

Understanding Zeros and Coherence in Japanese

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This paper demonstrates the importance of identifying two types of zero arguments (zeros) to help teachers and learners of Japanese as a Second Language (JSL) understand the coherence of Japanese discourse. Zeros can be categorized into two types: “zero predicate-argument” and “zero nominal-argument.” We will illustrate these two types of zeros and demonstrate why it is important to consider both types in order to have a better understanding of the cohesion among sentences, and hence of the coherence of discourse. The necessity to consider both zero types to improve our computer program, “Zero Detector,” an automatic zero detecting tool, will also be addressed.

1.0 Introduction

There have been many studies about how people learn second languages and what is responsible for successful language learning. Recent second language acquisition (SLA) research has progressed beyond Krashen’s (e.g., 1982) emphasis on automatic processes of acquisition, and many researchers have attended to the effectiveness of instruction, while acknowledging the role of input. Empirical research has shown that that learners’ consciousness-raising through explicit instruction does contribute to successful second language learning (see Norris and Ortega, 2000 for a comprehensive review).

Many of the previous SLA studies have been conducted in an English-as-a-Second-Language (ESL) context. Placing it in a Japanese-as-a-Second-Language (JSL) environment, we need both to benefit from the universality of the findings and to be sensitive to language-specific provisions.¹ In practice, effective instruction should stem from a clear understanding of specific difficulties that learners are likely to encounter. These difficulties may be related to a unique feature that the target language does exhibit and the native language does not².

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

¹ This is our standpoint throughout this paper.

² Our study focuses on native English-speaking learners of Japanese at a university level.

non-linguistic knowledge. Ellipsis as a concept is probably a universal feature of languages. People avoid unnecessary and intrusive repetition, and leave “unsaid” what they believe is inferable in the context. However, the linguistic options that realize ellipsis in discourse vary markedly. In this respect, there is a striking contrast between English and Japanese³.

In this paper, we focus on a typical realization of this “unsaidness” in Japanese, what is called zero arguments (henceforth, zeros). After giving an overview of the underlying assumptions and pedagogical principles that we adopt from the SLA and reading research, we describe types of zeros and how they function as a cohesive device in Japanese. We then emphasize the effectiveness of recognizing these zeros to construct a coherent representation of discourse. We finally discuss the importance of instructing cohesion comprehension, and present a computerized teaching/learning aid to help develop cohesion recognition skills.

2.0 Background

2.1. Reading comprehension and cohesion

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) while applying his/her non-linguistic background knowledge (top-down processing) in order to construct a coherent representation of the text⁴. This view is known as the interactive model of reading (Carrel et al., 1988).

Effective readers constantly integrate top-down and bottom-up processing techniques in order to understand the text (Celce-Murcia et al., 2000). Such readers are effective strategy users; they know when to abandon unsuccessful reading strategies and 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 and a whole text. Compared with morphological/syntactic level processes, however, discourse level phenomena have received far less attention, and as a result, remain largely unexplored in Japanese. This paper focuses on the inter-sentential (or clausal) level cohesive relations that contribute to the coherence of text and discusses

³ Huang (1984) classifies English as “hot” and Japanese as “cool” languages according to the extent to which they allow the kind of ellipsis that we deal with in this paper.

⁴ In this study, we deal with written discourse, so we use the term “text” instead of “discourse” for the rest of the paper, but of course, most of our discussion can also be applied to spoken discourse.

cohesion recognition as a significant phenomenon in its own right.

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. This claim is confirmed in research by Demel (1990)⁵. Also, activities involving the recognition/interpretation of cohesive ties have been suggested by Williams (1983) and Lubelska (1991) among others. In a JSL context, Kitajima (1997) demonstrates experimentally that referential strategy training has a positive effect on reading comprehension.

2.2. Zeros as a cohesive device

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.

