
The Effect of Pitch and Pause in Processing Relative Clauses in Japanese

Satoru Muraoka, Toshio Matsuura, and Tsutomu Sakamoto

1. Introduction

Japanese is a head-final language, so an argument structure cannot be fixed before a predicate is inputted at the end of a clause. Although this characteristic causes many ambiguities in processing Japanese sentences, many previous studies show that the parser integrates the incoming NPs into the parsing tree before the head of a clause (e.g., verb) is received in processing Japanese sentences (Kamide & Mitchell, 1999; Miyamoto, 2002; and others). These results verify that the parser processes a sentence incrementally regardless of possible ambiguities.

In this paper, we turn our attention to the information that the parser can use before it receives a predicate, and investigate the effect of prosodic information in processing relative clauses in Japanese. We focused on pitch contour information and temporal information (i.e., pause), and conducted a decision-making experiment to verify how these two types of information affect the processing of relative clauses.

This paper is organized as follows. In section 2, we point out the source of difficulty in processing complex sentences. Section 3 summarizes some previous studies on the relationships among prosody, syntax, and parsing. In section 4, we report the results of an experiment, which indicate that pitch contour information

facilitates syntactic processing, while temporal information increases processing difficulty. Section 5 discusses the reason why temporal information increases processing difficulty.

2. Ambiguities in processing complex sentences

When the parser processes a Japanese sentence that involves a relative clause (a complex sentence), it faces two types of ambiguity that need to be resolved.

- (1) Two types of ambiguity in processing complex sentences.
 - a. Is the sentence a simple one or complex one? (First-pass ambiguity)
 - b. Where is the point to open, or start the relative clause? (Second-pass ambiguity)

(1a) indicates a case in which the parser faces an ambiguity before it encounters the head noun of the relative clause (Mazuka & Itoh, 1995; Hirose & Inoue, 1998). This type of ambiguity is exemplified as follows:

- (2) Simple sentence or complex sentence
 - a. Furuhashi-san-ga Takashima-san-o ...
Furuhashi-Mr.-NOM Takashima-Mr.-ACC
 - b. Simple sentence
Furuhashi-san-ga Takashima-san-o tasuketa.
Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped
“Mr. Furuhashi helped Mr. Takashima.”
 - c. Complex sentence
Furuhashi-san-ga Takashima-san-o tasuketa seinen-ni shigamitsuita.
Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped the young man-DAT clung-to
“Mr. Furuhashi clung to the young man who helped Mr. Takashima.”

At the stage of (2a), the parser first builds a simple sentence structure (2b) in accordance with a general principle such as the Minimal Attachment Principle (Fra-

zier & Fodor, 1978). Only after input of a head noun does the parser notice that the sentence contains a relative clause. This prevents the parser from proceeding with a simple sentence analysis and has to reanalyze it as a complex sentence such as (2c).

In this process of reanalysis, the parser faces another ambiguity as is indicated in (1b): second-pass ambiguity. In the following example (3), there are two possible points to open (or start) a relative clause: the Early Opening point (a) and the Late Opening point (b).

- (3) Furuhashi-san-ga [_(a) Takashima-san-o [_(b) tasuketa seinen-ni...
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped the young man-DAT

As is shown in (4) below, this ambiguity of clause opening is resolved when the parser encounters the matrix predicate (e.g., verb).¹

- (4)a. Early Opening type (henceforth EO-type)

Furuhashi-san-ga [_i ec_i^{SUBJ} Takashima-san-o tasuketa] seinen_i-ni shigamitsuita.
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped the young man-DAT clung-to
 “Mr. Furuhashi clung to the young man who helped Mr. Takashima.”

- b. Late Opening type (henceforth LO-type)

Furuhashi-san_i-ga Takashima-san-o [_i ec_i^{SUBJ} ec_j^{OBJ} tasuketa] seinen_j-ni
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped the young man-DAT
 shookaishita.

introduced

“Mr. Furuhashi introduced Mr. Takashima to the young man whom he helped.”

