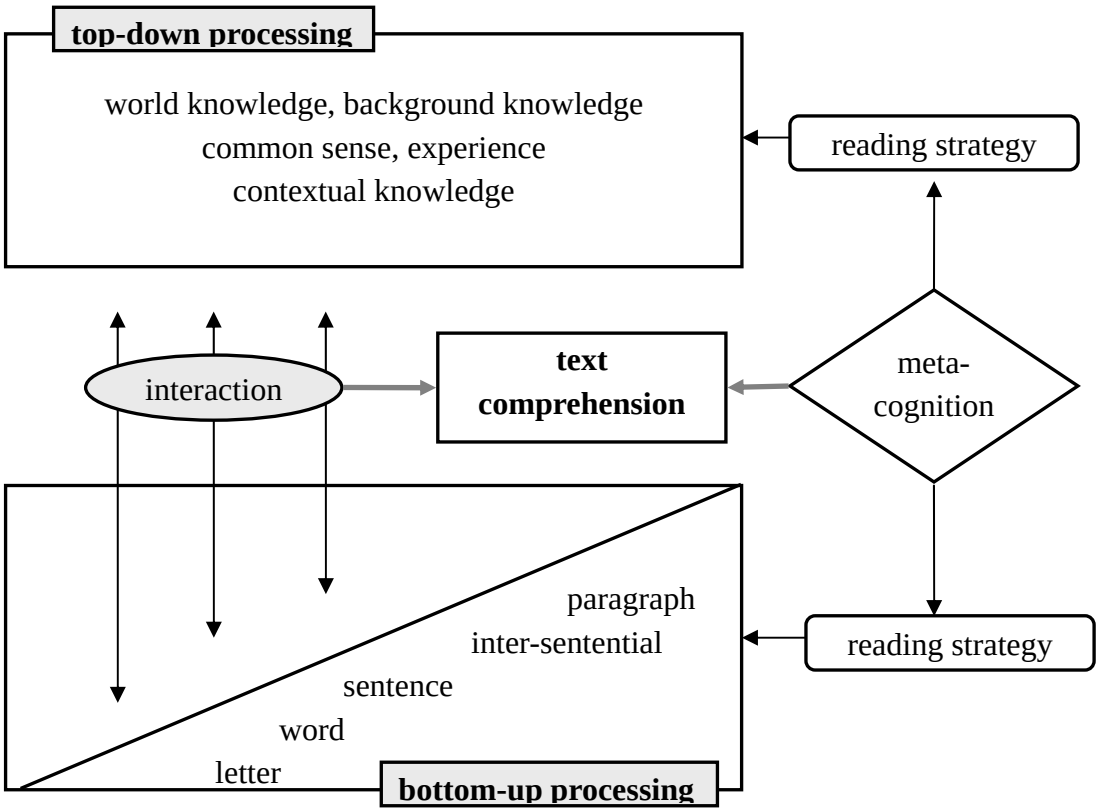


Figure 7.1: Interactive model of reading processes

Effective readers constantly integrate top-down and bottom-up processing techniques in

order to understand the text (ibid.). Such readers are effective strategy users; they know when to abandon unsuccessful reading strategies and when to recruit new ones. For instance, they may utilize background knowledge for top-down processing, and switch to bottom-up decoding when they are "meta-cognitively" aware that the former fails or they need compensation, or vice versa.

In bottom-up processing, letter/word recognition and sentence-level syntactic/semantic processing are followed by inferring the relationships between individual clauses or sentences, and then by understanding a larger unit, such as a paragraph (or a discourse segment) and then a whole text. Compared with morphological/syntactic level processes, however, discourse level phenomena have received less attention, and as a result, remain largely unexplored in the study of reading in Japanese and many other languages. This thesis focuses on the inter-sentential (or clausal) level cohesive relations that contribute to the coherence of text, and discusses cohesion recognition as a significant phenomenon in its own right.

7.1.2 Cohesion, coherence and reading comprehension

Cohesion is a linguistically realized device that creates textual unity, i.e., coherence. Coherence represents the natural, reasonable connections among utterances that make for easy understanding. Therefore, good readers take advantage of cohesive devices that writers employ for the text to be coherent. Deficiencies in cohesion recognition/interpretation may cause readers to miss/misinterpret important cohesive links, and ultimately, to have difficulty in their comprehension process. This claim is confirmed in research by Demel (1990), among others.[3] Also, activities involving the recognition/interpretation of cohesive ties have been suggested by Williams (1983) and Lubelska (1991), among others. In the JSL context, Kitajima (1997) demonstrates experimentally that referential strategy training has a positive effect on reading comprehension.[4]

As we mentioned earlier (in Chapter 2), ZEROS are a major realization of "reference" in Japanese that takes the form of "ellipsis." Like other forms of reference, ZEROS also establish cohesive ties between themselves and their referents, as illustrated in (7.1).

[3] The role of cohesion (coreference, in particular) in comprehension in general is discussed in Garrod and Sanford (1990). Kintsch and van Dijk (1978) and Just and Carpenter (1980) discuss the role of cohesion in psychological models of comprehension.

[4] The teaching of cohesion and coherence, from a writing instruction perspective, is also an active area of research (e.g., Lee, 2002).

(7.1) a. まず　たまねぎを　切ってください
mazu　*tamanegi-o*　*kitte-kudasai.*
first　onion-ACC　cut-please

'First, cut onions.'

b. そして　Ø　なべに　入れてください
sosite　(*Ø-o*)　*nabe-ni*　*irete-kudasai.*
then　(Ø-ACC)　pot-in　put-please

'Then, put (them 'onions') in a pot.'

Here, *tamanegi* 'onions' in (a) is referred to by a ZERO in (b), which constitutes a cohesive tie between the two utterances. As a result, the two utterances are perceived as a coherent unit, rather than as a random string of discrete sentences. What characterizes this tie is the invisibility of one of its ends, unlike English, which explicitly indicates both ends, usually by a noun phrase (NP) and pronoun pair (i.e., 'onions' – 'them').

Lexical pronouns in English carry less information than full NPs, which could also create ambiguity. However, they at least provide an indication of reference, complete with clues for the animacy, number and gender of the referents, unlike Japanese ZEROS. This difference (both in visibility and informativeness) is a representative example of cross-linguistic variation in language systems such as Japanese and English (and other explicit-argument languages). As suggested by research that concerns cross-linguistic variations in language acquisition and processing, linguistic distance has an effect on comprehension (Koda, 1996). Thus, explicit instruction and extensive training for recognizing ZERO-involving cohesive ties may have positive effects on comprehension of discourse with ZEROS, especially for learners with a non-ZERO-prone L1.

In order to plan effective instruction and training, there is a crucial prerequisite for teachers, i.e., the knowledge of potential difficulties for learners. This knowledge can be characterized according to two aspects: (i) assessment of difficulty levels, and (ii) prediction of problem areas, which will be discussed in detail respectively in sections 7.1.2.1 and 7.1.2.2.

7.1.2.1 Assessing reading difficulty

Levels of difficulty of reading materials has generally been assessed in terms of the vocabulary (and *kanji*, Chinese characters, for Japanese) that they contain, structural complexity, sentence and text length, or thematic content.

Among these criteria, vocabulary is probably one of the most measurable factors

known to be useful in predicting reading difficulty, or more generally, "readability." Such a measure is embodied, for instance, by counts of content words, syllables, and so on, i.e., all elements countable by various readability formulas. The formulas, such as "Flesch Reading Ease" and "Flesch-Kincaid Grade Level," were originally designed (for English) to help classroom teachers choose materials for their students. The formulas usually consider only two factors: (i) the number of syllables in a word, and (ii) the number of words in a sentence. As a more sophisticated type of measure, *Reading Tutor* provides an online "level checker" that takes text as input and statistically analyzes *kanji* (Chinese characters) and vocabulary contained in the text according to their JLPT level-based difficulty (Kawamura, 1999).[5]

However, readability is more complex than mere counts of words or syllables, or distributions and frequencies of certain groups of words can suggest. Other potential factors for readability measures include "propositional analysis" and "cohesion analysis," as pointed out by Horning (1987).

Propositions are idea units into which each sentence is broken, and are built around verbs, which are accompanied by their arguments. In his reading time and recall experiments, Kintsch (1974) found that more propositions require more reading time, and that certain types of propositions are easier to recall than others. In addition, repetition of arguments has a strong effect on readability. The number of different arguments found in the propositional analysis of a discourse is also related to readability.

Cohesion analysis is another facet of readability. Cohesion analysis, originally proposed in detail by Halliday and Hasan (1987), examines a text for five types of cohesive ties (see 2.5.1). As with propositional analysis, cohesive ties have been empirically proven to be related to readability (e.g., Irwin, 1986; McNamara, 2001).

Along the line of the cohesion analysis approach, Fujiwara and Yamura-Takei (2003, 2004) suggested that knowing the different types of ZEROS (as defined in Chapter 2) and their frequency and distribution (as provided in Chapter 4) could help the teacher determine the difficulty level of the text. We conjecture that the output of *ZD*, as presented in Chapter 6, would serve as a basis for this determination.

In this regard, our goals are in spirit similar to what the *Coh-Metrix* project, currently on-going at the University of Memphis, attempts to achieve.[6] The *Coh-Metrix* is an automated cohesion metric tool that computes properties of text cohesion and computes a coherence score that integrates text cohesiveness with the reader's world knowledge and aptitude (McNamara, Louwerse, and Graesser,

[5] JLPT (Japanese-Language Proficiency Test) has four different levels, for each of which the essential vocabulary list is publicly provided.

[6] The project website can be found at http://cohmetrix.memphis.edu/cohmetrixpr/index.html (accessed on September 11, 2004). The project aims to improve L1 reading comprehension in English of young children and university students, but its insights are significant and applicable to JSL contexts.

unpublished grant proposal). One of the factors they consider for their coherence metric is referential coherence established with the use of anaphora and conceptual overlap, etc., into which category our ZEROS also fall.

As potential measurable or observable factors regarding the use of ZEROS, we consider the following three aspects: (i) density, (ii) type, and (iii) processing cost.

Density of ZEROS

How many ZEROS are contained in a certain discourse? This is something that even native speakers or experienced teachers cannot answer without careful analysis. As the analysis provided in 4.1 indicates, the density of ZEROS varies from text to text, averaging one ZERO in every 1.45 clause unit. Take, for example, two 5-clause discourses from a very beginning textbook; one includes no ZEROS, while the other contains two of them. The text writer might have intentionally manipulated this density, but his/her intention is not stated in either in the textbook or in the teacher's manual, probably leaving the recognition of this difference to intuition.

Generally speaking, more ZEROS occur as the text level advances. Let us examine two sets of 2-volume textbook series, *Hiroko 1, 2* and *Minna 1, 2*, in which volume 1 is followed by the more advanced volume 2. In *Hiroko 1*, ZEROS occur in every 2.37 utterances, while *Hiroko 2* has a higher density of ZEROS, one in every 1.39 utterances. The same is observed in *Minna* volumes, 1.60 versus 1.37 utterances. This implies that density of ZEROS corresponds to difficulty level (set by text writers) of a textbook.

Types of ZEROS

Density of ZEROS may be one simple indicator of readability. However, one can easily imagine that this will not explain everything. It is probable that, in addition to density, types of ZEROS involved will also affect readability of the text. Our fundamental assumption is that certain types of ZEROS are harder to process than others, and thus their distribution affects readability. We will use the two typologies that we described in 2.4 for ZEROS in order to investigate the validity of our assumption.

The first typology that we made for ZEROS concerns the argument type that classifies zero verbal argument and zero nominal argument. The centering analysis of our corpus indicates that 42% of CBs (i.e., centered entities maintained from the previous utterance; see Chapter 3) are realized by ZEROS of either argument type (see 4.4.2 for details). Assuming that cohesive links established by one type might be harder to recognize than those established by the other type, their distribution may have an effect on readability. Let us present sample discourses in which each type of CB is contained, (7.2) followed by (7.3a: verbal argument) and (7.3b: nominal argument).

(7.2)

おかの	上に	家が	ある。
oka-no	*ue-ni*	*ie-ga*	*aru.*
hill-GEN	on	house-NOM	exist

'There is a house on the hill.'

(7.3) a.

今にも	Ø	くずれそうだ。
imanimo	*(Ø-ga)*	*kuzure-soo-da.*
at-any-moment	(Ø-NOM)	collapse-appear-COP

'(It 'house') is about to collapse.'

b.

今にも	Ø	屋根が	くずれそうだ。
imanimo	*(Ø-no)*	*yane-ga*	*kuzure-soo-da.*
at-any-moment	(Ø-GEN)	roof-NOM	collapse-appear-COP

'(Its 'house's) roof is about to collapse.'

Intuitively, the link established by the zero nominal argument, as in (b), seems to be harder. Theoretically, centering predicts that (b) requires a higher inferential cost to process than (a); (a) is labeled CONTINUE, while (b) is RETAIN, in our definition. Recall that zero verbal arguments are triggered by syntactic requirements and zero nominal arguments by semantic incompleteness. Let us hypothesize here that using zero nominal arguments is harder than using zero verbal arguments to recognize the cohesive ties involved. We will provide some statistics from our corpus, as suggestive evidence for this hypothesis.

Out of 841 utterances in the corpus, 132 utterances (15.70%) have links to the previous utterance, i.e., CBs, by means of zero nominal arguments. This is not a strikingly large ratio, but when we turn to a text level analysis, 57 texts, out of a total of 83, include CBs realized by both types of ZEROS; the remaining 26 include only zero verbal argument CBs, and there were no texts that include only zero nominal CBs. This suggests that zero verbal arguments and zero nominal arguments often interact with each other to create a coherent whole as a discourse. Two sets of text (one narrative set and one expository set) are compared with respect to zero argument type CB distribution in Table 7.1.

Genre	Text	Zero verbal CB	Zero nominal CB
Narrative	A	7	0
	B	2	5
Expository	C	13	0
	D	7	6

Table 7.1: Distribution of CB according to zero argument type in texts

Text A (narrative) and C (expository) consist solely of zero verbal argument CBs. Here, we disregard non-ZERO CBs. In Text A, Tom's family members are described in each discourse segment, hence the dominant use of zero verbal arguments (mostly, zero nominatives). Text C describes the role of music in our daily life, i.e., how young people and doctors enjoy or utilize music, and hence again the frequent occurrence of zero verbal argument CBs (zero nominatives). In Text B (narrative) and D (expository), in contrast, CBs are expressed by both types in a mixed manner. Text B, for example, describes Mayumi's experience, by referring to her hospitalization, and also to her brother, classmates, friends, and teacher, which results in the use of zero nominal arguments. In the same way, Text D describes robots, while referring to their size and competition matches, etc. In the case of B and D type texts, failure to recognize zero nominal argument CBs is likely to cause readers to perceive a gap in cohesion relations.

The other typology for ZEROS depends on their referent types; we have used eight different types: local, global, intra-clausal, cataphorical, event, situational, indeterminate, and time/weather. This typology is also assumed to have impact on the degree of recognizability and interpretability. Our assumption is that ZEROS with explicit NP antecedents are easier to process than those without (see 4.4.1.4 for classification). These assumptions need further empirical justification with well-thought-out experiments, which in fact is included in our future agenda. Alternatively, we will provide here some statistical evidence that reveals the distributional differences for ZERO types in two distinct "genres"[7] of text, which inherently exhibit different degree of readability.