In Japanese, reference is made by means of repeated nouns (e.g., *inu* ‘dog’), demonstrative nouns (e.g., *sono otoko*, ‘the man’), demonstratives (e.g., *kore*, ‘this’), lexical pronouns (e.g., *kanojyo*, ‘she’)⁶, and zero arguments. Zero arguments (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 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% ellipsis⁷. This suggests that zeros in Japanese play a distributionally similar role to overt pronouns in English⁸.

Like other forms of reference, zeros also establish cohesive ties between themselves and their referents, as illustrated in (1).⁹

⁵ The role of cohesion (coreference, in particular) in comprehension in general is discussed in Garrot and Sanford (1990) and also in psychological models in comprehension proposed by Kintsch and van Dijk (1978) and Just and Carpenter (1980).

⁶ The use of (3rd person) lexical pronouns is very constrained and domain-specific. See Hinds (1978) for further discussion of overt pronouns in Japanese.

⁷ 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.”

⁸ For this reason, zeros are often called, in the literature, “zero pronouns.”

⁹ The following abbreviations are used in this paper: TOP for topic marker (*wa*), NOM for nominative case particle (*ga*), ACC for accusative case particle (*o*), DAT for dative case particle (*ni*), LOC for locative particles (*ni*, *e*, etc.), and ADN for adnominal particle (*no*). A zero is indicated as \emptyset .

- (1) a. *mazu* *tamanegi-o* *kitte-kudasai.*
 first onion-ACC cut-please
 “First, cut onions.”
- b. *sosite* \emptyset -(*o*) *nabe-ni* *irete-kudasai.*
 then \emptyset -(ACC) pot-LOC put-please
 “Then, put them in a pot.”

Here, *tamanegi* ‘onions’ in (1a) is referred to by a zero in (1b), which constitutes a cohesive tie between the two sentences. As a result, the sentences 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 (‘onions’ – ‘them’).

Due to the invisible nature of this particular cohesive device in Japanese, we assume that cohesive relations realized by zeros are less recognizable than those realized by other explicit forms, and that they create more inferential difficulties and hence cause breakdown in cohesion comprehension for JSL learners. However, very few JSL textbooks provide organized instruction and/or intensive exercises on this zero cohesion mechanism. This is our motive for this study. We attempt first to spell out this mechanism, and then to apply it to an automatic linguistic analysis for JSL teachers/learners.

In the next section, we present the subclassification of zeros, and explicate how their presence can be inferred in a linguistic framework.

3.0 Zero arguments

3.1. Zero predicate-argument

The first type of zero is defined as “zero predicate-argument.” Japanese is a head-final language. A sentence or a clause is headed by a predicate, which takes a set of arguments and adjuncts. Predicates in Japanese include verbs, adjectives, nominal adjectives and copula, and usually consist of a core predicate and some auxiliary elements.

Initially, we defined zeros as the unexpressed “obligatory” arguments¹⁰ of a core predicate (see below for discussion). They are, in other words, elements recoverable from the valency requirements of the predicate with which they occur, as exemplified in (2) and (2’).

- (2) *kino* *kareeraisu-o* *tabe-ta.*
 yesterday curry-and-rice-ACC eat-PAST

¹⁰ In the literature, required elements are termed “arguments” and “valents,” as in “argument structures” and in “valency requirements.” In this paper, we use these terms interchangeably.

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 “ \emptyset -(*ga*)” in the sentence (2), as in (2’). We call this zero type the “zero predicate-argument.”

- (2’) *kino* \emptyset -(*ga*) *kareeraisu-o* *tabe-ta*.
 yesterday \emptyset -(NOM) curry-and-rice-ACC eat-PAST
 “Yesterday, \emptyset ate curry and rice.”

“Obligatoriness” is a controversial issue, and there is no set agreement among linguists on its definition. Somers (1984) proposed, by 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 element 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 group (i) is often treated as part of idioms and is not omissible; Japanese nominative *-ga* and accusative *-o* fall into the category (ii), while dative *-ni* belongs to (iii). In light of this, we decided to include the arguments at levels (ii) and (iii) as the zeros that this paper deals with, i.e., unexpressed NPs which would be accompanied by nominative particle *-ga*, accusative *-o* and dative *-ni* if they were realized.