Since the matrix verb *shigamitsuita* ‘clung-to’ in (4a) is a two-place predicate that requires ‘NP-*ga* (NOM)’ and ‘NP-*ni* (DAT)’ as its arguments, the accusative marked NP (*Takashima-san-o* ‘Takashima-Mr.-ACC’) must be inside the relative clause. In this case, an empty category is posited in the subject position of the relative clause and coindexed with the relative head NP (*seinen* ‘the young man’). On the other hand, since the matrix verb *shookaishita* ‘introduced’ in (4b) is a three-

place predicate that requires NP-*ga* (NOM), NP-*ni* (DAT), and NP-*o* (ACC) as its arguments, the accusative marked NP is outside the relative clause. In this case, an empty category is posited at the subject position of the relative clause, which is coindexed with the matrix subject. Furthermore, another empty category is posited at the object position of the relative clause, which is coindexed with the relative head NP.²

If the word strings such as (3) are presented visually, there is no difference between the EO and LO types. The parser is therefore unable to detect the opening point of the relative clause until the matrix verb is encountered. On the other hand, if there is a difference between these two types in terms of phonological information, the parser may detect the opening point of a clause prior to the appearance of the matrix verb. In the following section, we briefly survey some previous studies concerning the phonological information and clause boundary.

3. Previous studies

3.1 Major phrase and syntactic structure

Pitch accent is an important prosodic feature in Japanese. Each word itself is specified with at most one accent, as is shown in (5).

- (5)a. ha'shi-ga 'a chopsticks-NOM'
 b. hashi'-ga 'a bridge-NOM'
 c. hashi-ga 'an edge-NOM'

Note. "' " denotes an accent.

Furthermore, each accent is realized differently according to its position in the syntactic structure. For example, when there are two accented words, *Yu'mi* (a name of a woman) and *se'etaa* 'sweater', the accent of the second word is realized lower than that of the first word as is shown in Figure 1.

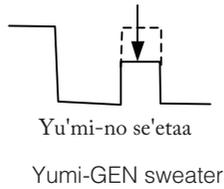


Figure 1. *Accent realization of 'Yu'mi-no se'etaa 'Yumi's sweater'*

This phenomenon is called an “accent reduction” or a “downstep”. Since McCawley (1968), the domain of accent reduction is called the “Major Phrase” (henceforth MajP). Accent reduction occurs when more than one accented word exists in a single MajP.

It is well known that MajP formation is affected by the syntactic structure of a sentence. (Selkirk & Tateishi, 1991; Kubozono, 1993; and others). Selkirk & Tateishi (1991) propose a rule for MajP formation as in (6).

- (6) Major Phrase: {Left, XP} (Selkirk & Tateishi, 1991, p.529 (10))

In our example (4), according to Selkirk & Tateishi (1991), the MajP boundaries would be inserted as shown in (7b) and (8b).

- (7)a. Syntactic structure of an EO-type sentence

Furuhashi-san-ga [_{VP}[_{NP}[_{CP} ec^{SUBJ} [_{VP} Takashima-san-o
Furuhashi-Mr.-NOM Takashima-Mr.-ACC

tasuketa]] seinen-ni] shigamitsuita.

helped the young man-DAT clung-to

“Mr. Furuhashi clung to the young man who helped Mr. Takashima.”

- b. Prosodic structure of an EO-type sentence

{_{MajP} Furu'hashi-san-ga}{_{MajP} Taka'shima-san-o tasu'keta seinen-ni
Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped the young man-DAT
shigamitsu'ita}.

clung-to

Note. “{ ” denotes the boundary of the prosodic structure (MajP).

(8)a. Syntactic structure of an LO-type sentence

Furuhashi-san-ga [_{VP} Takashima-san-o [_{NP}[_{CP} ec^{SUBJ} [_{VP} ec^{OBJ} tasuketa]] seinen-ni]
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped the young man-DAT
 shookaishita].