Narrative and expository texts, as two distinct genres, have their own special characteristics. Each genre has its own communicative purpose, which as a consequence gives it internal structure, often called rhetorical structure, and probably affects some linguistic features therein.[8] Then, how about the use of ZEROS? Does

[7] A genre is defined as "a culturally and linguistically distinct form of discourse" in Celce-Murcia and Olshtain (2000, page 6), in contrast to a register that "reflect(s) the level of formality or informality of an instance of discourse or its degree of technical specificity versus general usage."

[8] Intuitively, we regard narratives as an easier type, as is also evidenced by the fact that almost all beginning level reading materials consist of narrative texts.

the pattern of use of ZEROS also characterize a genre? In an attempt to answer this question, we will make a comparison of the two different sets of text in regard to the distribution of ZEROS of various types. We will use the *Nitizyo* sub-corpus (14 texts, 498 utterances) as a narrative sample and *Gendai* (15 texts, 364 utterances) as an expository sample.

First, let us look at the distribution of referent types in Figure 7.2. Here, we add data from another genre, i.e., the email corpus (64 texts, 914 utterances).

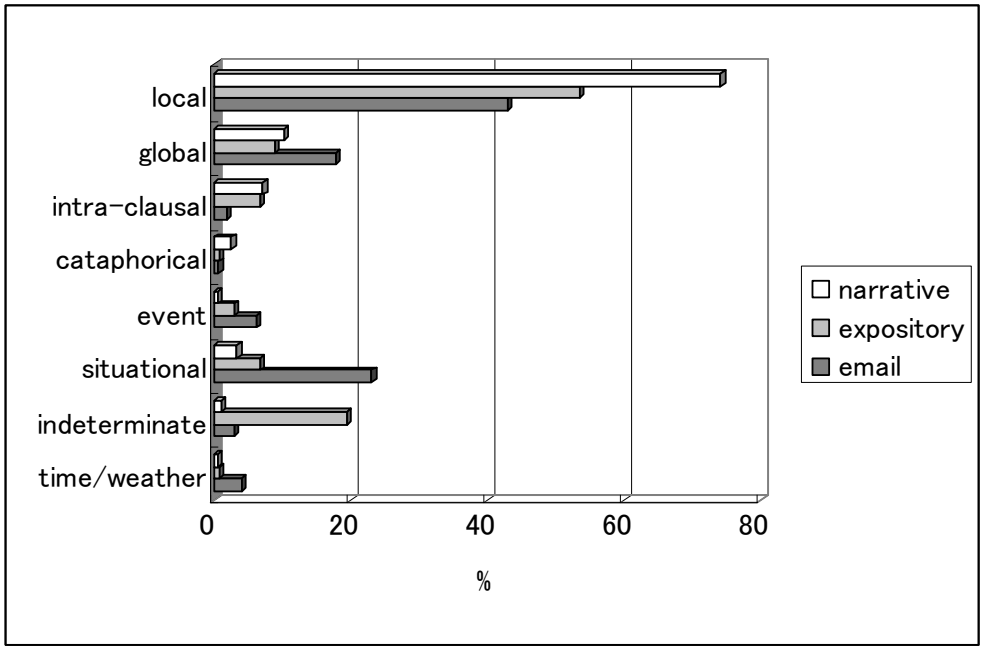


Figure 7.2: Comparison of ZERO referent type distributions
in three different genres of text

Each genre of text exhibits a certain characteristic: a relatively high ratio of ZEROS of "local" reference (74.14%) in narrative texts, and a remarkably higher ratio of "indeterminate" reference in expository texts (19.41%) than in the other two genres (1.15% and 2.99% respectively). In contrast, email texts can be characterized by high frequency of "global" (17.91%) and "situational" reference (23.13%).

These results roughly conform to some general characteristics of the three text genres. The primary communicative purpose of narrative texts is to describe an experience, an event, or a sequence of events in the form of a story. Thus, they naturally involve some main characters (human entities) and objects (non-human entities) that are usually repeated, locally or globally, in the progress of the story. It is, therefore, persuasive that the two prevailing reference types for this genre are "local" and "global."

Expository texts, on the other hand, aim to provide information; they inform readers about technical or logical ideas with which readers are usually unfamiliar. More specifically, they describe objects, phenomena, and mechanisms, etc., and much of this content is abstract and technical, with no particular personages involved. This explains the abundant use of "indeterminate" reference, rather than reference to explicit NP antecedents.

Email text, as described in Fais and Yamura-Takei (2003), is often said to be a hybrid of written and spoken texts. Its communicative purpose is normally to exchange information to achieve a specific goal set by the participants. The purpose of this particular corpus (i.e., a collection of messages exchanged among six employees of a Japanese company), is to make necessary arrangements for "scheduling a sports outing" and for "organizing the writing and publication of a history of the company" (*ibid.*, page 172). Thus, interactions rely heavily on the shared or prior knowledge of the participants. This feature explains the high frequency of "situational" references in this genre.

In sum, "local/global" are referent types peculiar to narrative texts; "indeterminate" is peculiar to expository texts, and "situational" to email texts. These genre-specific generalizations have also proven statistically valid. When the distribution of "local/global," "situational," and "indeterminate" references in the three genres of text are compared, the difference is significant ($x^2 = 134.57$, DF=4, $p < .001$). We assume that knowing this genre-specific tendency is a useful piece of information for teachers when they use these genres of materials.

In addition to these generalized observations, teachers should be aware of inevitable variations within the same genre. Let us compare two texts from the expository set: Text A, which explains the new-employee training system in Japan and Text B, which describes newly invented golf balls. Table 7.2 shows the distribution of referent types in the two texts.[9]

Type	Text A	Text B	Expository Average
local	66.67%	14.29%	53.59%
global	26.67%	7.14%	8.86%
event	6.67%	7.14%	2.95%
situational	0%	7.14%	6.75%
indeterminate	0%	64.29%	19.94%

Table 7.2: Distribution of reference types in two expository texts

[9] ZEROS of intra-clausal, cataphorical, and time/weather reference are not found in the texts.

As is apparent, the two texts are distinct from each other, and also, they deviate somewhat from the average of the whole expository sub-corpus. Striking are the relatively high proportion of "local/global" ZEROS in Text A, and the overwhelming frequency of "indeterminate" ZEROS in Text B. In this regard, Text A is closer to a narrative style text, probably because a human entity 'employees' are the CENTER of the discussion. In Text B, in contrast, 'golf balls' are centered and various "general" people connected to the balls are expressed as indeterminate ZEROS. From these statistics, teachers can reasonably predict potential problem areas for learners in the identification of "global" referents, in case of Text A, and in the interpretation of a discourse involving numerous indeterminate agents, in case of Text B (see 7.1.2.2).[10]

Processing cost of ZEROS

We have seen that "density" and "type" of ZEROS vary remarkably from text to text, and from genre to genre. Before we move on to "processing cost" of ZEROS, let us present some data comparing two distinct genres, narrative and expository, based on the centering account of coherence. Figure 7.3 presents the distribution of TRANSITION types found in the two sets of text.

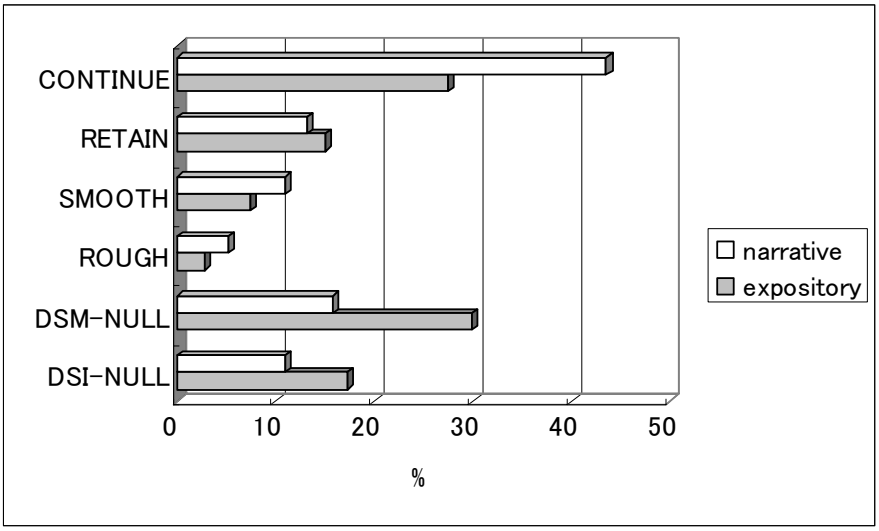


Figure 7.3: Comparison of TRANSITION type distribution for two genres of text

This figure shows that both narrative and expository sub-corpora exhibit the preferred distribution of TRANSITION types as defined in Rule 2 (the version of Brenann et al., 1987; see Chapter 3). Noticeable differences between the two include the relatively high proportion of CONTINUE in narrative texts, and the high frequency of discourse-medial NULL TRANSITION states in expository texts. The former is closely

[10] Several JSL teachers pointed out that Text B is one of the hardest materials in the textbook for learners (personal communication).

related to the frequency of "local" ZEROS mentioned earlier, which creates a locally coherent discourse. The latter indicates the more frequent breakdown in cohesive links between adjacent utterances, i.e., the low entity-coherence of expository texts. Judging solely from the entity-based estimation of coherence, expository texts are less coherent than narratives.

Next, we examined the TRANSITION types of utterances with ZERO-CBs in order to make a rough estimation of processing costs. Figure 7.4 presents the distribution.

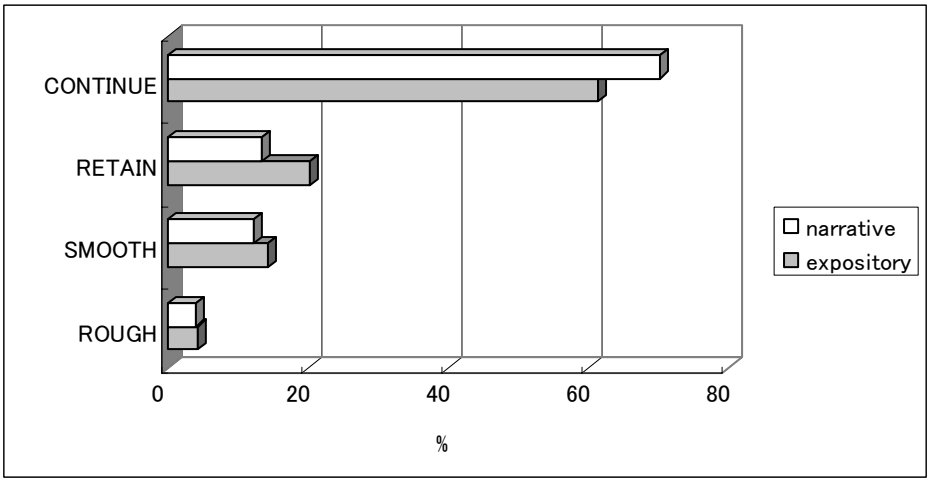


Figure 7.4: TRANSITION types of utterances with ZERO-CBs in two genres of texts

It is interesting to see that the ratio of the CONTINUE TRANSITION utterances in narrative texts is higher than that in expository, while the ratio of the other three TRANSITIONS yielded the reverse results.

In order to more closely and more precisely examine the centering-predicted degree of coherence, we will turn to the inference cost induced by the TRANSITION sequence types. Again, let us compare *Nitizyo* and *Gendai*, the narrative and expository sub-corpora. Table 7.3 below shows the ratios of "low cost," "medium cost" and "high cost" sequences in the two sets of corpus (see 4.4.4.2 for the definition of each cost group).

	Narrative *Nitizyo*	Expository *Gendai*	Average of the whole corpus
Low cost	**56.91%**	47.90%	47.13%
Medium cost	28.86%	29.41%	34.15%
High cost	14.23%	**22.69%**	18.71%

Table 7.3: Comparison of ratios of ZERO-CBs
in three levels of processing cost environments

As indicated by the figures in bold, more ZEROS are used in low processing cost environments in narrative than in expository. In expository texts, in contrast, more ZEROS than average are used in the centering conditions that require high processing demands.

We have seen potential factors concerning ZEROS that might affect readability of text, and provided some statistics from our corpus that explain text-to-text and genre-to-genre differences. These differences are what we suggest teachers should be aware of, in addition to the well-utilized differences in terms of vocabulary and sentence structure.

7.1.2.2 Predicting comprehension problems

In the previous subsection, we presented the differences in density, type and processing cost of ZEROS observed in two distinct genres of text: narrative and expository. We also paid attention to text-to-text variations, hoping that these observations and the generalizations drawn from them will reveal implications for the determination of readability. In this subsection, we will demonstrate that our findings will help spot certain problem areas in terms of ZERO interpretation that affect comprehension of a discourse.

As for density, we simply assume that the more ZEROS a discourse contains, the more difficult the interpretation of the discourse will make. This assumption is contrary to the claims (for English) by Irwin (1986) that a greater number of cohesive ties increases reading speed and improves recall. This contradiction is largely due to the implicitness of cohesive ties that we are concerned with; invisible ZEROS have a higher inference cost than other visible cohesive ties, such as an NP-pronoun pair. McNamara (2001) reported that increasing the "explicit" coherence relations improves memory and comprehension. "Implicit" coherence relations created by ZEROS appear to have a different story.

As for types, we assume that some types should be easier to process than others. Take "local" and "global" for instance. ZEROS whose antecedents are found "locally" in the immediately preceding utterances should be easier than ZEROS whose antecedents need "global" search. Among "local" ZEROS, there also should be differences in processing difficulty according to whether they can be interpreted by centering mechanisms alone or whether they require additional semantic-driven inference. Fujiwara and Yamura-Takei (2003, 2004) conducted a study with 20 JSL learners in an American university concerning their interpretation of three different types of ZEROS: (i) local, (ii) local augmented with semantic information, and (iii) global. Results indicate that type (iii) is harder to interpret than the other two, and these results have proven statistically significant ($x^2 = 6.00$; DF = 2; $p < .05$). This suggests that these categorizations (local versus global) can be used to predict difficulty in interpreting

different types of ZEROS. We also suggested that ZEROS with explicit NP antecedents are easier to process than those without, such as "situational" ZEROS, a claim that needs to wait for an empirical validation.

Finally, in terms of processing cost, centering provides hypothetical predictions concerning the processing difficulty of ZEROS. Theoretically and intuitively, ZEROS used in the CON-CON sequence are easier than those in, say, the CON-SHIFT sequence. TRANSITION-sequence-based prediction of comprehension problems is convincing and promising. However, computation of centering TRANSITIONS is not an easy task for teachers or even for trained linguists, and its automation is beyond the scope of this study. Alternatively, we suggest an effective use of *ZD* output. A sample segment is given in (7.4).