This definition of zeros provides the following three basic valency patterns for verbs and potential zeros, as given in (3).

- (3) a. NOM + V \emptyset -(*ga*) *tomaru*. “ \emptyset stops.”
 b. NOM + ACC + V \emptyset -(*ga*) \emptyset -(*o*) *tomaru*. “ \emptyset stops \emptyset .”
 c. NOM + DAT + ACC + V \emptyset -(*ga*) \emptyset -(*ni*) \emptyset -(*o*) *osieru*. “ \emptyset teaches \emptyset \emptyset .”

The knowledge of valency patterns of each predicate¹¹ plays a key role in identifying the presence of unexpressed arguments.

3.2. Zero nominal-argument

The second type of zero is the “zero nominal-argument.” Unlike “zero predicate-argument,” “zero nominal-argument” cannot be recovered from the valency requirements of the predicate. Instead, they are inferred from some features specified by their head nouns. Look at example (4).

¹¹ Ishiwata (1983), for example, provides valency patterns for 1154 predicates (including verbs and adjectives).

- (4) *sintyo-wa* *50 senti da.*
 height-TOP 50-centimeters is

Sentence (4) has the “zero nominal-argument” but does not have the “zero predicate-argument.” The utterance satisfies the valency requirements of the predicate: the copula verb “*da*” with a topicalized subject and a pre-copula nominal. Therefore, sentence (4) contains no “zero predicate-argument.” However, this sentence alone is semantically incomplete. The noun *sintyo* ‘height’ calls readers’ attention to “of-what/whom” information and readers recover that information in the flow of text. That missing information can usually be supplied by an NP (“the robot,” for example) followed by an adnominal particle *no*, as in (4’).

- (4’) \emptyset -(*no*) *sintyo-wa* *50 senti da.*
 \emptyset -(ADN) height-TOP 50-centimeters is
 “(The robot’s) height is 50 centimeters.”

Hence, we regard an unexpressed ‘NP *no*’ in the NP *no* NP (a.k.a., A *no* B) construction as the other type of zero. We call this less-acknowledged zero type the “zero nominal-argument” and include it in our definition of zeros. There is one thing to note about this term. Although zero nominal-arguments might be most closely equivalent to possessive pronouns in English (i.e., ‘his,’ ‘her,’ ‘its,’ and ‘their’), we avoid using “zero possessive.” This is because A *no* B does not restrict the semantic relationship between the two nominals joined by the particle *no* to possession, but encodes a wide variety of relationships, as will be later demonstrated in our examples.

Zero predicate-arguments are unexpressed elements that are predictable from the valency requirements of their heads, i.e., given predicates. Zero nominal-arguments, analogously, are missing elements that can be inferred from some features specified by their head (B) nouns¹². We conjecture that certain nouns are more likely to take (zero) nominal-arguments than others, and that the head (B) nouns which take zero nominal-arguments, extracted from our corpus¹³, are representative samples of this particular group of nouns.

We examined our corpus and located, based on the native speaker intuitions and the linguistic expertise of the authors, a total of 320 zero nominal arguments (unexpressed A nouns) that are attached to B nouns. We then classified these (A *no*) B examples into groups, modelled on Shimazu, Naito and Nomura’s (1986) A *no* B classification scheme.

This analysis provides us with some syntactic/semantic properties (as defined in the

¹² We regard, in A *no* B construction, B to be a syntactic head and ‘A *no*’ to be a modifier.

¹³ Our corpus is a collection of reading materials from seven JSL textbooks, which consists of 83 texts (a total of 2007 clauses) that contain 1,385 zero arguments.

*Goi-Taiki Japanese Lexicon*¹⁴) of typical B nouns. These are summarized in Table 1¹⁵.

