The Visibility of Syntactic Movement to Phonological Component in Japanese

A Dissertation Submitted for the Degree
of Doctor of Philosophy in Linguistics

Shingo Sugiyama

Sophia University

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Shingo Sugiyama

M.A., Sophia University, 2002
B.A., Dokkyo University, 2000

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to my parents

Abstract

This study aims at clarifying the interaction between argument structure and prosody in Japanese in connection with movement operation in general through the observation of various sorts of F_0 boosting operations.

We found that the adjunct-argument-head sequences (the normal word order) were pronounced in such a way that the structures yielded a gradually descending F_0 contour, while the argument-adjunct-head sequences (the scrambled word order) were pronounced with higher F_0 values in the adjunct positions than those in the preceding argument positions in both of the NP and the VP cases. In other words, F_0 booting effect was observed on the adjunct positions in the scrambled word order cases. We might interpret this result as argument-adjunct asymmetry on the realization of prosody to the effect that adjuncts consistently induce F_0 booting in Japanese. However, we found that adjuncts did not induce higher F_0 values in the simple adjunct-head sequences than arguments did in the simple argument-head sequences in either NP or VP cases, which implies that the F_0 boosting effect observed in adjunct positions in the scrambled word order may in fact be caused by the leftward movement operation of the arguments. This interpretation was supported by the behaviors of F_0 contours of double object constructions with and without scrambling such that the structures without scrambling yielded the normal downstepping pattern, whereas those with short scrambling showed the F_0 boosting effect immediately after the scrambled object. The generalization from these observations is that leftward movement operation, scrambling, (or traces left behind by the operation) must be visible to phonological component in Japanese in order to produce surface F_0 contours.

Similar observation was found in uniformly left-branching structures consisting of four accented Prosodic Words which involve relative clause structure. When the antecedent stood in the

third position, where the effect of what Kubozono (1989, 1993) calls the Principle of Rhythmic Alternation is expected, it was subject to the principle as expected, or even more than expected, which might cause intonational neutralization between uniformly left-branching structures and symmetrically branching structures as Kubozono (1989, 1993) reports. On the other hand, when the antecedent stood in the fourth position, where the effect of the principle is not expected, F_0 boosting was observed in the antecedent position depending on speakers. Likewise, in uniformly left-branching structures consisting of four unaccented Prosodic Words which involve relative clause structure, when the antecedent stood in the third position, it was highly likely that a Minor Phrase boundary was inserted before the antecedent, resulting in the eurhythmic 2-2 pattern. On the other hand, when the antecedent stood in the fourth position, a Minor Phrase boundary was or was not inserted before the antecedent. However, a Minor Phrase boundary was quite hardly inserted between the second and the third Prosodic Words in that case. Throughout the observation, we concluded that Phonological Phrasing may be sensitive to the internal structure of relative clause construction. In other words, empty category of some sort (empty operator, *pro* or something) in relative clause construction must be visible to phonological component in Japanese on a given condition in order to generate surface pitch contours.

After those discussions, I tried to derive prosodic representations in Japanese in terms of Optimality Theory, following Ito and Mester's (2007) 'prosodic adjunction', which could produce surface F_0 contours in Japanese.

Finally, the main theme of this paper, that is, the visibility of syntactic movement operation to phonological component in Japanese may lead to the reconsideration of whole architecture of grammar. The reason is that since the advent of Generative Grammar, it has been basically regarded as a matter of course that phonological component cannot refer to core syntactic operation, movement, for autonomy of components in the model.

Acknowledgements

First and foremost, I am deeply grateful to Kensaku Yoshida of Sophia University, who supervised my study. Without his valuable comments and suggestions, this thesis would not have been completed. I would also thank Shigeko Shinohara for various comments from the point of view of experimental phonology. I am equally grateful to Haruo Kubozono of National Institute for Japanese Language and Linguistics, who has continuously given me valuable insights since the first meeting with him at an academic conference in 2002. I also appreciate Yasuhiko Kato of Sophia University, who continuously gave me important comments and suggestions from syntactic viewpoint. Thanks are also due to Takahito Shinya, Hisao Tokizaki and Masao Okazaki, with whom I have been able to make interesting discussions on the various issues especially about syntax-phonology interface. I would also like to express my gratitude to Michael Milward for checking my English sentences.