(7.4) a. 大人は ジェーンを 見て
otona-wa *zyeen-o* *mi-te*
adult-TOP Jane-ACC see-and

'When adults see Jane,'

b. Ø 「外人」などと 言いませんが、
(Ø-ga) *"gaizin" nado-to* *ii-mas-en-ga*
(Ø-NOM) "foreigner"-QUO say-POL-NEG-but,

'(they) do not say "foreigner" but'

c. Ø 特別な目で ジェーンを 見ます。
(Ø-ga) *tokubetuna me-de* *zyeen-o* *mi-masu.*
(Ø-NOM) special eye-with Jane-ACC see-POL

'(they) see Jane with special eyes.'

d. Ø 金髪で 鼻が 高くて
(Ø-ga) *kinpatu-de* *hana-ga takaku-te*
(Ø-NOM) blond-is nose-NOM high-and

日本人と ずいぶん違うから・・・
nihonzin-to *zuibun tigau-kara…*
Japanese-from very different-because

'Because (she 'Jane') is blond and has a high nose, so different from Japanese people, …'

Figure 7.5 demonstrates the ZERO-specified *ZD* output of the segment (7.4), in which CENTERS are connected with arrows.

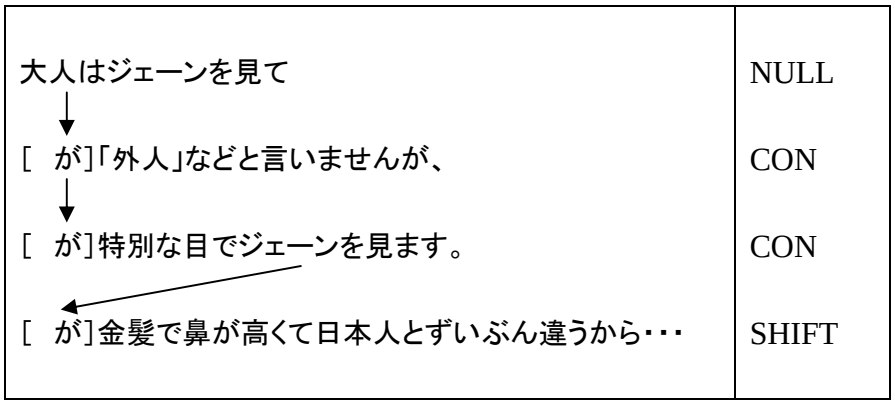


Figure 7.5: Sample *ZD* output with manual addition of coherence relations (1)

Using arrows to make explicit cohesive links or anaphoric relations is one of the conventional techniques traditionally employed by teachers in reading instruction (Williams, 1983; Baumann and Stevenson, 1986; Lubelska, 1991). This technique provides a rough approximation of centering TRANSITIONS, as is clear from the arrows in NULL-CON, CON-CON and CON-SHIFT sequences. The arrow between CON-SHIFT-sequence utterances indicates an abrupt shift in CENTERS. This intuitively easy-to-perceive alternative would work better than technical explication with centering terms, especially for centering-naïve language teachers, and this is where *ZD* output (in clause-by-clause parallel arrangement, with ZEROS specified) can be of pedagogical significance.

In order to show another benefit of this method, let us present another sample from our corpus in (7.5).

(7.5) a.

この犬のロボットは	頭が	よくて、
kono inu-no robotto-wa	*atama-ga*	*yoku-te,*
this dog-GEN robot-TOP	brain-NOM	good-and

‘This robot dog is smart, and’

b.

Ø	Ø	Ø	教えてやると
(Ø-ga)	*(Ø-ni)*	*(Ø-o)*	*osiete-yaru-to*
(Ø-NOM)	(Ø-DAT)	(Ø-ACC)	teach-EMP-if

‘If (you) teach (it) (tricks)’

c.	Ø	いろいろ	Ø	覚える。
	(Ø-ga)	*iroiro*	*(Ø-o)*	*oboeru.*
	(Ø-NOM)	variously	(Ø-ACC)	learn.

'(It) learns many (tricks).'

Figure 7.6 below shows the *ZD* output with a manual arrow insertion.

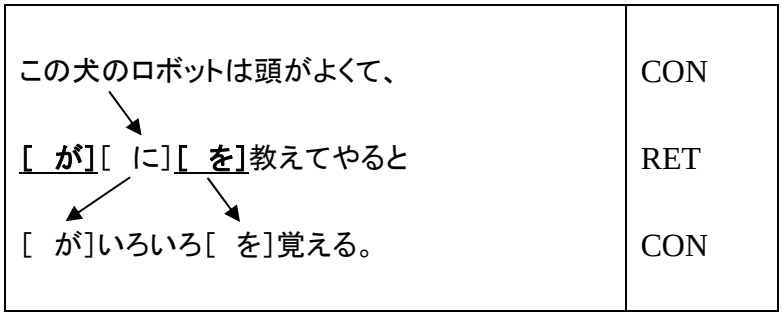


Figure 7.6: Sample *ZD* output with manual addition of coherence relations (2)

As the angles of the arrows suggest, the transition of CENTERS is not maximally straightforward: see, for example, the CON-RET-CON sequence. In addition, there are two ZEROS (indicated by underlining) that are not connected by arrows to any explicit antecedent NPs in the text; they are potentially hard-to-interpret ZEROS without NP antecedents, "situational" in this case. This sequence seems to require a high degree of inference from world knowledge about pet dogs, a situation that teachers should be aware of.

7.1.3 Summary: Teaching

We have discussed how *ZD* helps teachers promote effective reading comprehension instruction. We discussed the two main aspects of teaching. In particular, firstly, *ZD* helps teachers predict the difficulties with ZEROS that learners might encounter, by analyzing text in advance. This supports the careful selection of teaching materials and the well-thought-out creation of reading comprehension questions and tests. Moreover, it is a crucial duty for teachers to be prepared for potential problems that might arise in the classroom. This is based on the claim by Moe and Irwin (1986) that "a clear understanding of cohesion can help educators predict comprehension problems" (page 3).

In addition, teacher awareness, not limited to lexical/syntactic characteristics (that are usually easier to observe) but extended to critical inter-sentential phenomena, should lead to a more thorough understanding of the language and a more effective instruction

of the language as discourse. Graesser, McNamara, and Louwerse (2003) claim that "[v]ery few teachers are aware of the broad landscape of coherence relations" and "[m]ost researchers who have studied text coherence have not yet considered the implications of coherence for teaching reading" (pages 21-22); their claim is intended to speak to the case of L1 instruction in English, yet it is also applicable to the case of L2 instruction in Japanese. This gap is exactly what this thesis, particularly this chapter, attempts to fill. Our major claim is that *ZD* will provide a basis, i.e., ZERO-specified texts, on which teachers can make the aforementioned observations and determinations that we assume are crucial to effective reading instruction.

7.2 Enhancing learning

In this section, we will examine how *Zero Detector* can promote recognition, by JSL learners, of ZEROS and better understanding of a discourse that contains them, and hence acquisition of native-like perception of coherence of the discourse. In this respect, we regard learners as "indirect" users of the program, having teachers in a facilitator or mediator role who uses *ZD* output as teaching materials. In the scope of the present study, teachers supposedly create innovative worksheets using *ZD* output to be discussed in class with or without the use of technology, rather than having learners use the program hands-on.[11]

In what follows, we will begin with a brief overview of language teaching paradigms, in relation to CALL history, and then discuss in which CALL design, rooted in the relatively new teaching paradigm, *ZD* can be most effectively used.

7.2.1 Language teaching paradigms and CALL

Research in Second Language Acquisition (SLA), in its long history, has been concerned with the question of whether and what kind of language instruction best promotes learners' second language development, and, as a result, has produced a variety of teaching paradigms and methods. The history seems to have witnessed a number of shifts in focus; namely "focus on what" has always been a major question for SLA researchers and practitioners.

The first, and probably most, influential approach was the so-called traditional grammar-based teaching, later dubbed by Long (1991) "Focus on FormS." This approach sees language as a system of linguistic forms and functions. Included in this view are the grammar-translation method, which involves teaching forms exclusively or in isolation, and the audiolingual method, which places emphasis on mechanical drilling

[11] We will leave the hands-on use of *ZD* in a self-study mode for future work, which we believe is a promising and interesting direction, from both technological and pedagogical perspectives.

and memorization of language forms.

What came after this strictly form-based approach was communicative language teaching. This approach views language as a means of communication. The natural approach and immersion approach are of this type, which is labeled "Focus on Meaning," and aims to provide students with opportunities to engage in communicative activities that exclude explicit grammar instruction.

Language teachers and learners, however, face the dilemma that, via traditional methods, learners do not become fluent, and, via communicative methods, students do not become accurate enough. It seems that too much attention to form risks fluency and too much attention to communication compromises accuracy. Therefore, in implementing a balanced teaching methodology, it is necessary to somehow integrate "attention to form" and "attention to meaning" for successful second language instruction. This view was first implemented by Long (1991), as a new paradigm termed "Focus on Form" that attempts to draw learners' attention to linguistic form within a meaningful context, as in task-based language teaching (TBLT).

The shifts in focus that are realized in these three different paradigms are summarized in Table 7.4. The table also includes a brief history of CALL, whose design has been influenced by each teaching principle. The main focus of this section is to discuss what could fit in the cells indicated by '?' in the table.

Paradigm	**Focus on FormS**	**Focus on Meaning**	**Focus on Form**
Methodology	grammar-translation, audiolingual	communicative approach, immersion	TBLT
CALL Design	drill and practice, stimulus-response	simulation, role playing	? [1]
	Structural CALL	Communicative CALL	? [2]

Table 7.4: Interrelationship between teaching methodology and CALL design

In the realm of "Focus on FormS," CALL systems also emphasize forms rather than functions and meaning. One representative teaching methodology in this group is Audiolingualism, which peaked in the 1960s. The language laboratory, or simply LL, has spread widely in educational institutions of various levels. The audiolingual approach, based on behaviorism and structuralism, presented the learner with a carefully graded series of conditional and habit-forming modes of exercises, often derogatorily labeled "drill-and-kill." CALL programs in this vein, usually categorized as "Structural CALL," present a stimulus to which the learner has to provide a response. The stimulus is usually in the form of text presented on screen, and the response is made

by entering an answer, normally in the form of multiple choice or fill-in-blank, at the keyboard.

It was at the beginning of the 1970s that the "communicative approach" began to take over. This is generally attributed to Hymes (1972) who defined "communicative competence" as opposed to Chomskyan "linguistic competence." In this paradigm, namely "Focus on Meaning," CALL programs also focused on communicative language activities. Such activities are realized in CALL, for example, in the form of role playing and simulation (games) that involve interaction with computers fully utilizing multimedia devices, such as sound, graphics and videos, in addition to simulation programs. This type of CALL is often called "Communicative CALL." For example, an attempt to apply the principles of communicative language learning to the three emerging technologies, NLP, interactive video and speech processing, was made in the Athena Language Learning Project (Murray, 1995).

For the purpose of "Focus on Form," what type of CALL design is effective and possible? Focus on Form is usually put into practice in the form of **task-based language learning (TBLL)**. TBLL is based on the idea that the acquisition of language and linguistic competence as well as language and language learning awareness can best be realized through tasks which encourage learners not to focus explicitly on the structure and the rules of L2. Learners will acquire the form of the foreign language because they are engaged in exploring aspects of the target language on the basis of authentic content. In this regard, TBLL is closely related to or is compatible with **data-driven learning (DDL)**, proposed by Tim Johns (Johns and King, 1991), which focuses on the exploitation of authentic materials and real, exploratory tasks and learner-centered activities, with the aid of linguistic analysis tools. Most obviously, concepts described as DDL form a relevant backbone of aspects explored and exemplified in TBLL. These concepts can also be realized in CALL applications and environments, and this type of CALL is often labeled Corpus-based CALL, or Task-based CALL (e.g., González-Lloret, 2003), which can go in the cell marked [2] in the table above. As for the cell marked [1], we will leave possible concrete ideas as a future issue (see 7.2.5).

In the next section, we will move further into the discussion on the underlying rationale and potential practical applications of this particular type of CALL, rooted in the principles of "Focus on Form" and "data-driven language learning."

7.2.2 Focus on Form and CALL

There are many SLA researchers involved in CALL, and also many CALL researchers who are concerned with SLA. There is also a symbiotic relationship between rigorous research in SLA and CALL; as Chapelle (1997) put it "[a] glance through the CALL literature of the 1990s reveals the profession's quest for principled means of designing

and evaluating CALL (page 19)." One such quest concerns the implementation of Focus on Form concepts.

Skehan (1998) presents five cognitive principles for implementing effective task-based instruction (TBI), one of which is to "[m]aximize the chances of a focus on form through attentional manipulation (page 132)." Chapelle (2001) presents six criteria for evaluating appropriateness of CALL activities, one of which emphasizes "[t]he degree of opportunity present for beneficial focus on form (page 55)." More recently, Skehan (2003) explores connections between technology and the concepts of Focus on Form.

7.2.3 Focus on Form and JSL

In the field of language pedagogy, studies for ESL usually precede those for other (European and then Asian) languages. Unexceptionally, Focus on Form, which was originally formulated in 1991 by Long, began to be discussed in the JSL community in the late 1990s (e.g., Koyanagi, 1998, 2001, 2002). Koyanagi (2002) reviews previous JSL acquisition work and sees Focus on Form as a promising teaching principle from which JSL pedagogy can benefit and to which Japanese language studies can contribute. Prior to that, Nagatomo (1995) discussed the role of consciousness-raising in the acquisition of Japanese adjectives. Yokoyama (1998, 1999, and 2001) attended to the role of input/output, emphasizing the noticing function, and discussed its implications for JSL classroom activities. She states that some language forms are not suited for learning as "knowledge," but rather suited for learning through input (Yokoyama, 1999), which is one of the driving forces for us to consider *ZD* as an acquisition aid, assuming that ZEROS are the kind of phenomenon for which it is difficult to make rules.

7.2.4 Attention and noticing

7.2.4.1 Model of SLA

Just like computer systems, humans receive input and produce output. For human language processing, input is the language that they hear or receive and from which they can learn. Output, by analogy, is the language they utter or produce, from which you can observe what they have learned. Unlike computers, however, what lies in between is a "black box."

Research efforts in SLA have long been focusing on the elucidation of unspecified processes in the box, and have reached a more or less agreed-upon model. A prototypical model that consists of six basic components is illustrated in Figure 7.7, following Gass (1997) and Chapelle (1998).

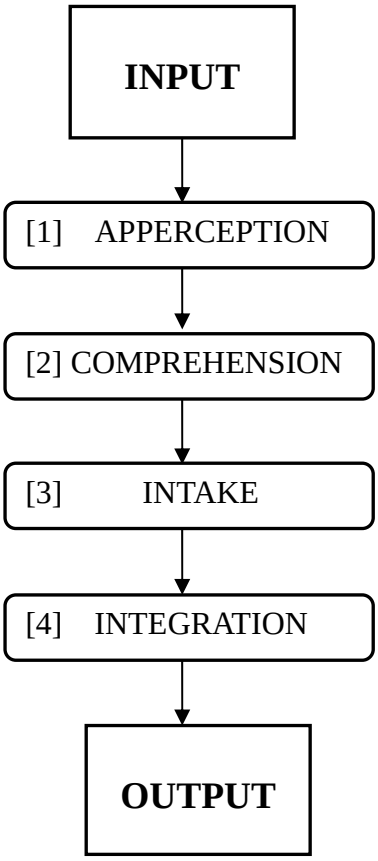


Figure 7.7: A model of second language acquisition

The concept of **input** is probably the single most important concept of second language acquisition. It is trivial to point out that no individual can learn a second language, dubbed as L2, (or develop an L2 grammar) without input of some sort (Gass, 1997). Even when input is potentially available to a learner, however, we must ask what happens to it before it converts itself to **output**, i.e., L2 production, namely what goes on inside the black box. Gass proposed four stages that lie between input and output.