Properties of B nouns		Examples from our corpus	
syntactic	verbal noun ‘ <i>sahen-meishi</i> ’	(<i>siai no entyo</i>)	(match-ADN) extension
	derived noun ‘ <i>tensei-meishi</i> ’	(<i>baabekyu no nioi</i>)	(barbecue-ADN) smell
	formal noun ‘ <i>keishiki-meishi</i> ’	(<i>kao no yoko</i>)	(face-ADN) side
semantic	human /kinship	(<i>Hiroko no okaasan</i>)	(Hiroko-ADN) mother
	human /relationship	(<i>Jones-san no doryo</i>)	(Jones-ADN) colleague
	human /role	(<i>sinbun no dokusya</i>)	(newspaper-ADN) reader
	animate /body-part	(<i>raion no me</i>)	(lion-ADN) eye
	housing /part	(<i>toire no doa</i>)	(bathroom-ADN) door
	amount	(<i>robotto no taijyu</i>)	(robot-ADN) weight

Table 1: Syntactic/semantic properties of B nouns

When nouns that belong to syntactic (part-of-speech) subcategories such as verbal noun, derived (from adjectives/verbs) noun, and formal noun, and nouns that have such semantic attributes as kinship, body-part and human role, among others, appear alone (as “bare nouns”¹⁶), they seem to implicitly require unexpressed arguments to make the whole NPs make sense in a given text, as illustrated by the example in (5) that is taken from our corpus.

- (5) a. *ookii nizi-ga nisi-no sora-ni arimasita.*
 big rainbow-NOM west-ADN-sky-LOC was
 “A big rainbow was in the western sky.”
- b. \emptyset -(no) *sita-no-ho-o tiisai kumo-ga yukkuri minami-e tondeimasita.*
 \emptyset -(ADN)-below-ACC small cloud-NOM slowly south-LOC was-floating
 “Below the rainbow, small clouds were slowly floating to the south.”

In (5b), a formal noun *sita* ‘below’ serves as a special noun that triggers the presence of zero nominal-argument, a zero that constitutes a cohesive tie with its referent, *nizi* ‘rainbow,’ in (5a). This is an example of a formal (locative) noun that has a low-independent or incomplete feature in itself. Derivational nouns, such as *sahen-meishi* and *tensei-meishi*, inherit the syntactic properties (i.e., the argument structures) from the elements they are derived from. Nouns with the semantic

¹⁴ *Goi-Taiki* is a semantic feature dictionary (in an electronic format) that defines 300,000 Japanese nouns based on an ontological hierarchy of approximately 2,800 semantic attributes. It also gives nine part-of-speech subcategories for nouns (Ikehara et al., 1997).

¹⁵ Our result partially overlaps with some particular types of nouns studied 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. Iori (1997) argues that certain nouns are categorized as “one-place nouns.” Kojima (1992) examines so-called “low-independence nouns” and their syntactic behaviours in copula expressions.

¹⁶ By “bare nouns”, we mean nouns that do not have any overt modifiers, such as demonstratives, adjectives, and adnominal clauses.

properties listed above are relational nouns that are semantically unsaturated i.e., semantically dependent on an argument. The meaning of a noun *doryo* ‘colleague,’ for example, is possible in relation to someone else, in most contexts. The noun *me* ‘eye’ usually evokes a meronymic (part-whole) relationship to the body it is attached to.

Attention to the special groups of nouns that are summarized in Table 1 helps us to recognize cohesive relations realized by this type of zero.

3.3. Two types of zeros and coherence

We have presented, in the previous subsections, two types of zeros and how they can be recognized in sentences in which these zeros occur. We have shown that both types of zeros are inferable from the other overt parts of a clause or a sentence. This inference requires linguistic knowledge of valency requirements of a given predicate or noun, respectively, with which zeros co-occur.

Before we go on to look at how these two types of zero interact with each other to contribute to coherence in text, we give some statistical data from our corpus. Figure 1 shows the distribution of zero types found in the corpus.