For leading me to the world of phonetics, I am thankful for Tsutomu Sugawara and Keiichi Kojima, whose phonetic training bases my phonetic research today. Furthermore, I cannot thank them enough for their continuous mental support while I was out of condition. On that point, I also thank Kyoko Iitaka and Tamiko Ichijima for continuously encouraging me since I collaborated with them on linguistic aphasiology in 2002.

Of course, I would like to thank all the subjects who participated in the experiments reported in this thesis. Without their earnest cooperation, this thesis would be impossible.

Last but not least, I owe thanks to my parents, Kaoru Sugiyama in heaven and Tamae Sugiyama, and my dear friends, without whose encouragement, I could not have possibly continued the work here reported.

Contents

Introduction

0.1. Goals

This study is an experimental phonological work of pitch or fundamental frequency (hereafter F_0) in Tokyo Japanese in the context above the word level in Generative Grammar, that is, the mapping from syntactic structure to phonological structure, extending my Master Thesis, Sugiyama (2002).[1]

The main theme throughout this thesis is that syntactic movement operation can (and must) be visible to phonological component in Japanese in a systematic manner within the framework of Generative Grammar, the claim which has not hitherto been made in any language as far as I know. In addition, I will claim that empty elements within relative clauses must also be visible to phonological component on a given condition in order to produce surface F_0 contours.

The organization of this thesis is as follows: This thesis consists of five chapters all of which discuss the ups and downs of pitch in the dialect on the basis of experimental evidence. Chapter 1 overviews previous studies in syntax-phonology interface, especially from the point of view of predicate argument structure. There, not only Japanese but also other languages are discussed with the view to crosslinguistic observations. In Chapter 2, the pros and cons through the observations in Chapter 1 are discussed, based on experimental evidence. The point of the chapter is that at least leftward movement must be visible to phonology in Japanese in order to produce actual pitch contours. Chapter 3 discusses the realization of pitch contour in relative clause in Japanese, whose precise structure has yet to reach a consensus. Some claim that if it contains movement operation, the moved element is the empty operator. Others claim that if it does not, *pro* is placed in the original position through coindexation with the head noun. I will claim in the chapter that in any

[1] Throughout this thesis, I will use the terms ‘pitch’ and ‘F_0’ interchangeably. Tokyo Japanese is a dialect which is often loosely identified as standard Japanese.

case, the internal structure of relative clause (to be more specific, empty element of some sort) must be visible to phonological component on a given condition in Japanese so as to yield surface F_0 contours. Chapter 4 argues prosodic representation in Japanese on the basis of the results obtained in the previous chapters with Optimality Theory (Prince and Smolensky (1993). Lastly, Chapter 5 discusses theoretical implications from the previous discussion, and suggests the model that may explain the visibility of syntactic movement and some empty categories to phonological component in Japanese and that is compatible with the current Minimalist Program (Chomsky (2001)) including the notion of phase.

Last but not least, throughout this thesis, I will try to keep the analyses taken in this study as theory-neutral as possible.

0.2. Methodology

0.2.1. Subjects

One male and two female native Japanese speakers participated in the experiments reported here. One female speaker in her mid-thirties (YK) was raised in Tokyo, and the other female speaker in her thirty (AM) and the male speaker in his mid-twenties (SK) in Kanagawa prefecture in the vicinity of Tokyo. We can regard all of them as native speakers of Tokyo Japanese. They are all non-linguists.

0.2.2. Recording Procedure

All the recordings here reported were made in the studio of the Phonetics Laboratory at Sophia University.

All the gained materials were recorded on digital audio tapes (DAT). The subjects were not informed of the precise purpose of the experiments. They simply read the test sentences (or phrases) written in several papers at normal rate of speech. The sentences were randomly ordered and each of the speakers read the sentences eleven times per sentence.

0.2.3. Recorded Materials

The recorded materials were composed of as many sonorants as possible in relation to the naturalness of meaning of the test sentences in order to avoid the effect of the perturbations on the actual F_0 contours which might be expected to be caused by obstruents.

The sentence frame in which the test sentences were placed is *Yamadawa … toitta* "Yamada-Topic" … "said" = "Yamada said …".[2] Yamada is a surname which is very familiar to Japanese people.

0.2.4. Editing the Recordings

All the analyses were made on a computer screen using Praat created and developed by Paul Boersma and David Weenink at the University of Amsterdam. The materials were digitized with 44,100 sampling rate and 16 bit quantization level.