Firstly, a well-established fact about SLA is that not everything that learners hear or read is utilized as they form L2 grammars. The first stage of input utilization is the recognition that there is something to be learned, that is, that there is a gap between what the learner already knows and what there is to know. This is called apperception. **Apperception** is the process of understanding by which newly observed qualities of an object are initially related to past experiences. Apperception is an internal cognitive act in which a linguistic form is related to some bit of existing knowledge (or gap in knowledge). We can think of apperception as a priming device that prepares the input for further analysis. Thus, apperceived input is that bit of language that is noticed in some way by the learner because of some particular recognizable features.

Apperception relates to the potentiality of **comprehension** of the input; another

level in the process of acquisition is comprehended input.

Intake is the process of assimilating linguistic material; it refers to the mental activity that mediates input and grammars.

After the intake component has performed its task of processing the input and matching it against existing knowledge, the resulting outcome occurs in the form of **integration**. Integration is comprised of the processes for using or holding the intake in short term memory to influence the development of the linguistic system, or the "interlanguage" (Selinker, 1972). Finally, the system developed by integration, in turn, affects the L2 output that the learner produces.

In what follows, we will attend, among the components discussed so far, to the component of apperception, the process of noticing aspect in L2, in relation to attention.

7.2.4.2 Role of attention

Attention is a cognitive process crucial in human information processing. More precisely, it is the means by which humans actively process a limited amount of information from the enormous amount of information available through their senses, stored memories, and other cognitive processes. Since attention is a limited resource, there must be (i) processes that decide what to attend to, which are referred to as "selective attention"; and (ii) processes that allocate attentional resources to control performance of several tasks simultaneously, referred to as "divided attention." In order to make any decisions or allocations, there first must be the detection of stimuli. Performing a "dual task" therefore involves the detection of two stimuli that subsequently require efficient allocation of resources. The process is schematically described in Figure 7.8.

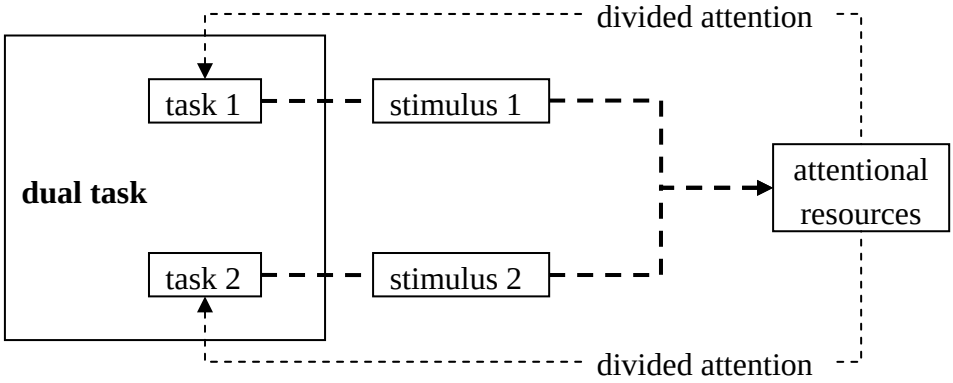


Figure 7.8: Dual task and attention

We will refer back to this scheme when we present our CALL design in the Focus on Form framework, in which attention plays an important role.

7.2.4.3 Noticing hypothesis

Attention to (language) input is essential for SLA, as well as for many other cognitive activities. Recent SLA research and theory progress beyond Krashen's (*e.g.*, 1982) emphasis on the automatic and "unconscious" processes of acquisition, and examine the role of attention in selecting input for processing (see Robinson, 2003 for a summary).

Schmidt (1990) argues, by questioning the notion of "unconsciousness" in Krashen's work, that learning must be "conscious" in the sense that learners must pay attention to input and "notice" it, and that "noticing is the necessary and sufficient condition for converting input to intake" (page 129).

This "noticing hypothesis" has been supported by the results of a number of empirical studies (e.g., Schmidt and Frota, 1986; Robinson, 1995, 1997; Jourdenais, Ota, Stauffer, Boyson, and Doughty, 1995; Leow, 1997, 2000) although it has also been objected to on theoretical and methodological grounds (Tomlin and Villa, 1994; Truscott, 1998). In spite of these caveats, Schmidt's hypothesis has inspired much subsequent important work, such as "input enhancement" (Sharwood Smith, 1991) and "Focus on Form" (Long, 1991; Long and Robinson, 1998).

7.2.4.4 Input enhancement

One important technical realization of the noticing hypothesis is input enhancement. It is a manipulation of target language input by making "salient" particular linguistic characteristics of L2 in order to prompt learners to notice them. Making something salient or noticeable in written input involves textual enhancement (i.e., visual enhancement of text), through the use of color, boldface, italics, highlighting, and increase in size or other perceptually salient features. For example, Doughty (1991) performed a computerized experiment regarding the effect of visual input enhancement (highlighting) on the acquisition of English relativization, which yielded a positive result. We conjecture that this salience effect can also be realized by making ZEROS visible, an approach that can be regarded as the ultimate visual enhancement of a particular linguistic feature.

This technique is listed at the top of the list of seven hypotheses about ideal SLA conditions that are relevant for CALL program design reviewed by Chapelle (1998). At the top of her list is that "the linguistic characteristics of target language input need to be made salient" (page 23). As Mills (2000) discussed the technology with which the enhancement is made easy, such as the Hypertext Markup Language (HTML) that we also employed for *ZD*, the input enhancement technique is better achieved in a computer-assisted environment.

More fundamentally, in order to make particular items noticeable, they must first

be detected in the input text. This can be done manually, but this is exactly where computerization, as realized in *ZD*, can make a great contribution, with the recent maturity of NLP techniques (see Chapter 5).

7.2.5 Summary: Learning

We have discussed the pedagogical framework in which learners can benefit from using *ZD*. We overviewed the underlying concepts of Focus on Form. The relationship of these major concepts and components within the principle of Task-based Language Teaching (TBLT) (Long, 2000) is illustrated in Figure 7.9 below.

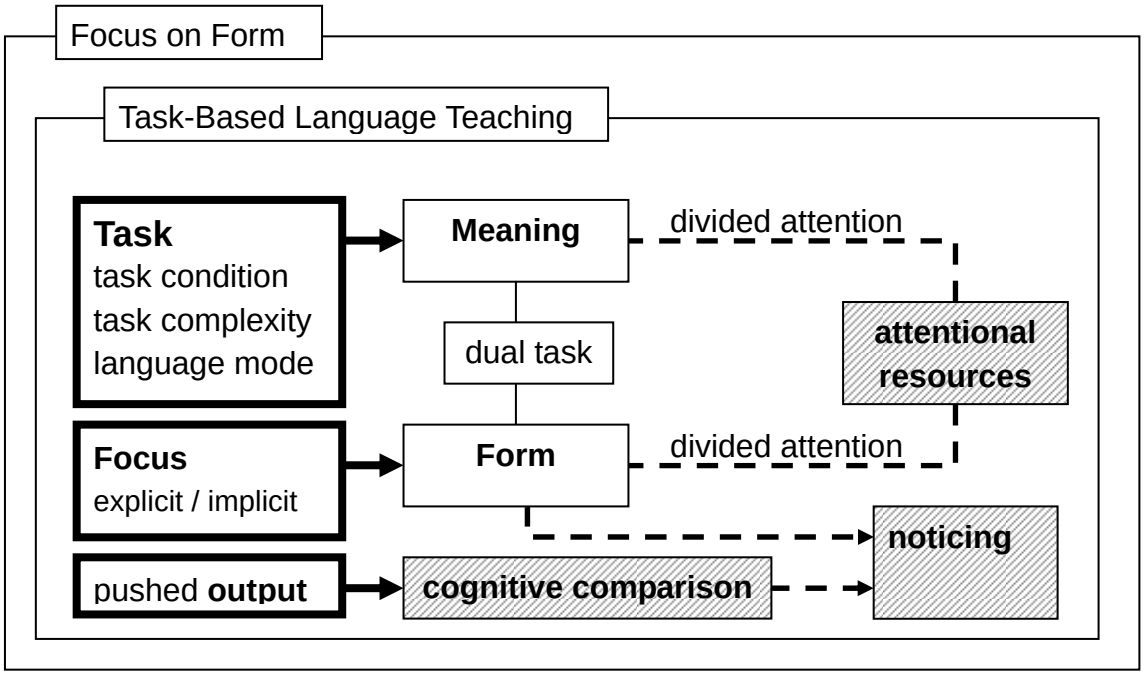


Figure 7.9: Relationship of major concepts and components in Focus on Form

The figure diagrams how pedagogical interventions (bold-framed) are related to relevant cognitive functions (highlighted). It is up to teachers who plan the TBLT activity to design meaningful "tasks" (while considering "language modes," "task conditions" and "task complexity"). *ZD* plays a part in the manipulation of the input in which some "forms" (ZEROS in this case) are "focused" by detecting and visually marking them, either in an explicit or implicit way (see the *ZD* output options in 6.8.1) so that some divided attention will be directed to "forms" and prompt noticing. As well as enhanced input, "pushed output" (or comprehensible output) is also considered to promote noticing by "cognitively comparing" what learners can produce and what they

cannot ("noticing the gap").[12] The analysis of learner output, to help comparison, would also be a site where *ZD* could play a part.

The design and development of a TBLT-based CALL program that incorporates a Focus-on-Form technique realized by *ZD*, as abstracted in the figure above, would be a promising future direction for research. Such a system would also serve as a test bed for what Chapelle (2001) calls CASLR (Computer-Assisted Second Language Research), which attempts to provide empirical evidence for second language acquisition theory by using a computerized research environment.

7.3 Potential of *ZD*

We have discussed possible pedagogical contributions of *Zero Detector* to the JSL context. Two possible areas for such contribution were presented: (i) enhancement of teachers' instruction of ZEROS and ZERO-containing discourse comprehension, and (ii) promotion of learners' recognition of ZEROS and better understanding of ZERO-containing discourse.

In both areas, *ZD* serves as a teacher's aid, rather than as an independent tutor, which was our initial intention, as we stated in Chapter 5. In addition, *ZD* is a simple and modest application; it just makes ZEROS visible and noticeable. Hence, it has great potential; teachers, as primary users, are given enormous flexibility and allowed full rein for their own creativity in using *ZD* and its output. In addition to what we have proposed in this chapter, there will be many other techniques and methods in which *ZD* can be used.

[12] Swain (1985, 1995, and 1998) argues for the necessity of providing learners with considerable opportunities for producing comprehensible output. See also Izumi (2002), Izumi and Bigelow (2000), and Izumi, Bigelow, Fujiwara and Fearnow (1999) for experimental studies on the noticing function of output.

Chapter 8

Conclusions

This final chapter summarizes the main issues this thesis has focused on. We highlight the major results and contributions of this work (Section 8.1) and present some interesting and challenging ideas emerging from the results to be developed in future research (Section 8.2).

8.1 Contributions of the thesis

Our primary goal was to investigate a unique linguistic phenomenon commonly found in Japanese discourse, what we dub ZEROS, from four different disciplinary perspectives, namely, theoretical, empirical, technological, and then pedagogical approaches, as schematically illustrated in Figure 8.1.

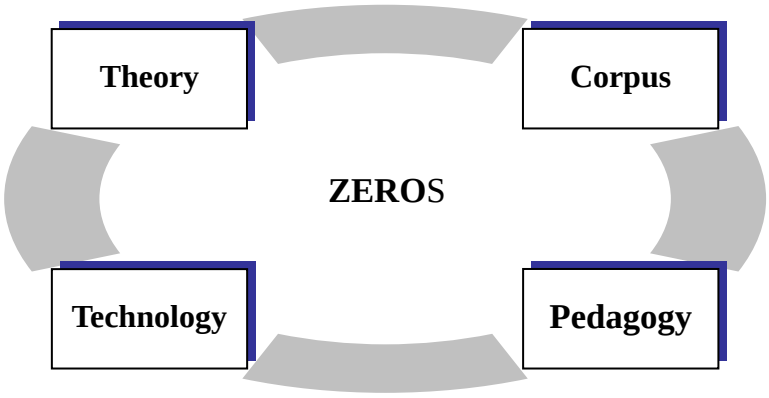


Figure 8.1: Diversified approaches to ZEROS

First, ZEROS were fully explicated “theoretically” for their nature and behaviors

within the relevant linguistic framework in Chapters 2 and 3. We reviewed the theoretical issues surrounding ZEROS and discussed key concepts in understanding ZEROS. Several typologies of ZEROS were proposed, with clear definitions. We emphasized the role of ZEROS as cohesion markers, and hence as coherence creators in Japanese discourse. We employed Centering theory as an explanatory tool to characterize the relationship between ZEROS and coherence/inference, and gave our version of definitions and parameter settings of centering terms and concepts.

Theoretically-grounded ZEROS were then examined "empirically" in the corpus study, which concerned the distribution of ZEROS and their contribution to coherence, in Chapter 4. To the best of our knowledge and belief, our study is the first and the most comprehensive study to present quantitative and qualitative data that examines the role of ZEROS with respect to coherence in Japanese discourse, in the centering framework, with numerous samples and reliable statistical evidence.

Thirdly, we presented, in Chapter 6, how the invisible ZEROS were "technologically" made visible. We discussed two sets of linguistically-sound heuristics that we employed for the recognition of the two types of ZEROS. The resulting development of *Zero Detector* was presented with a detailed description of the architecture. We also provided the results of an evaluation of its performance, which turned out to be feasible enough for the approach that we adopted.

Finally, two possible areas for the "pedagogical" contribution of *Zero Detector* were presented, in Chapter 7, based on the discussion of relevant reading research, SLA theories and language teaching and learning principles.

We placed, in the core of this interdisciplinary approach to ZEROS, the development of *Zero Detector*, an ICALL system. We assumed that a successful ICALL system is made possible with the collaboration of researchers (or research efforts) from the three communities: CALL, NLP, and SLA. This is what we intended to achieve in this single thesis, by placing *ZD* in the intersection of the three sub-disciplines, as illustrated in Figure 8.2.

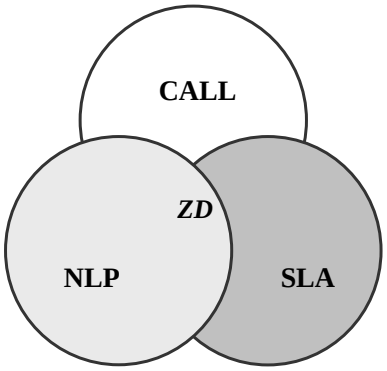


Figure 8.2: *ZD* at the intersection of three disciplines

As a final remark, we would like to emphasize that *ZD*, born and evolved in the intersection where theory, technology and pedagogy meet, is unique and innovative both as a system and as a project, for its emphasis on a previously unrecognized discourse-level phenomenon and its multi-disciplinary research methodologies, with considerable scholastic and technical depth.

8.2 Future Work

Besides many contributions that this thesis did offer, some were left undone or underdeveloped, either for lack of time, or for lack of room in the thesis. In general, such work has been left undone since it would have taken us too far afield and would have turned us away from the major points of this thesis. In this section, we describe some of the issues that we believe deserve to be investigated in future work.