introduced

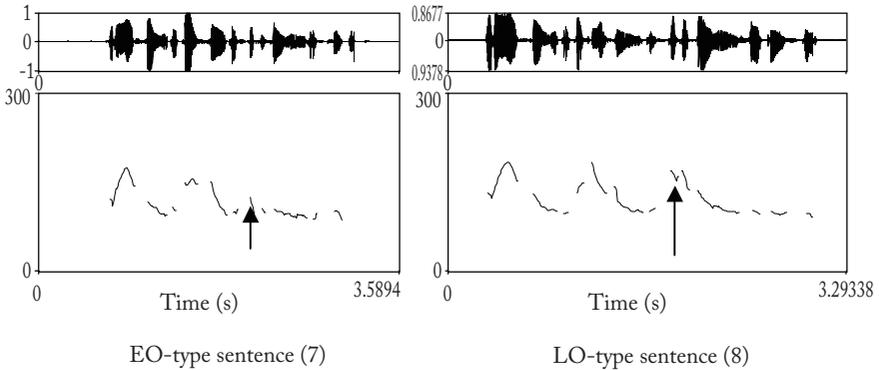
“Mr. Furuhashii introduced Mr. Takashima to the young man whom he helped.”

b. Prosodic structure of an LO-type sentence

{_{MajP} Furu'hashi-san-ga}{_{MajP} Taka'shima-san-o}{_{MajP} tasu'keta seinen-ni
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped the young man-DAT
 shookaishita}.

introduced

As is shown in Figure 2, the F0 of *tasu'keta* ‘helped’ in (8) is realized higher than that of (7) (pitch contour resetting).



Note. The arrow (→) in the diagram denotes an F0 peak of *tasu'keta* ‘helped’.

Figure 2. Pitch contour in (7) and (8) produced by a native speaker of Japanese (28 years 3 months, male)

Including accent reduction and pitch contour resetting, the following information denotes the boundary of a MajP.

- (9) Prosodic phenomena that denotes the boundary of a MajP
- a. accent reduction and pitch contour resetting
 - b. (obligatory) initial lowering
 - c. pause insertion

If the parser utilizes one (or all) of the prosodic information shown in (9), it would be possible to detect where the left-clause boundary should be posited before encountering a matrix predicate.

3.2 Pitch Pattern and Interpretation of Ambiguous Sentences

Azuma (1997) conducted an experiment in which the participants were required to listen to stimuli with different pitch ranges and pause lengths based on sentence (10). The task was to decide which interpretation was semantically plausible: either (11a) or (11b).

- (10) Nara-de taoreta yoozi-o hakonda.
 Nara-in fell infant-ACC carried
- (11)a. $[_{NP} [_{CP} ec_i^{SUBJ} \text{Nara-de taoreta}] yooji_i\text{-o}] \text{hakonda.}$ (Azuma, 1997, p.23)
 “(One) carried the infant who fell in Nara.”
- b. Nara-de $[_{NP} [_{CP} ec_i^{SUBJ} \text{taoreta}] yooji_i\text{-o}] \text{hakonda.}$ (Azuma, 1997, p.23)
 “In Nara, (one) carried the infant who fell.”

The results indicated that manipulation of pitch contour information affects the interpretation of this syntactically ambiguous sentence. On the other hand, it was found that the insertion or deletion of a pause did not severely affect the interpretation of the ambiguous sentence. From these results, Azuma (1997) concluded as follows:

- (12)a. The most important prosodic feature that marks a syntactic boundary is F0. (Azuma, 1997, p.30 (1))
- b. Pauses do not contribute as much in marking a syntactic boundary as F0. (Azuma, 1997, p.30 (2))

4. Experiment

We have revealed in section 3.2. that sentences with global ambiguity are not suitable for investigating the effect of prosodic information in the reanalysis of ambiguous relative clauses. Therefore, we designed an experiment to study the relationship between left clause boundaries and pitch contour information using sentences without global ambiguity.

LO-type sentences such as (14a) are not used in our experiment in order to avoid the possibility of global ambiguity. (14a) has a three-place predicate *shookaishita* ‘introduced’ as a matrix verb and a two-place predicate *tasuketa* ‘helped’ as a verb of the relative clause. In total, it needs five arguments for interpretation, but there are only three NPs. So, the parser needs to posit two empty categories. One of them must be posited in the relative clause and be coindexed with the relative head noun (*seinen* ‘the young man’). The other can be posited either in the relative clause (14b) or in the matrix clause (14c).