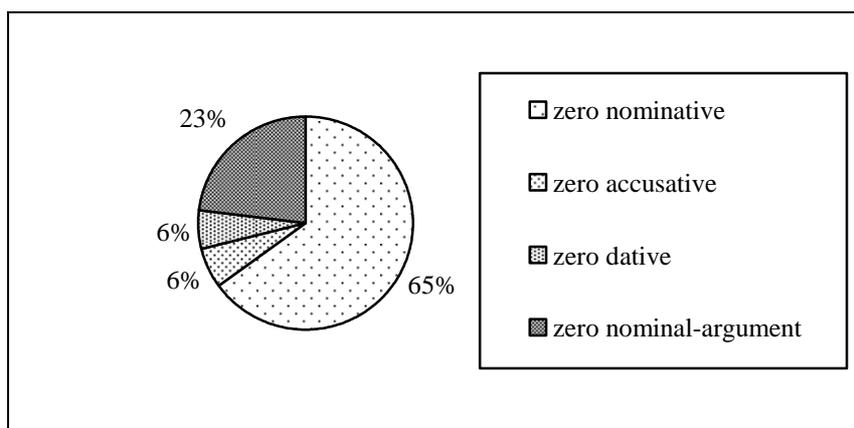


Figure 1: Distribution of zero types

The vast majority is comprised of zero nominatives, as is indicated by the fact that Japanese is known as a subject-drop language. Zero predicate-arguments of three case roles altogether make up 77 %, while zero nominal-arguments, a less-studied type, occupies almost a quarter (23%), in our corpus.

Our major claim is that it is important to recognize both “zero predicate-arguments” and “zero nominal-arguments” because they serve as referential cohesive devices, together constitute cohesive chains and contribute to text coherence (see Iori, 1997 for similar discussion). This is illustrated by example (6), taken from our corpus.

(6) a. *daimyo-wa zibun-no-han to Edo-ni uti-ga atte,*

feudal lord-TOP self-ADN-clan-and-Edo-LOC home-NOM is and
 “Feudal lords had their homes both in their clan and in Edo, and”

- b. **Ø-(ga)** **Ø-(no)**-han-ni I-nen, Edo-ni I-nen sumanakereba-narimasen-desita.
 Ø-(NOM) Ø-(ADN) clan-LOC 1-year Edo-LOC 1-year had-to-live
 “They had to spend one year in their clan and another year in Edo.”
- c. **Ø-(no)**-okusan-to-kodomo-wa Edo-ni *sunde-imasita*.
 Ø-(ADN) wife-and-child-TOP Edo-LOC lived
 “Their wives and children lived in Edo.”
- d. **Ø-(ga)** Edo-made *aruite-ikanakereba-narimasen-desita-kara*,
 Ø-(NOM) Edo-as-far-as had-to-walk-so
 “They had to walk as far as Edo, so”
- e. **Ø-(ga)** *totemo taihen-desita*.
 Ø-(NOM) very hard-was
 “it was very hard.”

This text segment contains three “zero predicate-arguments” (nominative case) and two “zero nominal-arguments”¹⁷ that all refer to the entity mentioned in (6a), *daimyo* ‘feudal lord.’ These zeros are indicated in bold in clauses (6b) through (6d). Together they create a “cohesive chain” and contribute to the connectivity of the content that describes the life of feudal lords in the Edo period. The zero nominal-argument in (6c), in particular, serves to connect utterance (6c) to adjacent utterances (6b) and (6d), maintaining the same topic (or “center” in the centering theory terminology, e.g., Grosz, Joshi and Weinstein, 1995). Unless both types of zeros are recognized, the characterization of this connectivity would be impossible. Example (6) clearly illustrates the necessity of recognizing both types of zeros to better capture topic continuity and coherence of text.

Let us look at another sample text, taken from a novel¹⁸. Its surface-level direct English translation is given first, in (7).

- (7) “Waiting, and man returned. Carrying paper cup. Facial expression had no change.”

It is not explicitly stated who does the “waiting,” or “carrying,” and whose “expression” is being talked about. In English, these sentences are ambiguous and even

¹⁷ The zero nominal-argument in (6b) creates an intra-clausal tie, while the one in (6c) an inter-clausal one. Our prime interest is in the latter type.