Further enhancement of ZD

The current *ZD* has achieved fairly good accuracy as a rule-based system with surface-level heuristics and shallow processing. However, it could improve with the addition of "deeper" semantic/pragmatic processing components. Also, the semantic properties for ATN could be re-examined in a larger scale corpus evaluation, for possible adjustment.

Addition of other functions

Automatic creation of comprehension questions involving ZEROS would be of help to

teachers in their material preparation. A function that allows the user to make on-screen correction of the *ZD* output errors would also be a plus.[1]

User study

ZD was evaluated for its performance, but a user study is yet to be conducted to examine how user-friendly the current system is.

Psychological validation

Centering TRANSITION sequence-based prediction of coherence/inference was proposed according to the result of our extensive corpus analysis. The validity of these corpus-driven estimates may need to be subjected to relevant behavioral experiments as well.

Pedagogical validity

Pedagogical validity of *ZD* was theoretically discussed. Empirical justification, which normally takes another couple of years to obtain results, should naturally follow. As Holland (1995) points out, NLP-based programs tend to take a long time to develop, and they tend to remain experimental. In order to avoid this, it should be experimentally used by learners, in a well-thought-out setting, and evaluated for its impact on the acquisition of ZEROS, which in fact lies in our future agenda for collaboration with JSL teachers.

Designing/development of a TBLL-based CALL curriculum

The next desirable step would be for *ZD* to be integrated into a larger-scale CALL program or curriculum that effectively utilizes the concept of Focus on Form in a well-planned TBLL activity. The designing and development of such a system would be a promising and rewarding effort for an interdisciplinary project team.

[1] We thank Takako Aikawa for these suggestions, which she made at the ACL 2003 exhibit.

Appendix A: List of corpus sources

Corpus I

This set of corpus materials, collected from the following eight publications, was used for the comprehensive analysis of ZEROS in Japanese discourse in Chapter 4 and for the training of the zero nominal argument recognition in Chapter 6. The abbreviated names, in the left column, were used in the thesis to indicate which corpus a sample discourse segment is taken from.

[*Hiroko 1*] *Hiroko san no tanosii nihongo 1*.
Nemoto, Maki and Eiko Yashiro. Tokyo: Bonjinsha. 1986
ひろこさんの たのしい にほんご 1（凡人社）

[*Hiroko 2*] *Hiroko san no tanosii hihongo 2*.
Nemoto, Maki, Eiko Yashiro, and Yukiko Nagata. Tokyo: Bonjinsha. 1995.
ひろこさんの たのしい にほんご 2（凡人社）

[*Minna 1*] *Minna no nihongo syokyuu I: Syokyuu de yomeru topikku 25*.
Makino, Akiko, Sachiko Sawada, Akemi Shigekawa, Yone Tanaka, and Mariko Mizuno. Tokyo: 3 A Network. 2000.
みんなの日本語初級 I 初級で読めるトピック25（スリーエーネットワーク）

[*Minna 2*] *Minna no nihongo syokyuu II: Syokyuu de yomeru topikku 25*.
Makino, Akiko, Sachiko Sawada, Akemi Shigekawa, Yone Tanaka, and Mariko Mizuno. Tokyo: 3 A Network. 2001.
みんなの日本語初級 II 初級で読めるトピック25（スリーエーネットワーク）

[*Gendai*] *Gendai nihongo syokyuu soogoo kooza*
(An Integrated Course for Beginners Modern Japanese).
Mizutani, Nobuko. Tokyo: Alc. 1992.
現代日本語初級総合講座（アルク）

[*Nitizyo*] *Nitizyo seikatu ni miru nihon no bunka*
Ken Ujiie. Available online at http://home.wlu.edu/~ujiek/ (retrieved on Septempter 1, 2003)
日常生活に見る日本の文化

[*Sokudoku*] *Tyuukyuu no nihongo*
(An Integrated Approach to Intermediate Japanese).
Miura, Akira and Naomi Hanaoka McGloin. Tokyo: The Japan Times. 1994.
中級の日本語（ジャパンタイムズ）

Corpus II

This other set of corpus materials, comprising the following two publications, was used solely for the evaluation of our system, *Zero Detector*, in Chapter 6.

Gendai nihongo syokyuu soogoo kooza hatten-hen
(An Integrated Course for Beginners - Advanced Edition, Modern Japanese).
Mizutani, Nobuko and Fumie Yanashima Tokyo: Alc. 1992.
現代日本語初級総合講座　発展編（アルク）

Syanai no ziken (‘It happened on a train’)
Shinichi Hoshi, “*N-si no yuuenti*” Tokyo: Kodansya. 1971.
「車内の事件」 エヌ氏の遊園地 （講談社文庫）

Appendix B: JLPT3/4 Valency Dictionary

This is the list of 334 predicates (verbs and adjectives) and their valency pattern(s) with semantic information.

These 334 predicates are those listed in the vocabulary for the Japanese-Language Proficiency Test (JLPT) levels 3 and 4 (distributed by the Japan Foundation and Japan Educational Exchange Services in 1994, and revised in 2002). The valency patterns are largely based on the listing provided by Ishiwata and Ogino (1983) and Ishiwata (1999).

This valency dictionary is used, in *Zero Detector*, as one of the database sets for the recognition of zero verbal arguments.

1	aisatusuru	挨拶する（あいさつする）	N1 が N2 に	N1（人間） N2（人間）
2	au	合う(あう)	N1 が N2 に	N1（＊） N2（＊）
		合う(あう)	N1 が N2 と	N1（＊） N2（＊）
3	au	会う （あう）	N1 が N2 に	N1（人間） N2（人間）
		会う （あう）	N1 が N2 と	N1（人間） N2（人間）
4	aku	開く(あく)	N1 が	N1（具体）
5	aku	空く(あく)	N1 が	N1（具体）
6	akeru	開ける(あける)	N1 が N2 を	N1（人間） N2（具体）
7	ageru	上げる(あげる)	N1 が N2 を	N1（人間） N2（具体）
		上げる(あげる)	N1 が N2 を N3 に	N1（人間） N2（具体） N3（場所）
8	ageru	あげる(あげる)	N1 が N2 を N3 に	N1（人間） N2（具体） N3（人間）
9	asobu	遊ぶ(あそぶ)	N1 が	N1（人間）
10	atumaru	集まる(あつまる)	N1 が	N1（具体）
		集まる(あつまる)	N1 が N2 から N3 に	N1（具体） N2（場所） N3（場所）
		集まる(あつまる)	N1 が N2 から N3 へ	N1（具体） N2（場所） N3（場所）
		集まる(あつまる)	N1 が N2 から N3 に	N1（人間） N2（場所） N3（場所）
		集まる(あつまる)	N1 が N2 から N3 へ	N1（人間） N2（場所） N3（場所）
11	atumeru	集める(あつめる)	N1 が N2 を	N1（人間） N2（具体）
		集める(あつめる)	N1 が N2 を N3 に	N1（人間） N2（具体） N3（場所）
12	abiru	浴びる(あびる)	N1 が N2 を	N1（人間） N2（具体）
		浴びる(あびる)	N1 が N2 を N3 に	N1（人間） N2（具体） N3（具体）
13	ayamaru	謝る(あやまる)	N1 が N2 を N3 に	N1（人間） N2（抽象） N3（人間）
14	arau	洗う(あらう)	N1 が N2 を	N1（人間） N2（具体）
15	aru	在る(ある)	N1 が	N1（＊）

		在る(ある)	N1 が N2 に	N1 (*) N2 (場所)
16	aru	有る(ある)	N1 が N2 (で)	N1 (*) N2 (*)
17	aruku	歩く(あるく)	N1 が	N1 (人間)
18	ansinsuru	安心する (あんしんする)	N1 が	N1 (人間)
19	annaisuru	案内する (あんないする)	*	
20	iu	言う(いう)	N1 が	N1 (人間)
		言う(いう)	N1 が N2 を N3 に	N1 (人間) N2 (抽象) N3 (人間)
		言う(いう)	N1 が N2 に S と	N1 (人間) N2 (人間) S
21	ikiru	生きる(いきる)	N1 が	N1 (人間)
22	iku	行く(いく)	N1 が	N1 (人間)
		行く(いく)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)
		行く(いく)	N1 が N2 から N3 へ	N1 (人間) N2 (場所) N3 (場所)
		行く(いく)	N1 が N2 から N3 に	N1 (具体) N2 (場所) N3 (場所)
		行く(いく)	N1 が N2 から N3 へ	N1 (具体) N2 (場所) N3 (場所)
23	igimeru	苛める(いじめる)	N1 が N2 を	N1 (人間) N2 (人間)
24	isogu	急ぐ(いそぐ)	N1 が	N1 (人間)
		急ぐ(いそぐ)	N1 が N2 を	N1 (人間) N2 (行為)
25	itasu	致す(いたす)	N1 が N2 を	N1 (人間) N2 (行為)
26	itadaku	頂く(いただく)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (人間)
		頂く(いただく)	N1 が N2 を N3 から	N1 (人間) N2 (具体) N3 (人間)
27	inoru	祈る(いのる)	N1 が N2 を	N1 (人間) N2 (抽象)
		祈る(いのる)	N1 が N を N3 に	N1 (人間) N2 (抽象) N3 (人間)
		祈る(いのる)	N1 が N2 に S と	N1 (人間) N2 (人間) S
28	irassyaru	いらっしゃる (いらっしゃる)	N1 が N2 に	N1 (人間) N2 (場所)
		いらっしゃる (いらっしゃる)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)
29	iru	居る(いる)	N1 が	N1 (人間 動物)
		居る(いる)	N1 が N2 に	N1 (人間 動物) N2 (場所)
30	iru	要る(いる)	N1 が	N1 (*)
31	ireru	入れる(いれる)	N1 が N2 を	N1 (人間) N2 (具体)
		入れる(いれる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
32	ueru	植える(うえる)	N1 が N2 を	N1 (人間) N2 (具体)
		植える(うえる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (場所)
33	ukagau	伺う(うかがう)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)
34	ukagau	伺う(うかがう)	N1 が N2 を N3 に	N1 (人間) N2 (行為) N3 (人間)
		伺う(うかがう)	N1 が N2 を N3 から	N1 (人間) N2 (行為) N3 (人間)
35	ukeru	受ける(うける)	N1 が N2 を	N1 (人間) N2 (具体)
36	ugoku	動く(うごく)	N1 が	N1 (具体)
		動く(うごく)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)

		動く(うごく)	N1 が N2 から N3 へ	N1 (人間) N2 (場所) N3 (場所)
		動く(うごく)	N1 が N2 から N3 に	N1 (具体) N2 (場所) N3 (場所)
		動く(うごく)	N1 が N2 から N3 へ	N1 (具体) N2 (場所) N3 (場所)
37	utau	歌う(うたう)	N1 が N2 を	N1 (人間) N2 (抽象)
38	utu	打つ(うつ)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
39	utusu	移す(うつす)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (場所)
40	uturu	移る(うつる)	N1 が	N1 (具体)
		移る(うつる)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)
		移る(うつる)	N1 が N2 から N3 へ	N1 (人間) N2 (場所) N3 (場所)
		移る(うつる)	N1 が N2 から N3 に	N1 (具体) N2 (場所) N3 (場所)
41	umareru	生まれる(うまれる)	N1 が	N1 (動物)
		生まれる(うまれる)	N1 が	N1 (具体)
42	uru	売る(うる)	N1 が N2 を	N1 (人間) N2 (具体)
		売る(うる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (人間)
43	untensuru	運転する (うんてんする)	N1 が N2 を	N1 (人間) N2 (具体)
44	undoosuru	運動する (うんどうする)	N1 が	N1 (人間)
45	erabu	選ぶ(えらぶ)	N1 が N2 を N3 に	N1 (人間) N2 (*) N3 (*)
		選ぶ(えらぶ)	N1 が N2 を N3 に	N1 (人間) N2 (人間) N3 (人間)
46	enryosuru	遠慮する (えんりょする)	N1 が	N1 (人間)
47	oideninaru	おいでになる (おいでになる)	N1 が	N1 (人間)
		おいでになる (おいでになる)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)
		おいでになる (おいでになる)	N1 が N2 から N3 へ	N1 (人間) N2 (場所) N3 (場所)
48	okiru	起きる(おきる)	N1 が	N1 (動物)
49	oku	置く(おく)	N1 が N2 を	N1 (人間) N2 (具体)
		置く(おく)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (場所)
50	okuru	送る(おくる)	N1 が N2 を N3 に	N1 (人間) N2 (人間) N3 (人間)
		送る(おくる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (場所)
51	okureru	遅れる(おくれる)	N1 が	N1 (行為)
		遅れる(おくれる)	N1 が N2 に	N1 (*) N2 (*)
52	okosu	起こす(おこす)	N1 が N2 を	N1 (人間) N2 (具体)
53	okonau	行う(おこなう)	N1 が N2 を	N1 (人間) N2 (行為)
54	okoru	怒る(おこる)	N1 が N2 を	N1 (人間) N2 (人間)
55	osieru	教える(おしえる)	N1 が	N1 (人間)
		教える(おしえる)	N1 が N2 を	N1 (人間) N2 (抽象)
		教える(おしえる)	N1 が N2 を N3 に	N1 (人間) N2 (抽象) N3 (人間)
		教える(おしえる)	N1 が N2 に S と	N1 (人間) N2 (人間) S
56	osu	押す(おす)	N1 が N2 を	N1 (人間) N2 (具体)
57	otiru	落ちる(おちる)	N1 が	N1 (抽象)