- (14)a. Furuhashi-san_i-ga Takashima-san-o tasuketa seinen_j-ni
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped the young man-DAT
 shookaishita.
 introduced
- b. Furuhashi-san_i-ga Takashima-san-o [_{ec_i}^{SUBJ} ec_j^{OBJ} tasuketa]
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped
 seinen_j-ni shookaishita.
 the young man-DAT introduced
 “Mr. Furuhashi introduced Mr. Takashima to the young man whom he helped.”
- c. Furuhashi-san-ga [_{ec_i}^{SUBJ} Takashima-san-o tasuketa]
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped
 seinen_i-ni ec^{OBJ} shookaishita.
 the young man-DAT introduced
 “Mr. Furuhashi introduced someone to the young man who helped Mr. Takashima.”

There is no way to eliminate ambiguity when the two empty categories are posited. If we use an LO-type sentence in our experiment, we will be faced with the same problem that has been encountered in Azuma's experiment. So, only EO-type sentences like (15) are used.

- (15)a. Furuhashi-san-ga Takashima-san-o tasuketa seinen-ni
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped the young man-DAT
 shigamitsuita.
 clung-to
 "Mr. Furuhashi clung to the young man who helped Mr. Takashima."
- b. A syntactic structure of (15a) [= (7a)]
 Furuhashi-san-ga [_{VP}[_{NP}[_{CP} ec_i^{SUBJ} [_{VP} Takashima-san-o tasuketa]]]
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped
 seinen_i-ni] shigamitsuita.
 the young man-DAT clung-to
 "Mr. Furuhashi clung to the young man who helped Mr. Takashima."
- c. A prosodic structure of (15a) [= (7b)]
 {_{MajP} Furu'hashi-san-ga}{_{MajP} Taka'shima-san-o tasu'keta
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped
 seinen-ni shigamitsu'ita}.
 the young man-DAT clung-to

Participants. Twenty-eight graduate and undergraduate students (17 females and 11 males) at Kyushu University in Japan, all native speakers of Japanese, participated in the experiment. Ages ranged from 19 years and 11 months to 24 years and 6 months, with the average age being 21 years and 9 months with a standard deviation of 1 year and 11 months on the day of testing.

Procedure. Each sentence is presented as an auditory stimulus from headphones. For each trial, an asterisk (*), indicating an eye fixation point, is presented at the center of a screen during the presentation of a sentence. After the auditory presentation, a question mark (?) is presented at the same time as when the asterisk disappears. The participants are instructed to respond as quickly and accurately as possible in deciding whether or not the sentence makes sense. (16) is an example

of sentences of correct ‘No’ responses.

- (16) *Ichi'kawa-san-ga Koizumi-san-o be'ngoshita koochoo-ni nakuna'tta.
 Ichikawa-Mr.-NOM Koizumi-Mr.-ACC defended principal-DAT died

Sentences of correct ‘No’ responses such as (16) have a one-place predicate (e.g., *nakunatta* ‘died’) as a matrix verb, so these sentences are ungrammatical because of θ -criterion violation (Chomsky, 1981). Responses are registered by pressing the keys marked ‘Yes’ or ‘No’. Six practice trials are given to the participants prior to the commencement of the actual testing.

Materials. Thirty-six sets of four conditions each (= 144 sentences) are used in our experiment. Conditions are organized in a 2 x 2 design: the types of prosodic information (# condition vs. #+P condition) and the syntax-prosody alignment (matched condition vs. mismatch condition).

(17) Explanation of conditions (I): the types of prosodic information

a. # condition.

The information which denotes the boundary of MajP is pitch contour resetting.

b. #+P condition.

The information which denotes the boundary of MajP is both pitch contour resetting and pause insertion.

(18) Explanation of conditions (II): the syntax-prosody alignment

a. Matched Condition.

A sentence has a prosodic pattern correctly predicted by an EO-type syntactic structure. Its prosodic pattern (EO-type) matches with its syntactic structure (EO-type).

b. Mismatch Condition.