0.2.5. Statistical Interpretation

It is very important to present a statistical interpretation of the gained experimental data in order to employ them as reliable evidence for the claims made in this thesis. Throughout this work, I will use *t-test* for the comparison of the relevant two means in order to examine whether the values in question are so different as to be statistically significant. As usual, the level of .05 in two-tailed scales is considered as the standard showing the minimum level of significance in this thesis.

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[2] The reason for placing the test sentences in such a framework is to avoid the effect of 'final-lowering' to the effect that the F_0 level is suppressed in sentence-final position according to Pierrehumbert and Beckman (1988).

Chapter 1: Previous Studies on Syntax-Phonology Interface

1.1. Overview

1.1.1. Phonological Phrasing

Over the past three decades or so, we have seen the development of the studies concerning syntax-phonology interface in a variety of languages. Especially in 1980s, the researchers had earnestly discussed how syntactic component and phonological component link and concluded that there exists an independent level of representation between the two (e.g. Inkelas's (1989) Indirect Reference Hypothesis), contrary to, for example, the direct reference approach by Kaisse (1985), which claimed that phonological processes can make direct reference to higher level categories of syntax. The level of representation in question is called 'prosodic structure'. In general, prosodic structure is supposed to consist of some independent categories, Syllable, Foot, Prosodic Word, Phonological Phrase, Intonational Phrase and Utterance from bottom up.[3] Most of the researchers in this field have taken deep interest in Phonological Phrase among others since the formation of Phonological Phrase tends to be closely related to syntactic structure crosslinguistically. I will also discuss several phenomena that occur in the domain of Phonological Phrase within the framework of Generative Grammar (Chomsky (1957, 1965, 1972, 1981, 1995, 2001)) in this thesis.[4]

There have been two main approaches to Phonological Phrasing (with the exception of the advent of Optimality Theory (Prince and Smolensky (1993))), end-based approach (Selkirk (1986)) and relation-based approach (Nespor and Vogel (1986), Hayes (1989), among others). However, these two approaches each have advantages and disadvantages.

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[3] On top of those levels, Japanese has the 'Mora' level below the Syllable level.

[4] It has been argued that Phonological Phrase divides into two subtypes in Japanese, one of which is 'Major Phrase', a domain for downstep, and the other is 'Minor Phrase', a domain for Initial Lowering. I will explain the definitions of these two phenomena later in the discussion. Moreover, following Kubozono (1993), I use the term 'downstep' for what Pierrehumbert and Beckman (1988) call 'catathesis' for our familiarity with the term.

The original end-based approach claims that Phonological Phrases are derived by reference to the right or left ends of syntactic constituents of some level (for example, maximal projections). This algorithm itself is very simple, but due to its simplicity, many phenomena that do not follow the algorithm have been found in many languages. For instance, Hale and Selkirk (1987) propose a parameter 'lexical government' in that approach in order to account for Phonological Phrasing in Tohono O'odham. Phonological Phrase is a domain of the distinctive tonal pattern in the language. The definition of lexical government is that a lexical head *A* governs *B* if and only if *A* m-commands *B* and every barrier for *B* dominates *A*. They argue that the right end of an XP that is not lexically governed corresponds to the right end of a Phonological Phrase in Tohono O'odham. Self-explanatorily, the notion of lexical government is extremely syntactic, so phonology includes unnecessary syntactic information. Furthermore, there remains another problem with this approach, which has been dealt with in a number of literatures, that is, branchingness. Cowper and Rice (1987), for example, argue that in Mende, consonant mutation occurs in a Phonological Phrase that is formed by reference to the left edge of a syntactic maximal projection which is branching. Moreover, Bickmore (1990) examines the phonological status of a rule, High Tone Deletion in Kinyambo and concludes that the rule applies within a Phonological Phrase made by reference to the right edge of a syntactic maximal projection that is branching. Cowper and Rice (1987) argue that introducing the parameter, branchingness, is a small price to pay for the elimination of direct reference to syntax, but the parameter is not a standard syntactic feature, and so this move may weaken the end-based approach, one of whose great virtues is an extremely principled access to syntactic information.

To sum up, these two notions of lexical government and branchingness are the main disadvantages of the approach (for Phonological Phrasing in Japanese by this approach, see Selkirk and Tateishi (1988, 1991)).