		落ちる(おちる)	N1 が N2 から N3 に	N1(人間) N2(場所) N3(場所)
		落ちる(おちる)	N1 が N2 から N3 へ	N1(人間) N2(場所) N3(場所)
		落ちる(おちる)	N1 が N2 から N3 に	N1(具体) N2(場所) N3(場所)
		落ちる(おちる)	N1 が N2 から N3 へ	N1(具体) N2(場所) N3(場所)
58	ossyaru	おっしゃる(おっしゃる)	N1 が	N1(人間)
		おっしゃる(おっしゃる)	N1 が N2 を N3 に	N1(人間) N2(抽象) N3(人間)
		おっしゃる(おっしゃる)	N1 が N2 に S と	N1(人間) N2(人間) S
59	otosu	落とす(おとす)	N1 が N2 を N3 に	N1(人間) N2(具体) N3(場所)
60	odoru	踊る(おどる)	N1 が	N1(人間)
61	odoroku	驚く(おどろく)	N1 が N2 に	N1(人間) N2(*)
62	oboeru	覚える(おぼえる)	N1 が N2 を	N1(人間) N2(*)
63	omoidasu	思い出す(おもいだす)	N1 が N2 を	N1(人間) N2(*)
64	omou	思う(おもう)	N1 が N2 を	N1(人間) N2(*)
		思う(おもう)	N1 が N2 を N3 と	N1(人間) N2(*) N3(*)
65	oyogu	泳ぐ(およぐ)	N1 が	N1(動物)
66	oriru	降りる(おりる)	N1 が N2 を	N1(人間) N2(具体)
		降りる(おりる)	N1 が N2 から N3 に	N1(人間) N2(場所) N3(場所)
		降りる(おりる)	N1 が N2 から N3 へ	N1(人間) N2(場所) N3(場所)
		降りる(おりる)	N1 が N2 から N3 に	N1(具体) N2(場所) N3(場所)
		降りる(おりる)	N1 が N2 から N3 へ	N1(具体) N2(場所) N3(場所)
67	oriru	下りる(おりる)	N1 が	N1(抽象)
		下りる(おりる)	N1 が N2 から N3 に	N1(人間) N2(場所) N3(場所)
		下りる(おりる)	N1 が N2 から N3 へ	N1(人間) N2(場所) N3(場所)
		下りる(おりる)	N1 が N2 から N3 に	N1(具体) N2(場所) N3(場所)
		下りる(おりる)	N1 が N2 から N3 へ	N1(具体) N2(場所) N3(場所)
68	oru	おる(おる)	N1 が	N1(人間)
69	oreru	折れる(おれる)	N1 が	N1(具体)
70	owaru	終わる(おわる)	N1 が	N1(行為)
		終わる(おわる)	N1 が N2 を	N1(人間) N2(行為)
71	kau	買う(かう)	N1 が N2 を	N1(人間) N2(具体)
		買う(かう)	N1 が N2 を N3 に	N1(人間) N2(具体) N3(人間)
		買う(かう)	N1 が N2 を N3 から	N1(人間) N2(具体) N3(人間)
72	kaesu	返す(かえす)	N1 が N2 を N3 に	N1(人間) N2(具体) N3(人間)
73	kaeru	帰る(かえる)	N1 が	N1(人間)
		帰る(かえる)	N1 が N2 から N3 に	N1(人間) N2(場所) N3(場所)
		帰る(かえる)	N1 が N2 から N3 へ	N1(人間) N2(場所) N3(場所)
		帰る(かえる)	N1 が N2 から N3 に	N1(具体) N2(場所) N3(場所)
		帰る(かえる)	N1 が N2 から N3 へ	N1(具体) N2(場所) N3(場所)

74	kaeru	変える(かえる)	N1 が N2 を	N1 (人間) N2 (具体)
		変える(かえる)	N1 が N2 を N3 から N4 に	N1 (人間) N2 (具体) N3 (具体) N4(具体)
		変える(かえる)	N1 が N2 を N3 から N4 と	N1 (人間) N2 (具体) N3 (具体) N4(具体)
75	kakaru	かかる(かかる)	N1 が	N1 (*)
		かかる(かかる)	N1 が N2 に	N1 (具体) N2 (具体)
76	kaku	書く(かく)	N1 が N2 を	N1 (人間) N2 (抽象)
		書く(かく)	N1 が N2 を N3 に	N1 (人間) N2 (抽象) N3 (具体)
		書く(かく)	N1 が N2 を N3 に	N1 (人間) N2 (抽象) N3 (人間)
		書く(かく)	N1 が N2 に S と	N1 (人間) N2 (具体) S
		書く(かく)	N1 が N2 に S と	N1 (人間) N2 (人間) S
77	kakeru	かける(かける)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
78	kakeru	かける(かける)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (人間)
79	kakeru	掛ける(かける)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
80	kakeru	かける(かける)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
81	kakeru	かける(かける)	N1 が N2 を N3 に	N1 (人間) N2 (抽象) N3 (人間)
82	kazaru	飾る(かざる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
83	kasu	貸す(かす)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (人間)
84	katazukeru	片付ける(かたづける)	N1 が N2 を	N1 (人間) N2 (具体)
85	katu	勝つ(かつ)	N1 が N2 に	N1 (人間) N2 (抽象)
		勝つ(かつ)	N1 が N2 に	N1 (人間) N2 (人間)
86	kaburu	貸す(かす)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
87	kamau	構う(かまう)	N1 が N2 を	N1 (人間) N2 (人間)
88	kayou	通う(かよう)	N1 が N2 に	N1 (人間) N2 (場所)
		通う(かよう)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)
		通う(かよう)	N1 が N2 から N3 へ	N1 (人間) N2 (場所) N3 (場所)
		通う(かよう)	N1 が N2 から N3 に	N1 (具体) N2 (場所) N3 (場所)
		通う(かよう)	N1 が N2 から N3 へ	N1 (具体) N2 (場所) N3 (場所)
89	kariru	借りる(かりる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (人間)
		借りる(かりる)	N1 が N2 を N3 から	N1 (人間) N2 (具体) N3 (人間)
90	kawaku	乾く(かわく)	N1 が	N1 (具体)
91	kawaru	変わる(かわる)	N1 が N2 に	N1 (*) N2 (*)
92	kangaeru	考える(かんがえる)	N1 が S と	N1 (人間) S
		考える(かんがえる)	N1 が N2 を N3 と	N1 (人間) N2 (*) N3 (*)
93	ganbaru	頑張る(がんばる)	N1 が	N1 (人間)
		頑張る(がんばる)	N1 が N2 に	N1 (人間) N2 (行為)
94	kieru	消える(きえる)	N1 が	N1 (具体)

		消える(きえる)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)
		消える(きえる)	N1 が N2 から N3 へ	N1 (具体) N2 (場所) N3 (場所)
95	kiku	聞く(きく)	N1 が N2 を	N1 (人間) N2 (行為)
96	kikoeru	聞こえる(きこえる)	N1 が	N1 (具体)
97	kimaru	決まる(きまる)	N1 が N2 に	N1 (*) N2 (*)
		決まる(きまる)	N1 が N2 と	N1 (*) N2 (*)
98	kimeru	決める(きめる)	N1 が N2 を N3 に	N1 (人間) N2 (*) N3 (*)
		決める(きめる)	N1 が N2 を N3 と	N1 (人間) N2 (*) N3 (*)
99	kyoosoosuru	競争する (きょうそうする)	N1 が	N1 (人間)
		競争する (きょうそうする)	N1 が N2 と	N1 (人間) N2 (行為)
100	kiru	切る(きる)	N1 が N2 を	N1 (人間) N2 (具体)
101	kiru	着る(きる)	N1 が N2 を	N1 (人間) N2 (具体)
102	kudasaru	下さる(くださる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (人間)
		下さる(くださる)	N1 から N2 を N3 に	N1 (人間) N2 (具体) N3 (人間)
103	kumoru	曇る(くもる)	N1 が	N1 (具体)
104	kuraberu	比べる(くらべる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
		比べる(くらべる)	N1 が N2 を N3 と	N1 (人間) N2 (具体) N3 (具体)
105	kuru	来る(くる)	N1 が	N1 (具体)
		来る(くる)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)
		来る(くる)	N1 が N2 から N3 へ	N1 (人間) N2 (場所) N3 (場所)
		来る(くる)	N1 が N2 から N3 に	N1 (具体) N2 (場所) N3 (場所)
		来る(くる)	N1 が N2 から N3 へ	N1 (具体) N2 (場所) N3 (場所)
106	kureru	くれる(くれる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (人間)
		くれる(くれる)	N1 から N2 を N3 に	N1 (人間) N2 (具体) N3 (人間)
107	kureru	暮れる(くれる)	N1 が	N1 (時)
108	keikakusuru	計画する (けいかくする)	N1 が N2 を	N1 (人間) N2 (行為)
109	keikensuru	経験する (けいけんする)	N1 が N2 を	N1 (人間) N2 (*)
110	kegasuru	怪我する(けがする)	N1 が	N1 (人間)
111	gesyukusuru	下宿する (げしゅくする)	N1 が N2 に	N1 (人間) N2 (場所)
112	kesu	消す(けす)	N1 が N2 を	N1 (人間) N2 (具体)
113	kekkonsuru	結婚する (けっこんする)	N1 が	N1 (人間)
		結婚する (けっこんする)	N1 が N2 と	N1 (人間) N2 (人間)
114	kenkasuru	喧嘩する(けんかする)	N1 が	N1 (人間)
		喧嘩する(けんかする)	N1 が N2 と	N1 (人間) N2 (人間)
115	kenkyuusuru	研究する (けんきゅうする)	N1 が N2 を	N1 (人間) N2 (抽象)
		研究する (けんきゅうする)	N1 が N2 を	N1 (人間) N2 (具体)
116	kengutusuru	見物する (けんぶつする)	N1 が N2 を	N1 (人間) N2 (具体)
117	kosyoosuru	故障する (こしょうする)	N1 が	N1 (具体)

118	kotaeru	答える(こたえる)	N1 が	N1 (人間)
		答える(こたえる)	N1 が N2 に	N1 (人間) N2 (行為)
		答える(こたえる)	N1 が N2 に	N1 (＊) N2 (行為)
119	komaru	困る(こまる)	N1 が	N1 (人間)
		困る(こまる)	N1 が N2 に	N1 (人間) N2 (＊)
120	komu	込む(こむ)	N1 が	N1 (具体)
121	kopiisuru	コピーする (こぴーする)	N1 が N2 を	N1 (人間) N2 (具体)
122	goranninaru	ご覧になる (ごらんになる)	N1 が N2 を	N1 (人間) N2 (具体)
123	kowasu	壊す(こわす)	N1 が N2 を	N1 (人間) N2 (具体)
124	kowareru	壊れる(こわれる)	N1 が	N1 (具体)
125	sagasu	探す(さがす)	N1 が N2 を	N1 (人間) N2 (具体)
126	sagaru	下がる(さがる)	N1 が	N1 (抽象)
		下がる(さがる)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)
		下がる(さがる)	N1 が N2 から N3 へ	N1 (人間) N2 (場所) N3 (場所)
		下がる(さがる)	N1 が N2 から N3 に	N1 (具体) N2 (場所) N3 (場所)
		下がる(さがる)	N1 が N2 から N3 へ	N1 (具体) N2 (場所) N3 (場所)
127	saku	咲く(さく)	N1 が	N1 (具体)
128	sageru	下げる(さげる)	N1 が N2 を	N1 (人間) N2 (具体)
		下げる(さげる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (場所)
129	sasiageru	差し上げる (さしあげる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (人間)
130	sasu	さす(さす)	N1 が N2 を	N1 (人間) N2 (具体)
131	sawagu	騒ぐ(さわぐ)	N1 が	N1 (人間)
132	sawaru	触る(さわる)	N1 が N2 に	N1 (人間) N2 (具体)
133	sanposuru	散歩する(さんぽする)	N1 が	N1 (人間)
134	sikaru	叱る(しかる)	N1 が N2 を	N1 (人間) N2 (人間)
135	sitakusuru	支度する(したくする)	N1 が	N1 (人間)
136	sippaisuru	失敗する (しっぱいする)	N1 が	N1 (行為)
		失敗する (しっぱいする)	N1 が N2 に	N1 (人間) N2 (行為)
137	situreisuru	失礼する (しつれいする)	N1 が	N1 (人間)
138	sinu	死ぬ(しぬ)	N1 が	N1 (動物)
		死ぬ(しぬ)	N1 が	N1 (具体)
139	simaru	閉まる(しまる)	N1 が	N1 (具体)
140	simeru	閉める(しめる)	N1 が N2 を	N1 (人間) N2 (具体)
141	simeru	締める(しめる)	N1 が N2 を	N1 (人間) N2 (具体)
142	syussekisuru	出席する (しゅっせきする)	N1 が N2 に	N1 (人間) N2 (行為)
143	syuppatusuru	出発する (しゅっぱつする)	N1 が N2 を	N1 (人間) N2 (場所)
		出発する (しゅっぱつする)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)
144	zynbisuru	準備する (じゅんびする)	N1 が N2 に	N1 (人間) N2 (抽象)

		準備する（じゅんびする）	N1 が N2 に	N1（人間） N2（具体）
145	syookaisuru	紹介する（しょうかいする）	N1 が N2 を N3 に	N1（人間） N2（抽象） N3（人間）
		紹介する(しょうかいする)	N1 が N2 を N3 に	N1（人間） N2（具体） N3（人間）
		紹介する（しょうかいする）	N1 が N2 を N3 に	N1（人間） N2（人間） N3（人間）
146	syootaisuru	招待する（しょうたいする）	N1 が N2 を N3 に	N1（人間） N2（人間） N3（場所）
147	syootisuru	承知する（しょうちする）	N1 が N2 を	N1（人間） N2（行為）
148	syokuzisuru	食事する（しょくじする）	N1 が	N1（人間）
149	siraseru	知らせる(しらせる)	N1 が N2 を N3 に	N1（人間） N2（抽象） N3（人間）
		知らせる(しらせる)	N1 が N2 に N3 と	N1（人間） N2（人間） N3（抽象）
150	siraberu	調べる(しらべる)	N1 が N2 を	N1（人間） N2（＊）
151	siru	知る(しる)	N1 が	N1（人間）
		知る(しる)	N1 が S と	N1（人間） S
		知る(しる)	N1 が N2 を N3 と	N1（人間） N2（＊） N2（＊）
152	sinpaisuru	心配する（しんぱいする）	N1 が N2 を	N1（人間） N2（抽象）
		心配する（しんぱいする）	N1 が S と	N1（人間） S
153	suu	吸う(すう)	N1 が N2 を	N1（人間） N2（具体）
154	sugiru	過ぎる(すぎる)	N1 が	N1（時）
		過ぎる(すぎる)	N1 が N2 を	N1（人間） N2（場所）
155	suku	空く(すく)	N1 が N2 が	N1（人間） N2（具体）
156	suku	空く(すく)	N1 が	N1（具体）
157	susumu	進む(すすむ)	N1 が	N1（抽象）
		進む(すすむ)	N1 が N2 から N3 に	N1（人間） N2（場所） N3（場所）
		進む(すすむ)	N1 が N2 から N3 へ	N1（人間） N2（場所） N3（場所）
		進む(すすむ)	N1 が N2 から N3 に	N1（具体） N2（場所） N3（場所）
		進む(すすむ)	N1 が N2 から N3 へ	N1（具体） N2（場所） N3（場所）
158	suteru	捨てる(すてる)	N1 が N2 を	N1（人間） N2（具体）
		捨てる(すてる)	N1 が N2 を N3 に	N1（人間） N2（具体） N3（場所）
159	suberu	滑る(すべる)	N1 が	N1（具体）
		滑る(すべる)	N1 が N2 を	N1（具体） N2（場所）
160	sumu	住む(すむ)	N1 が N2 に	N1（人間） N2（場所）
161	sumu	済む(すむ)	N1 が	N1（行為）
162	suru	する(する)	N1 が N2 を	N1（人間） N2（行為）
163	suwaru	座る(すわる)	N1 が	N1（人間）
		座る(すわる)	N1 が N2 に	N1（人間） N2（場所）
164	seikatusuru	生活する（せいかつする）	N1 が	N1（人間）
165	seisansuru	生産する（せいさんする）	N1 が N2 を	N1（人間） N2（具体）
166	sewasuru	世話する(せわする)	N1 が N2 を	N1（人間） N2（動物）
167	sensoosuru	戦争する（せんそうする）	N1 が	N1（人間）