A sentence has a prosodic pattern predicted by an LO-type syntactic structure. Its prosodic pattern (LO-type) does not match with its syntactic structure (EO-type).

The thirty-six sets of sentences are distributed in a Latin Square design to pre-

vent the problem of repeatedly encountering the same sentence, and we created four lists. Each list of sentences contains thirty-six sentences of correct ‘Yes’ responses, thirty-six sentences of correct ‘No’ responses and twenty-four filler sentences (twelve sentences of correct ‘Yes’ responses and twelve sentences of correct ‘No’ responses). These add up to a total of 96 sentences, which are presented to each participant. Sentences in (19) are examples of sentences of correct ‘Yes’ responses.

(19)a. Matched # condition

Furu'hashi-san-ga #	Taka'shima-san-o	tasu'keta
Furuhashi-Mr.-NOM	Takashima-Mr.-ACC	helped
seinen-ni	shigamitsu'ita.	
the young man-DAT	clung-to	

b. Mismatch # condition.

Furu'hashi-san-ga #	Taka'shima-san-o #	tasu'keta
Furuhashi-Mr.-NOM	Takashima-Mr.-ACC	helped
seinen-ni	shigamitsu'ita.	
the young man-DAT	clung-to	

c. Matched #+P condition.

Furu'hashi-san-ga #+P	Taka'shima-san-o	tasu'keta
Furuhashi-Mr.-NOM	Takashima-Mr.-ACC	helped
seinen-ni	shigamitsu'ita.	
the young man-DAT	clung-to	

d. Mismatch #+P condition.

Furu'hashi-san-ga #+P	Taka'shima-san-o #+P	tasu'keta
Furuhashi-Mr.-NOM	Takashima-Mr.-ACC	helped
seinen-ni	shigamitsu'ita.	
the young man-DAT	clung-to	

Note. “#” denotes the position of pitch contour resetting, “P” denotes the position where pause is inserted.

The means of the F0 peaks in NP-*ga* (NOM), NP-*o* (ACC), and relative verb are presented respectively in Table 1.

Table 1. *The means of the F0 peaks (in Hz) in the three first constituents.*

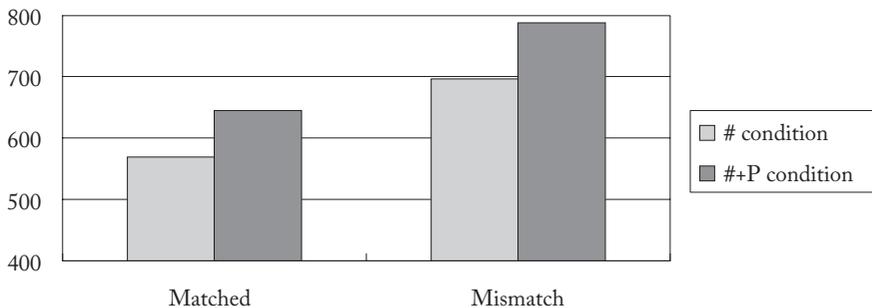
	NP- <i>ga</i> (NOM)	NP- <i>o</i> (ACC)	relative verb
Matched # condition (19a)	202.6	201.7	137.3
Mismatch # condition (19b)	200.9	200.0	200.1
Matched #+P condition (19c)	202.2	204.5	139.9
Mismatch #+P condition (19d)	201.4	201.0	201.0

The means of pause length between NP-*ga* (NOM) and NP-*o* (ACC), and between NP-*o* (ACC) and relative verb are presented respectively in Table 2.

Table 2. *The means of pause length (in millisecond) in the three first constituents.*

	NP- <i>ga</i> (NOM) - NP- <i>o</i> (ACC)	NP- <i>o</i> (ACC) - relative verb
Matched # condition (19a)	21.4	12.0
Mismatch # condition (19b)	21.9	16.8
Matched #+P condition (19c)	407.3	13.3
Mismatch #+P condition (19d)	400.2	400.1

Results. Before performing the analysis, reaction times outside of 2.5 standard deviations at both the high and low ranges were replaced by boundaries indicated by 2.5 standard deviations from the individual means of participants in each category. The statistical tests which follow analyze both participant (F_1) and item (F_2) variability. The means of reaction times and error rates for target sentences for correct 'Yes' responses are presented respectively in Figure 3 and Figure 4.