¹⁸ This is an excerpt from a novel by Shinichi Hoshi, “Syantai-no Jiken (It Happened on a Train).”

ungrammatical. In Japanese, however, native speakers find no difficulty in interpreting this segment, and moreover, they find it quite coherent. These readers use their prior knowledge that ‘the woman had asked the man to bring her some water to take medicine’ and that ‘the woman pick-pocketed an envelope from his inner pocket as the man stood up’ (top-down processing) to reach the correct interpretation, which is also supported by linguistic clues in text (bottom-up processing). The original Japanese is analyzed in (8), with unexpressed elements indicated.

- (8) a. \emptyset -(*ga*) \emptyset -(*o*) *matteiru-to*
 \emptyset -(NOM) \emptyset -ACC be waiting-and
- b. *otoko-wa kaettekita.*
 man-TOP returned
- c. \emptyset -(*ga*) *kamikoppu-o motteiru.*
 \emptyset -(NOM) paper-cup-ACC be carrying
- d. \emptyset -(*no*) *hyojyo-ni henka-wa nakatta.*
 \emptyset -(ADN) expression-LOC change-TOP was not

In this example, three cohesive ties, between (8a) - (8b), (8b) - (8c), and (8c) - (8d), involve both types of zeros and constitute one cohesive chain that centers on ‘the man.’ To promote bottom-up processing in cohesion recognition, learners need to pay attention to linguistic clues available in text (valency requirements of predicates/nouns, in this case), and teachers need to train learners to develop cohesion recognition skills as a crucial reading strategy.

3.4. Linguistic distance and effective instruction

We have shown a unique feature of a Japanese cohesive device. This is in striking contrast to English, as mentioned earlier, which requires overt pronouns in place of zeros. The English counterpart of example (8) is given in (9).

- (9) “**I** (=the woman) waited for **him**, and the man returned. **He** was carrying a paper cup. There was no change in **his** expression.”

Lexical pronouns in English carry less information than full NPs, which could create ambiguity. However, they at least provide an indication of reference, complete with clues for 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 concern cross-linguistic variations in language acquisition and processing, linguistic distance has an effect on comprehension (Koda, 1996). Thus, explicit instruction and training for recognizing zero-involving cohesive ties may have positive effects on acquisition of zeros. This observation has led us to the development of an automatic zero detecting program that aims to promote effective instruction of zeros.

4.0 Zero Detector

4.1. Objectives and performance

Zeros are a major type of referential cohesive expression in Japanese. This poses a challenge for some JSL learners in accurately comprehending Japanese text. In order to enhance the JSL teachers'/learners' understanding of Japanese text with zeros, we have developed a language teaching/learning aid program, Zero Detector (henceforth ZD). ZD utilizes natural language processing (NLP) techniques¹⁹ to find zeros in the input text and mark the invisible zeros. This helps to make teachers/learners of Japanese more aware of the ellipted expressions (zeros), and hence of the text coherence that zeros represent.

ZD is currently capable of detecting both types of zeros with an average accuracy of 80%, and is under further continued enhancement. A sample output of ZD, using the text (8) above, is given in Figure 1.