On the other hand, relation-based approach mainly claims that Phonological Phrases contain a head and all elements on the non-recursive side of the head that are still within the maximal projection of the head, and requires such parameters as [1] obligatory, optional, or prohibited inclusion of the first complement on the recursive side of the head and [2] the complement may or may not branch. Although the approach may be able to explain certain degree of Phonological Phrasing in natural languages, it may be unnecessarily rich and lack predictive power (for further discussion about these two approaches, see Inkelas and Zec (1990, 1995)).

1.1.2. Argument-Adjunct Asymmetry in Phonological Phrasing

1.1.2.1. Crosslinguistic Observations

In connection with relation-based approach, some researchers insist that argument-adjunct distinction may play a crucial role in the realization of prosody. For example, Gussenhoven (1992) argues that in English, only the argument is stressed in a verb-argument sequence, whereas both the verb and the adjunct are stressed in a verb-adjunct sequence as in (1) (Gussenhoven (1992:87). Upper cases represent stressed constituents).[5]

(1) a. John remained in the TENT.

b. John SMOKED in the TENT.

Gussenhoven (1992) also claims that similar observation to the above one can be found in Dutch. The corresponding stress patterns to those in (1) are as follows:

(2) a. Jan is in de TENT gebleven. (=1a)

b. Jan heeft in de TENT geROOKT. (=1b)

5 For more details about argument-adjunct asymmetry in Phonological Phrasing in English, see Gussenhoven (1984), Selkirk (1984, 1995), among others.

He discusses that in Dutch, only the argument is stressed in an argument-verb sequence, whereas both the adjunct and the verb are stressed in an adjunct-verb sequence.

Meanwhile, Chen (1987) argues that in Xiamen, Phonological Phrasing is determined as a domain of tone sandhi by reference to the right edge of syntactic maximal projections except where maximal projection is an adjunct, whereas an XP argument induces a Phonological Phrase boundary on its right. For instance, he states that in the string (3), there are two readings in both phonetic and semantic senses (Chen (1987:117)).

(3) Bi-kok (#) ts'ut # e k'i-ts'ia
U.S. make particle car
'U.S.-made cars'
(where '#' indicates nonapplication of tone sandhi.)

In one reading, the NP *Bi-kok* 'U.S.' is interpreted as the subject (i.e., argument) of *ts'ut* 'make' within the relative clause, and is bounded on the right by a Phonological Phrase boundary. In the other reading, the NP *Bi-kok* behaves as an adjunct of *ts'ut* and tone sandhi takes place between *Bi-kok* and *ts'ut*.

In addition, Chen (1990) claims that in Basque, vowel degemination occurs within a Phonological Phrase that is constructed by reference to the right edge of the argument NP of the head verb but not by reference to that of the adjunct adverb of the head verb. Examples of those phrasing patterns are as follows (Chen (1990:40)):

(4) hark [librua ong(i) = irakurri zuen]

he book well read Aux

'He read the book well.'

(5) hark [librua # arin irakurri zuen]

he book quickly read Aux

'He read the book quickly.'

(where '=' indicates application of vowel degemination, and '#' blocking of it.)

In sentence (4), the adjunct adverb *ongi* 'well' does not induce a Phonological Phrase boundary on its right, so vowel degemination occurs between the adjunct *ongi* and the head verb *irakurri* 'read'. In sentence (5), on the other hand, the argument NP *librua* 'book' does induce a Phonological Phrase boundary on its right, so vowel degemination is blocked between the argument *librua* and the adjunct adverb *arin* 'quickly'.

Chen (1990) therefore concludes that in Phonological Phrasing, the notion of argument and adjunct may need to be referred to.

Thus far, we have seen the cases where argument and adjunct behave in a different fashion in Phonological Phrasing crosslinguistically. In the next subsection, we will see that similar observation can be found in Japanese as well.

1.1.2.2. In Japanese

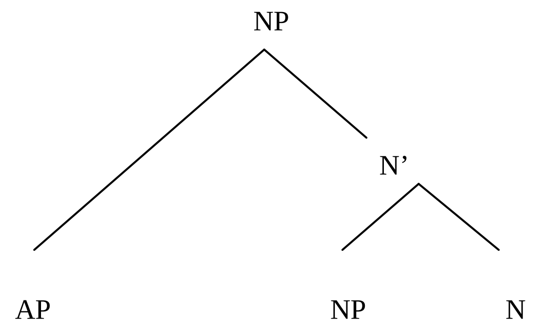
Sugiyama (2002) claims that argument-adjunct asymmetry in prosodic structuring can be found in Japanese as well. For the following discussion, let us see the experimental result from

Sugiyama (2002) in detail.