Figure 3. *Mean Reaction time (in millisecond) for each condition.*

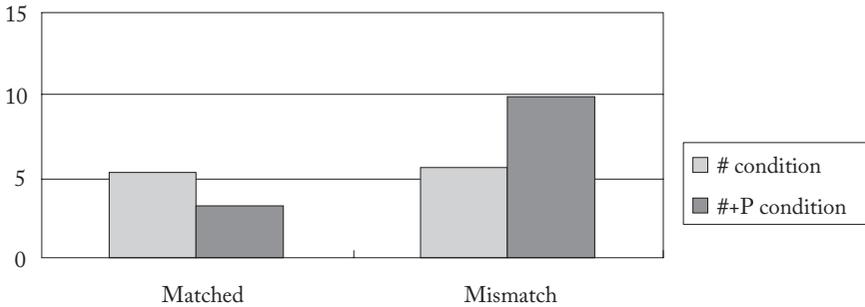


Figure 4. Mean error rate (%) for each condition.

An analyses of variance (ANOVA) with repeated measures was conducted on reaction times and error rates for correct 'Yes' responses. In reaction times, the main effects of both the type of prosodic information (# condition vs. #+P condition) [$F_1(1, 27) = 6.91, p < .05, F_2(1, 35) = 9.10, p < .005$] and the relation between syntactic structure and prosody (matched condition vs. mismatch condition) [$F_1(1, 27) = 19.46, p < .001, F_2(1, 35) = 6.02, p < .05$] were significant. But the interaction between the two factors was not significant [$F_s < 1$]. In error rates, the main effect of the type of prosodic information (# condition vs. #+P condition) was not significant [$F_s < 1$], but the main effect of the relation between syntactic structure and prosody (matched condition vs. mismatch condition) was significant [$F_1(1, 27) = 5.44, p < .05, F_2(1, 35) = 4.29, p < .05$]. And the interaction was significant only in item analysis, but not in subject analysis [$F_1(1, 27) = 2.76, p = .11, F_2(1, 35) = 5.53, p < .05$].

5. General Discussion

The result that the response for the mismatch condition (19b, d) is significantly slower than that for the matched condition (19a, c) shows that the F0 information affects syntactic processing. This result does not contradict Azuma's conclusion. Thus, it is found that the parser utilizes the F0 information not only in first-pass analysis of sentences with global ambiguity but also in second-pass reanalysis of sentences with local (tentative) ambiguity.

On the other hand, the result that the response for the #+P condition (19c, d) is significantly slower than that for the # condition (19a, c) shows that temporal information (i.e., pause) increases processing difficulty. This result is not easily compatible with Azuma's conclusion. He concluded that though influence of temporal information is small and not as much as F0, temporal information facilitates syntactic processing to some extent. If temporal information facilitates syntactic processing, it is predicted that the response time for the #+P condition is shorter, or at least not significantly longer, than the # condition. However, this prediction is not borne out in the results of our experiment.

With regard to the reason why temporal information inhibits syntactic processing of relative clauses in our experiment, it may be pointed out that pause has a close relation with discourse (cf. Sugito, 1989). In a speech production process, discourse information (e.g., focus) has a great influence on the pause length (Lev-elt, 1989). There is a possibility that the existence of a salient pause induces the language processor to start processing discourse information. Simultaneous processing of both syntactic and discourse information may invoke greater processing difficulty. This processing difficulty might have resulted in a longer reaction time in the #+P (pitch reset and pause) Condition.

Acknowledgements

This work has been supported in part by Japan Society for the Promotion of Science, Grant-in-Aid for Scientific Research (A) 17202010, (C) 17520269, and the Center for the Study of Language Performance (Faculty of Humanities, Kyushu University). The authors are grateful to Teo Chuu Yong for proofreading the manuscript.

Note

1. In the case that an *o*-marked NP is inputted next to the *ni*-marked NP *seinen-ni* 'young man-DAT', this ambiguity is resolved before receiving a matrix predicate.