168	sentakusuru	洗濯する（せんたくする）	N1 が	N1（人間）
169	soozisuru	掃除する（そうじする）	N1 が	N1（人間）
170	soodansuru	相談する（そうだんする）	N1 が N2 に	N1（人間） N2（人間）
		相談する（そうだんする）	N1 が N2 と	N1（人間） N2（人間）
171	sodateru	育てる（そだてる）	N1 が N2 を	N1（人間） N2（動物）
		育てる（そだてる）	N1 が N2 を	N1（人間） N2（具体）
172	sotugyoosuru	卒業する（そつぎょうする）	N1 が N2 を	N1（人間） N2（場所）
173	taiinsuru	退院する（たいいんする）	N1 が	N1（人間）
174	taoreru	倒れる（たおれる）	N1 が	N1（具体）
		倒れる（たおれる）	N1 が N2 に	N1（具体） N2（場所）
175	tasu	足す（たす）	N1 が N2 を N3 に	N1（人間） N2（数） N3（数）
		足す（たす）	N1 が N2 を N3 と	N1（人間） N2（数） N3（数）
176	dasu	出す（だす）	N1 が N2 を	N1（人間） N2（具体）
		出す（だす）	N1 が N2 を N3 に	N1（人間） N2（具体） N3（場所）
177	tazuneru	訪ねる（たずねる）	N1 が N2 を	N1（人間） N2（人間）
178	tazuneru	尋ねる（たずねる）	N1 が N2 を N3 に	N1（人間） N2（抽象） N3（人間）
		尋ねる（たずねる）	N1 が N2 に S と	N1（人間） N2（人間） S
179	tatu	立つ（たつ）	N1 が	N1（人間）
		立つ（たつ）	N1 が N2 に	N1（人間） N2（場所）
180	tateru	立てる（たてる）	N1 が N2 を N3 に	N1（人間） N2（具体） N3（場所）
181	tateru	建てる（たてる）	N1 が N2 を N3 に	N1（人間） N2（具体） N3（場所）
182	tanosimu	楽しむ（たのしむ）	N1 が N2 を	N1（人間） N2（＊）
183	tanomu	頼む（たのむ）	N1 が N2 を N3 に	N1（人間） N2（行為） N3（人間）
184	taberu	食べる（たべる）	N1 が N2 を	N1（人間） N2（具体）
185	tariru	足りる（たりる）	N1 が	N1（＊）
186	tyekkusuru	チェックする（ちぇっくする）	N1 が N2 を	N1（人間） N2（具体）
187	tigau	違う（ちがう）	N1 が N2 と	N1（＊） N2（＊）
188	tyuuisuru	注意する（ちゅういする）	N1 が N2 を	N1（人間） N2（＊）
189	tyuusisuru	中止する（ちゅうしする）	N1 が N2 を	N1（人間） N2（行為）
190	tyuusyasuru	注射する（ちゅうしゃする）	N1 が N2 に	N1（人間） N2（人間）
191	tukau	使う（つかう）	N1 が N2 を	N1（人間） N2（具体）
192	tukamaeru	捕まえる（つかまえる）	N1 が N2 を	N1（人間） N2（具体）
193	tukareru	疲れる（つかれる）	N1 が	N1（動物）
194	tuku	着く（つく）	N1 が N2 に	N1（具体） N2（場所）
195	tuku	点く（つく）	N1 が	N1（具体）
196	tukuru	作る（つくる）	N1 が N2 を	N1（人間） N2（具体）
197	tukeru	点ける（つける）	N1 が N2 を N3 に	N1（人間） N2（具体） N3（具体）
198	tukeru	付ける（つける）	N1 が N2 を N3 に	N1（人間） N2（具体） N3（具体）

199	tukeru	漬ける(つける)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
200	tutaeru	伝える(つたえる)	N1 が N2 を N3 に	N1 (人間) N2 (抽象) N3 (人間)
		伝える(つたえる)	N1 が N2 に S と	N1 (人間) N2 (人間) S
201	tuzuku	続く(つづく)	N1 が	N1 (行為)
		続く(つづく)	N1 が	N1 (具体)
202	tuzukeru	続ける(つづける)	N1 が N2 を	N1 (人間) N2 (行為)
203	tutumu	包む(つつむ)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
204	tutomeru	勤める(つとめる)	N1 が N2 に	N1 (人間) N2 (場所)
205	turu	釣る(つる)	N1 が N2 を	N1 (人間) N2 (動物)
206	tureru	連れる(つれる)	N1 が N2 を	N1 (人間) N2 (人間)
207	dekakeru	出かける(でかける)	N1 が	N1 (人間)
208	dekiru	出来る(できる)	N1 が N2 が	N1 (人間) N2 (行為)
		出来る(できる)	N1 が N2 に	N1 (行為) N2 (人間)
209	dekiru	できる(できる)	N1 が N2 に	N1 (＊) N2 (場所)
		できる(できる)	N1 が N2 で	N1 (具体) N2 (具体)
210	tetudau	手伝う(てつだう)	N1 が N2 を	N1 (人間) N2 (行為)
211	deru	出る(でる)	N1 が	N1 (具体)
		出る(でる)	N1 が N2 に	N1 (具体) N2 (場所)
212	tooru	通る(とおる)	N1 が	N1 (抽象)
		通る(とおる)	N1 が N2 に	N1 (人間) N2 (抽象)
		通る(とおる)	N1 が N2 を	N1 (具体) N2 (場所)
		通る(とおる)	N1 が N2 を	N1 (人間) N2 (場所)
213	todokeru	届ける(とどける)	N1 が N を N3 に	N1 (人間) N2 (具体) N3 (場所)
214	tobu	飛ぶ(とぶ)	N1 が	N1 (具体)
		飛ぶ(とぶ)	N1 が N2 を	N1 (具体) N2 (場所)
		飛ぶ(とぶ)	N1 が N2 から N3 に	N1 (具体) N2 (場所) N3 (場所)
		飛ぶ(とぶ)	N1 が N2 から N3 へ	N1 (具体) N2 (場所) N3 (場所)
215	tomaru	止まる(とまる)	N1 が	N1 (具体)
216	tomaru	泊まる(とまる)	N1 が N2 に	N1 (人間) N2 (場所)
217	tomeru	止める(とめる)	N1 が N2 を	N1 (人間) N2 (具体)
		止める(とめる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (場所)
218	torikaeru	取り替える (とりかえる)	N1 が N2 を	N1 (人間) N2 (具体)
		取り替える (とりかえる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
		取り替える (とりかえる)	N1 が N2 を N3 と	N1 (人間) N2 (具体) N3 (具体)
219	toru	取る(とる)	N1 が N2 を	N1 (人間) N2 (具体)
220	toru	撮る(とる)	N1 が N2 を	N1 (人間) N2 (抽象)
221	naosu	直す(なおす)	N1 が N2 を	N1 (人間) N2 (具体)
222	naoru	直る(なおる)	N1 が	N1 (具体)

223	naoru	治る(なおる)	N1 が N2 が	N1 (動物) N2 (抽象)
224	naku	鳴く(なく)	N1 が	N1 (動物)
225	naku	泣く(なく)	N1 が	N1 (人間)
226	nakusu	無くす(なくす)	N1 が N2 を	N1 (人間) N2 (具体)
227	nakunaru	無くなる(なくなる)	N1 が	N1 (具体)
228	nakunaru	亡くなる(なくなる)	N1 が	N1 (人間)
229	negeru	投げる(なげる)	N1 が N2 を	N1 (人間) N2 (具体)
		投げる(なげる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (場所)
230	nasaru	なさる(なさる)	N1 が N2 を	N1 (人間) N2 (行為)
231	narau	習う(ならう)	N1 が N2 を	N1 (人間) N2 (行為)
		習う(ならう)	N1 が N2 を N3 に	N1 (人間) N2 (行為) N3 (人間)
		習う(ならう)	N1 が N2 を N3 から	N1 (人間) N2 (行為) N3 (人間)
		習う(ならう)	N1 が N2 に S と	N1 (人間) N2 (人間) S
		習う(ならう)	N1 が S と N1 から	N1 (人間) S N2 (人間)
232	narabu	並ぶ(ならぶ)	N1 が	N1 (具体)
233	naraberu	並べる(ならべる)	N1 が N2 を	N1 (人間) N2 (具体)
		並べる(ならべる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (場所)
234	naru	なる(なる)	N1 が N2 に	N1 (*) N2 (*)
		なる(なる)	N1 が N2 と	N1 (*) N2 (*)
235	naru	鳴る(なる)	N1 が	N1 (具体)
236	nareru	慣れる(なれる)	N1 が N2 に	N1 (人間) N2 (抽象)
237	nigeru	逃げる(にげる)	N1 が	N1 (具体)
		逃げる(にげる)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)
		逃げる(にげる)	N1 が N2 から N3 へ	N1 (人間) N2 (場所) N3 (場所)
		逃げる(にげる)	N1 が N2 から N3 に	N1 (具体) N2 (場所) N3 (場所)
		逃げる(にげる)	N1 が N2 から N3 へ	N1 (具体) N2 (場所) N3 (場所)
238	nyuuinsuru	入院する (にゅういんする)	N1 が	N1 (人間)
239	nyugakusuru	入学する (にゅうがくする)	N1 が	N1 (人間)
240	niru	似る(にる)	N1 が N2 に	N1 (*) N2 (*)
		似る(にる)	N1 が N2 と	N1 (*) N2 (*)
241	nugu	脱ぐ(ぬぐ)	N1 が N2 を	N1 (人間) N2 (具体)
242	nusumu	盗む(ぬすむ)	N1 が N2 を N3 から	N1 (人間) N2 (具体) N3 (人間)
243	nuru	塗る(ぬる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
244	nureru	濡れる(ぬれる)	N1 が	N1 (具体)
245	nemuru	眠る(ねむる)	N1 が	N1 (動物)
246	neru	寝る(ねる)	N1 が	N1 (動物)
247	nokoru	残る(のこる)	N1 が N2 に	N1 (具体) N2 (場所)
248	noboru	登る(のぼる)	N1 が N2 を	N1 (人間) N2 (場所)

		登る(のぼる)	N1 が N2 を	N1(具体) N2(場所)
		登る(のぼる)	N1 が N2 から N3 に	N1(人間) N2(場所) N3(場所)
		登る(のぼる)	N1 が N2 から N3 へ	N1(人間) N2(場所) N3(場所)
		登る(のぼる)	N1 が N2 から N3 に	N1(具体) N2(場所) N3(場所)
		登る(のぼる)	N1 が N2 から N3 へ	N1(具体) N2(場所) N3(場所)
249	nomu	飲む(のむ)	N1 が N2 を	N1(人間) N2(具体)
250	norikaeru	乗り換える (のりかえる)	N1 が N2 を	N1(人間) N2(具体)
251	noru	乗る(のる)	N1 が N2 に	N1(人間) N2(具体)
252	haikensuru	拝見する (はいけんする)	N1 が N2 を	N1(人間) N2(具体)
253	hairu	入る(はいる)	N1 が N2 に	N1(具体) N2(具体)
254	haku	履く(はく)	N1 が N2 を	N1(人間) N2(具体)
255	hakobu	運ぶ(はこぶ)	N1 が N2 を N3 に	N1(人間) N2(具体) N3(場所)
256	hazimaru	始まる(はじまる)	N1 が	N1(行為)
257	hajimeru	始める(はじめる)	N1 が N2 を	N1(人間) N2(行為)
258	hasiru	走る(はしる)	N1 が	N1(具体)
		走る(はしる)	N1 が N2 を	N1(具体) N2(場所)
		走る(はしる)	N1 が N2 から N3 まで	N1(具体) N2(場所) N3(場所)
259	hataraku	働く(はたらく)	N1 が	N1(人間)
260	hanasu	話す(はなす)	N1 が N2 を	N1(人間) N2(抽象)
		話す(はなす)	N1 が N2 を N3 に	N1(人間) N2(抽象) N3(人間)
		話す(はなす)	N1 が N2 に S と	N1(人間) N2(人間) S
261	harau	払う(はらう)	N1 が N2 を	N1(人間) N2(具体)
		払う(はらう)	N1 が N2 を N3 に	N1(人間) N2(具体) N3(人間)
262	haru	貼る(はる)	N1 が N2 を	N1(人間) N2(具体)
263	hareru	晴れる(はれる)	N1 が	N1(具体)
264	hantaisuru	反対する (はんたいする)	N1 が N2 に	N1(人間) N2(抽象)
265	hieru	冷える(ひえる)	N1 が	N1(具体)
266	hikaru	光る(ひかる)	N1 が	N1(具体)
267	hiku	引く(ひく)	N1 が N2 を	N1(人間) N2(具体)
268	hiku	弾く(ひく)	N1 が N2 を	N1(人間) N2(具体)
269	bikkurisuru	びっくりする (びっくりする)	N1 が	N1(人間)
270	hikkosu	引っ越す(ひっこす)	N1 が	N1(具体)
		引っ越す(ひっこす)	N1 が N2 から N3 に	N1(具体) N2(場所) N3(場所)
		引っ越す(ひっこす)	N1 が N2 から N3 へ	N1(具体) N2(場所) N3(場所)
271	hiraku	開く(ひらく)	N1 が	N1(具体)
		開く(ひらく)	N1 が N2 を	N1(人間) N2(具体)
272	hirou	拾う(ひろう)	N1 が N2 を	N1(人間) N2(具体)
273	hueru	増える(ふえる)	N1 が	N1(*)

274	huku	吹く(ふく)	N1 が N2 を	N1 (人間) N2 (具体)
275	hutoru	太る(ふとる)	N1 が	N1 (動物)
276	humu	踏む(ふむ)	N1 が N2 を	N1 (人間) N2 (具体)
277	huru	降る(ふる)	N1 が	N1 (具体)
278	benkyoosuru	勉強する(べんきょうする)	N1 が N2 を	N1 (人間) N2 (抽象)
279	hengisuru	返事する(へんじする)	N1 が	N1 (人間)
		返事する(へんじする)	N1 が N2 に	N1 (人間) N2 (人間)
280	hoosoosuru	放送する (ほうそうする)	N1 が N2 を	N1 (人間) N2 (抽象)
281	homeru	褒める(ほめる)	N1 が N2 を	N1 (人間) N2 (人間)
282	honyakusuku	翻訳する (ほんやくする)	N1 が N2 を	N1 (人間) N2 (抽象)
283	magaru	曲がる(まがる)	N1 が	N1 (具体)
		曲がる(まがる)	N1 が N2 を	N1 (具体) N2 (場所)
284	makeru	負ける(まける)	N1 が N2 に	N1 (人間) N2 (抽象)
		負ける(まける)	N1 が N2 に	N1 (人間) N2 (人間)
285	matigaeru	間違える(まちがえる)	N1 が N2 を	N1 (人間) N2 (*)
286	matu	待つ(まつ)	N1 が N2 を	N1 (人間) N2 (人間)
287	maniau	間に合う(まにあう)	N1 が N2 に	N1 (人間) N2 (*)
288	mawaru	回る(まわる)	N1 が	N1 (具体)
289	mieru	見える(みえる)	N1 が N2 に	N1 (具体) N2 (人間)
		見える(みえる)	N1 が N2 に	N1 (具体) N2 (場所)
290	migaku	磨く(みがく)	N1 が N2 を	N1 (人間) N2 (具体)
291	miseru	見せる(みせる)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (人間)
292	mitukaru	見つかる(みつかる)	N1 が	N1 (*)
293	mitukeru	見つける(みつける)	N1 が N2 を	N1 (人間) N2 (*)
294	miru	見る(みる)	N1 が N2 を	N1 (人間) N2 (具体)
295	mukau	向かう(むかう)	N1 が N2 に	N1 (*) N2 (*)
296	mukaeru	迎える(むかえる)	N1 が N2 を	N1 (人間) N2 (人間)
		迎える(むかえる)	N1 が N2 を N3 に	N1 (人間) N2 (人間) N3 (場所)
297	mesiagaru	召し上がる (めしあがる)	N1 が N2 を	N1 (人間) N2 (具体)
298	moosiageru	申し上げる (もうしあげる)	N1 が N2 を	N1 (人間) N2 (抽象)
299	moosu	申す(もうす)	N1 が N2 と	N1 (人間) N2 (人間)
300	motu	持つ(もつ)	N1 が N2 を	N1 (人間) N2 (抽象)
		持つ(もつ)	N1 が N2 を	N1 (人間) N2 (具体)
		持つ(もつ)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (具体)
301	modoru	戻る(もどる)	N1 が	N1 (具体)
		戻る(もどる)	N1 が N2 から N3 に	N1 (人間) N2 (場所) N3 (場所)
		戻る(もどる)	N1 が N2 から N3 へ	N1 (人間) N2 (場所) N3 (場所)
		戻る(もどる)	N1 が N2 から N3 に	N1 (具体) N2 (場所) N3 (場所)