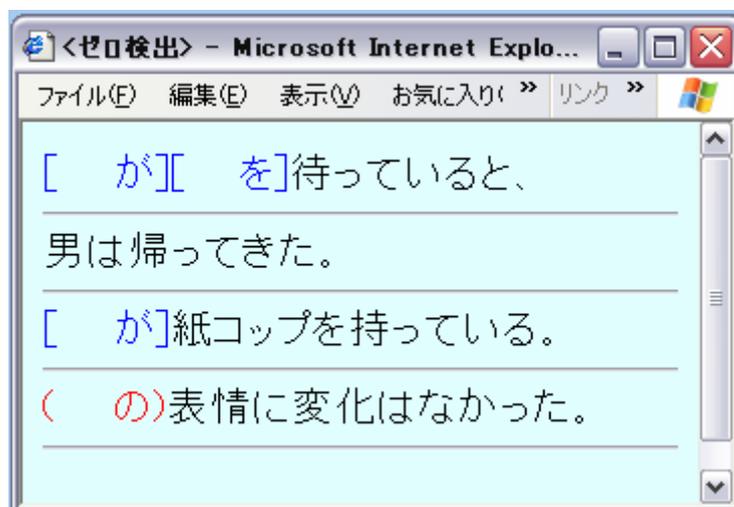


Figure 1: Sample ZD output

Detected zeros are indicated by brackets, with accompanying case particles. Here, we insert zeros, maintaining a canonical ordering of predicate-arguments: nominative *ga*,

¹⁹ The techniques include morphological and syntactic processing of an input text and accessing and matching with a relevant database (such as valency pattern dictionary/semantic attribute dictionary).

followed by accusatives *o* and datives *ni*. Also, we avoid using a topic marker *wa* in order to adhere to the canonical valency patterns of the predicates.

4.2. Implications for JSL teaching

The design of ZD is based on a “noticing hypothesis,” proposed by Schmidt (1990), that conjectures that prompting learners on a particular learning item facilitates acquisition. We attempt to achieve this noticing effect by making invisible zeros visible in effectively enhanced formats, using an “input enhancement” (Sherwood Smith, 1991) technique.

We expect learners to be more aware of the invisible cohesive elements when they are exposed to this enhanced input, and to use a bottom-up reading strategy (at an inter-clausal/sentential level) when necessary. Therefore, it is up to the teachers to decide when “modified input” (with zeros marked) can most effectively be given to which level learners. This is an area that requires further empirical investigation.

Because of this, we regard teachers as primary users of the program and aim to help them enhance their instruction of text with zeros. For example, ZD helps teachers predict the difficulties with zeros that learners might encounter, by analysing text in advance. This supports the careful selection of teaching materials and the well-thought-out creation of reading comprehension questions and tests. This is based on the claim by Moe and Irwin (1986) that “a clear understanding of cohesion can help educators predict comprehension problems” (p. 3). Also, teacher awareness, not limited to lexical/syntactic characteristics but extended to critical inter-sentential phenomena, should lead to a more thorough understanding of the language and effective instruction of the language as discourse.

5. 0 Concluding remarks and future work

We have illustrated two types of zeros that constitute cohesive ties and chains among sentences, and, as a result, contribute to coherence of the text. The detailed description of each type explains how native speakers of Japanese might automatically spot the presence of zeros in their bottom-up processing, which we hope will lead to a systematic, explicit way of explicating zero mechanisms instead of relying on heavily intuition-based instruction.

Discussion of the role of zeros in text suggested what teachers should expect learners to develop as a vital reading strategy. Such a strategy includes inference skills. Our assumption is that cohesive ties involving zeros are less recognizable than those with explicit types of cohesive devices, and hence result in inferential difficulties that may lead to comprehension breakdown. Thus, we emphasised the need for a recognition training for these implicit cohesion relations, and presented a computerized zero detecting tool that provides text with explicit zeros presented in an effectively enhanced format. We conjecture that this enhanced input will promote acquisition,

based on the “noticing hypothesis,” but it requires further empirical examination to determine when this input can most effectively be used with which level learners.

Other future directions include the categorization of zeros according to their referent types to demonstrate that different types of zeros also predict different levels of comprehension difficulty. The major subcategorizations include “local” zeros that refer to the elements in the immediately preceding clause, “global” zeros that go beyond the adjacent clause to search for their referents, and “situational” zeros that refer not to explicitly mentioned entities but to contextually evoked elements in context (these classifications are detailed in Fais and Yamura-Takei, 2003). Technically, learners and teachers would benefit from the additional functions of ZD to help search for appropriate referents of zeros, and to automatically generate comprehension questions concerning zeros, such as “whose facial expression is being talked about here?”

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