- (i) Furuhashi-san_i-ga Takashima-san-o [_{NP} [ec_i^{SUBJ} ec_j^{OBJ} tasuketa] seinen_j-ni]
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped the young man-DAT
 tegami-o
 a letter-ACC

- (ii) Furuhashi-san_i-ga [_{NP} [ec_i^{SUBJ} Takashima-san-o tasuketa] seinen_i-ni]
 Furuhashi-Mr.-NOM Takashima-Mr.-ACC helped the young man-DAT
 tegami-o
 a letter-ACC

As (i) contains two *o*-marked NPs in a matrix clause, this sentence violates the double *o* constraint (Harada, 1973), which prevents the parser from building a parsing tree like (i). So it has to attach *Takashima-san-o* 'Takashima-Mr.-ACC' to the relative clause as (ii) in order to avoid a double *o* constraint violation. In latter sections, we do not take this case into consideration and take up only the case in which a matrix predicate is inputted next to a head noun of a relative clause.

2. There are some other possibilities about references of the empty categories in (4b). However, as our focus is on the opening point of the relative clause, we leave it open as to how the references of empty categories are determined. (See also Hirose & Inoue (1998), endnote 3, for discussion on this point)

References

- Azuma, J. (1997). Prosodic features marking a syntactic boundary of Japanese (in Japanese). In Spoken Language Working Group (Ed.), *Bunpoo-to Onsee [Grammar and Speech]* (21–44). Tokyo: Kuroshio Publishers.
- Chomsky, N. (1981). *Lectures on Government and Binding*. Dordrecht: Foris Publications.
- Frazier, L., & Fodor, J. D. (1978). The sausage machine: A new two-stage parsing model. *Cognition* 6, 291–325.
- Harada, S.-I. (1973). Counter Equi NP Deletion. *Annual Bulletin* 7, 113–147. University of Tokyo, Research Institute of Logopedics and Phoniatics. [Also in: Fukui, N. (Ed.). (2000). *Syntax and Meaning: S. I. Harada Collected Works in Linguistics* (181–215). Tokyo: Taishukan Publishing.]
- Hirose, Y., & Inoue, A. (1998). Ambiguity of Reanalysis in Parsing Complex Sentences in Japanese. In B. D. Joseph, C. Pollard (Series Eds.) & D. Hillert (Vol. Ed.), *Syntax and Semantics Vol. 31. Sentence Processing: A Crosslinguistic Perspective* (113–147). San Diego, CA: Academic Press.
- Kamide, Y., & Mitchell, D. C. (1999). Incremental Pre-head Attachment in Japanese Parsing. *Language and Cognitive Processes* 14, 631–772.

- Kubozono, H. (1993). *The Organization of Japanese Prosody*. Tokyo: Kuroshio Publishers.
- Levelt, W. J. M. (1989). *Speaking: From Intention to Articulation*. Cambridge, MA: The MIT Press.
- Mazuka, R., & Itoh, K. (1995). Can Japanese Speakers Be Led Down the Garden Path? In R. Mazuka & N. Nagai (Eds.), *Japanese Sentence Processing (295–329)*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- McCawley, J. D. (1968). *The Phonological Component of a Grammar of Japanese*. The Hague: Mouton.
- Miyamoto, E. T. (2002). Case Markers as Clause Boundary Inducers in Japanese. *Journal of Psycholinguistic Research* 31, 307–347.
- Selkirk, E., & Tateishi K. (1991). Syntax and Downstep in Japanese, In C. Georgopoulos & R. Ishihara (Eds.), *Interdisciplinary Approaches to Language. Essays in Honor of S.-Y. Kuroda (519–543)*. Dordrecht: Kluwer Academic Press.
- Sugito, M. (1989). Danwa-ni-okeru poozu to intoneesyon [Pause and Intonation on discourse] (in Japanese). In M. Sugito (Ed.), *Nihongo-to Nihongo Kyooiku 2: Nihongo-no onsei-to onin (Jyoo) [Japanese language and its education 2: Japanese sound and prosody (Vol. 1)]*, (343–364). Tokyo: Meiji-shoin.