		戻る(もどる)	N1 が N2 から N3 へ	N1 (具体)　N2 (場所)　N3 (場所)
302	morau	もらう(もらう)	N1 が N2 を N3 に	N1 (人間)　N2 (具体)　N3 (人間)
		もらう(もらう)	N1 が N2 を N3 から	N1 (人間)　N2 (具体)　N3 (人間)
303	yaku	焼く(やく)	N1 が N2 を	N1 (人間)　N2 (具体)
304	yakunitatu	役に立つ(やくにたつ)	N1 が	N1 (具体)
305	yakusokusuru	約束する (やくそくする)	N1 が N2 を N3 に	N1 (人間)　N2 (抽象)　N3 (人間)
306	yakeru	焼ける(やける)	N1 が	N1 (具体)
307	yasumu	休む(やすむ)	N1 が	N1 (人間)
		休む(やすむ)	N1 が N2 を	N1 (人間)　N2 (行為)
308	yaseru	痩せる(やせる)	N1 が	N1 (動物)
309	yamu	止む(やむ)	N1 が	N1 (具体)
310	yameru	止める(やめる)	N1 が N2 を	N1 (人間)　N2 (行為)
311	yaru	やる(やる)	N1 が N2 を	N1 (人間)　N2 (行為)
312	yaru	やる(やる)	N1 が N2 を N3 に	N1 (人間)　N2 (具体)　N3 (人間)
313	yusyutusuru	輸出する (ゆしゅつする)	N1 が N2 を	N1 (人間)　N2 (具体)
		輸出する (ゆしゅつする)	N1 が N2 を N3 に	N1 (人間)　N2 (具体)　N3 (人間)
314	yunyuusuru	輸入する (ゆにゅうする)	N1 が N2 を	N1 (人間)　N2 (具体)
		輸入する (ゆにゅうする)	N1 が N2 を N3 から	N1 (人間)　N2 (具体)　N3 (人間)
315	yureru	揺れる(ゆれる)	N1 が	N1 (具体)
316	yooisuru	用意する(よういする)	N1 が N2 を	N1 (人間)　N2 (抽象)
		用意する(よういする)	N1 が N2 を N3 に	N1 (人間)　N2 (具体)　N3 (人間)
317	yogoreru	汚れる(よごれる)	N1 が	N1 (具体)
318	yobu	呼ぶ(よぶ)	N1 が N2 を	N1 (人間)　N2 (人間)
319	yomu	読む(よむ)	N1 が N2 を	N1 (人間)　N2 (具体)
320	yoru	寄る(よる)	N1 が N2 に	N1 (具体)　N2 (場所)
		寄る(よる)	N1 が N2 に	N1 (人間)　N2 (場所)
		寄る(よる)	N1 が N2 へ	N1 (具体)　N2 (場所)
321	yorokobu	喜ぶ(よろこぶ)	N1 が N2 を	N1 (人間)　N2 (抽象)
322	riyoosuru	利用する(りようする)	N1 が N2 を	N1 (人間)　N2 (抽象)
		利用する(りようする)	N1 が N2 を	N1 (人間)　N2 (具体)
		利用する(りようする)	N1 が N2 を N3 に	N1 (人間)　N2 (抽象)　N3 (抽象)
		利用する(りようする)	N1 が N2 を N3 に	N1 (人間)　N2 (抽象)　N3 (具体)
		利用する(りようする)	N1 が N2 を N3 に	N1 (人間)　N2 (具体)　N3 (抽象)
		利用する(りようする)	N1 が N2 を N3 に	N1 (人間)　N2 (具体)　N3 (行為)
		利用する(りようする)	N1 が N2 を N3 に	N1 (人間)　N2 (具体)　N3 (具体)
323	ryokoosuru	旅行する(りょこうする)	N1 が	N1 (人間)
		旅行する(りょこうする)	N1 が N2 を	N1 (人間)　N2 (場所)
324	rensyuusuru	練習する(れんしゅうする)	N1 が	N1 (人間)

		練習する(れんしゅうする)	N1 が N2 を	N1 (人間) N2 (行為)
325	renrakusuru	連絡する(れんらくする)	N1 が N2 を N3 に	N1 (人間) N2 (抽象) N3 (人間)
326	wakasu	沸かす(わかす)	N1 が N2 を	N1 (人間) N2 (具体)
327	wakaru	分かる(わかる)	N1 が N2 が	N1 (人間) N2 (抽象)
		分かる(わかる)	N1 が N2 に	N1 (行為) N2 (人間)
		分かる(わかる)	N1 が S と	N1 (人間) S
328	wakareru	別れる(わかれる)	N1 が N2 と	N1 (人間) N2 (人間)
329	waku	沸く(わく)	N1 が	N1 (具体)
330	wasureru	忘れる(わすれる)	N1 が N2 を	N1 (人間) N2 (*)
331	watasu	渡す(わたす)	N1 が N2 を N3 に	N1 (人間) N2 (具体) N3 (人間)
332	wataru	渡る(わたる)	N1 が N2 を	N1 (人間) N2 (場所)
333	warau	笑う(わらう)	N1 が	N1 (人間)
334	wareru	割れる(われる)	N1 が	N1 (具体)

Appendix C: Semantic properties for ATN

This is the list of the nodes in the *Goi-Taikei* semantic attribute tree that we defined as ATN. Each node is given a label in Japanese (along with English translation that we added) and designated with a number. In the chart, indenting of each entry indicates the depth of the nodes in the hierarchy tree; ranging from the 4th level (indicated by no indenting) to the 10th level (indicated by 6-space indenting).

人間＜親族関係＞ human <kinship>	72
家族 family	73
夫妻 married couple	74
夫 husband	75
妻 wife	76
親・祖父母・先祖 parent/grandparent/ancestor	77
親 parent	78
父 father	79
母 mother	80
祖父母 grandparent	81
祖父 grandfather	82
祖母 grandmother	83
先祖 ancestor	84
子・孫・子孫 child/grandchild/descendant	85
息子 son	87
娘 daughter	88
孫 grandchild	89
孫（男） grandson	90
孫（女） granddaughter	91
子孫 descendant	92
兄弟 sibling	93
兄弟（年上） older sibling	94
兄 older brother	95
姉 older sister	96
兄弟（年下） younger sibling	97
弟 younger brother	98
妹 younger sister	99
親戚 relative	100
おじ・おば uncle/aunt	101
おじ uncle	102
おば aunt	103
おい・めい nephew/niece	104
おい nephew	105
めい niece	106
いとこ cousin	107
いとこ（男） male cousin	108
いとこ（女） female cousin	109
親戚（その他） other relative	110

人間＜対人関係＞ human <personal relation>	111
人間＜交際関係＞ human <social relation>	112
仲間・成員・仲間等 companion/member, etc.	113
中間・成員 companion/member	114
中間 companion	115
同士 comrade	116
信徒 believer	117
連れ companion	118
成員 member	119
のけ者・じゃま者	120

峠 mountain pass	478
谷 valley	479
崖 cliff	480
洞穴 cave	481

動物（部分） animal (part)	552
頭部 head	553
頭 head	554
顔 face	555
顔面 face	556
ひたい forehead	557
ほお cheek	558
あご chin	559
目（器官） eye (organ)	560
目（器官（本体）） eye (organ (main part))	561
目（器官（部分））eye (organ (part))	562
鼻 nose	563
鼻（本体） nose (main part)	564
鼻（部分） nose (part)	565
口（身体） mouth (body)	566
口（本体） mouth (main part)	567
唇[くちびる] lip	568
舌 tongue	569
くちばし peak	570
耳 ear	571
耳(本体) ear (main part)	572
耳(部分) ear (part)	573
首 neck	574
のど throat	575
うなじ nape	576
胴体 trunk	577
胸 chest	578
腹 belly	579
腰 waist	580
肩 shoulder	581
背 back	582
脇 side	583

尻 buttocks	584
尾 tail	585
胴体(その他） trunk (other)	586
乳房 breast	587
へそ navel	588
陰部 genitals	589
手・足 hand/leg	590
手(上肢） upper limb	591
腕 arm	592
肘[ひじ] elbow	593
手 hand	594
手首 wrist	595
手のひら palm of a hand	596
手の甲 back of a hand	597
手の指 fingers	598
足(下肢) lower limb	599
腿[もも] thigh	600
膝[ひざ] knee	601
脛[すね] shin	602
足 foot	603
足首 ankle	604
足の裏 sole of a foot	605
足の甲 instep	606
足の指 toe	607
指 finger	608
関節 joint	609
翼・ひれ・水かき等 wing/fin/webfoot, etc	610
翼 wing	611
ひれ fin	612
水かき等 webfoot	613
内臓・膜・筋肉 internal organ/membrane/muscle	614
内臓 internal organ	615
呼吸器 respiratory organ	616
消化器 digestive organ	617
循環器 circulatory organ	618
泌尿器 urinary organ	619

生殖器 sexual organ	620
神経系 nerve	621
腺 gland	622
膜 membrane	623
筋肉 muscle	624
皮・毛 skin/hair	625
皮 skin	626
皮膚 skin	627
ほくろ・いぼ mole/wart	628
甲殻 carapace	629
甲 shell	630
殻 shell	631
うろこ scale	632
毛 hair	633
毛髪 hair	634
眉・睫[まゆ・まつげ]eyebrow/eyelash	635
ひげ mustache/beard	636
体毛 body hair	637
羽毛 feather	638
骨・歯・爪等 bone/tooth/nail	639
骨 bone	640
歯・歯茎 tooth/gum	641
歯 tooth	642
歯茎 gum	643
爪・角・牙 nail/horn/tusk	644
爪 nail	645
角[つの] horn	646
牙 tusk	647

植物(部分) plant (part)	686
芽・苗 bud/seedling	687
苗 seedling	689
根 root	690
茎・株 stalk/stump	691
茎 stalk	692
株 stump	693
枝・葉 branch/leaf	694
実・種子・穂 fruit/see/ear	700

実 fruit	701
種子 seed	702
穂 ear	703
樹脂・果皮 resin/rind	704
細胞 cell	705

成分 ingredient	709

物品(持ち物) thing (belonging)	762

衣服(本体(上半身)) clothing (main (upper half))	819
衣服(本体(下半身)) clothing (main (lower half))	820
靴下 sock	825
履き物 footwear	833

家屋(部分) housing (part)	866
家屋(部分＜場＞) housing (part <space>)	867
縁側 porch	871
露台 balcony	872
家屋(部分＜場(その他)＞)) housing (part <space (other)>))	873
家屋(部分＜要素＞) housing (part <component>)	874
屋根 roof	875
天井 ceiling	876
柱・梁[はらい・はり] pillar/beam	877
壁 wall	878
窓 window	879
床 floor	880
土台 base	881
家屋(部分＜要素(その他)＞) housing (part <component (other)>)	882
家屋(付属) housing (accessory)	883
建具 fitting	884
幕 curtain	885

日覆い sunshade	886
棚･台･壇 shelf/table/platform	888

乗り物(部分) vehicle	991
乗り物(部分(移動(空圏))) vehicle (part (transfer (air)))	992
乗り物(部分(移動(水圏))) vehicle (part (transfer (water)))	993
乗り物(部分(移動(陸圏))) vehicle (part (transfer (land)))	994

案 plan	1036

創作物 creation	1037

名称 name	1065
人名 person's name	1066
題名 title	1067
名称(その他) name (other)	1068
番号 number	1065

図 diagram	1105

文書(部分) document (part)	1112
文書類 document	1113

価格 price	1185

報酬 pay	1195

功績 contribution	1213

表情 expression	1343
顔つき look	1344
目つき eye expression	1345
泣き weep	1346
笑い smile	1347
感嘆 exclamation	1348
声 voice	1349
身震い shudder	1350

行為 act	1560
動作 action	1561
立ち居 movement	1565
相続 inheritance	1619
賛否 approval or disapproval	1728
認否 approval or denial	1737

兆し sign	2071

裏返し opposite side	2256

盛衰 rise and fall	2298

種類 kind	2434

原因 cause	2450
結果 result	2451

理由 reason	2455
目的 purpose	2456
証拠 proof	2457

性質 property	**2483**
属性 attribute	2484
属性(主体) attribute (subject)	2485
長所 merit	2494
短所 demerit	2495
能力 ability	2502
教養 education	2504

状態 state	2507
状況 situation	2509
実況 real condition	2510

事情 circumstance	2511
常態･異常 normal/abnormal state	2512
形勢 situation	2518

境遇 lot	2536
安否 safety	2554

面 surface	2569
隙 gap	2573
片 piece	2578
枠 frame	2583

数量 amount	**2585**
数 number	2586
量 quantity	2587
個数･回数等 number/frequency, etc.	2588
値･額 value/price	2590
度量衡 weights and measures	2591
度 degree	2592
速度 speed	2593
量(その他) quantity (other)	2594
単位 unit	2595
計算値 figure	2596
全体･部分 whole/part	2598
部分 part	2600
組 pair	2601
群 group	2602
単複 singular and plural	2604
程度･限度 degree/limit	2607

場 space	**2610**
位置 position	2611
席 seat	2612
跡 mark	2613
範囲 scope	2614
点･許 point/place	2615
点(場所) point(space)	2616

許[もと」 place	2617
境･目 border/	2618
境 border	2619
目(位置)	2620
内外 inside and outside	2621
内 inside	2622
内部 interior	2623
奥 depth	2624
底 bottom	2625
外 outside	2626
口(場) mouth (space)	2627
表裏 two sides	2628
表[おもて] surface	2629
裏 reverse side	2630
陰(表裏) hidden space	2631
上下[じょうげ] top and bottom	2632
上･下[うえ･した] above and below	2633
上[うえ] above	2634
中[ちゅう] middle	2635
下[した] below	2636
上･下[かみ･しも] upper and lower	2637
上[かみ] upper part	2638
中[なか] middle part	2639
下[しも] lower part	2640
頂 top	2641
左右 right and left	2642
左 left	2643
右 right	2644
側[わき] side	2645
前後(場) front and rear	2646
前 front	2647
後(場) rear (space)	2648
方向 direction	2649
向き direction	2650
方面 direction	2651

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