In the experimental study, five native Japanese speakers (one male and four females) read twelve pairs of sentences five times per sentence. The sentences are divided into two groups according to their internal constructions. The members of one group each consist of NP and those of the other group of VP. In each pair, one is comprised of the accented adjunct-argument-head strings (the normal word order in Japanese) and the other of the accented argument-adjunct-head strings (the scrambled word order) in both NP and VP cases. The tree structures in the respective cases are shown in (6) and (7).

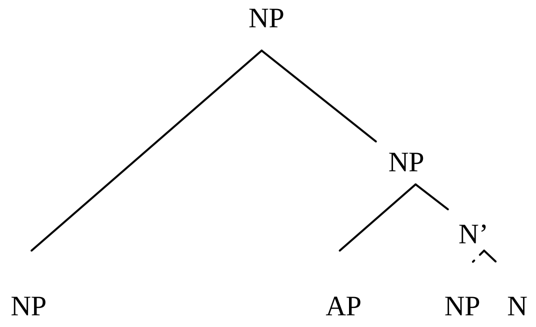
NP case:

(6) a. normal word order



$[_{NP}$ adjunct $[_{N'}$ argument $[_{N}$ head noun]]]

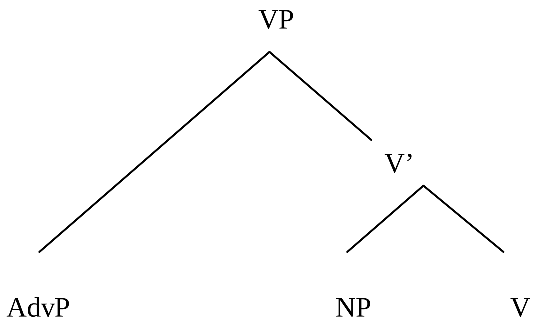
b. scrambled word order



[$_{NP}$ [argument]$_i$ [$_{NP}$ adjunct [$_{N'}$ [t_i] [$_N$ head noun]]]]

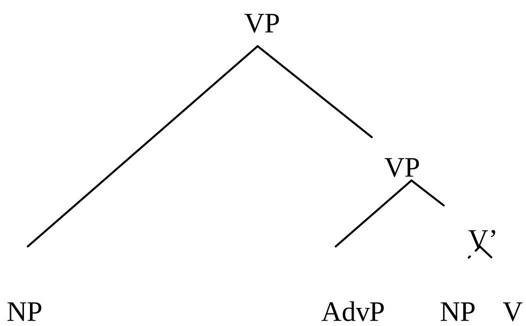
VP case:

(7) a. normal word order



[$_{VP}$ adjunct [$_{V'}$ argument [$_V$ head verb]]]

b. scrambled word order



[$_{VP}$ [argument]$_i$ [$_{VP}$ adjunct [$_{V'}$ [t_i] [$_V$ head verb]]]]

The pairs of examples in the respective cases are as follows (underlines indicate those three accented phrases in question and “ ’ ” indicates accents. In each pair, (a) is in the normal word order and (b) in the scrambled one):

NP case:

(8) a. ta’roo-wa daiki’bona do’oro-no ko’oji-ni tazusawa’t-ta

Taro -Top large scale road-Gen construction-Dat be engaged in-Past

‘Taro was engaged in the large-scale construction of the road.’

b. ta’roo-wa do’oro-no daiki’bona ko’oji-ni tazusawa’t-ta

‘Taro was engaged in the large-scale construction of the road.’

(9) a. ta’roo-wa so’okino ba’iku-no shu’uri-o moto’me-ta

Taro -Top early motorbike-Gen repair-Acc ask for-Past

‘Taro asked for the early repair of the motorbike.’

b. ta’roo-wa ba’iku-no so’okino shu’uri-o moto’me-ta

‘Taro asked for the early repair of the motorbike.’

(10) a. ta’roo-wa taegata’i no’do-no itami’ni zekkusi-ta

Taro-Top intolerable throat-Gen ache-Dat find no word to say-Past

‘Taro found no word to the intolerable ache of his throat to say.’

b. ta’roo-wa no’do-no taegata’i itami’ni zekkusi-ta

‘Taro found no word to the intolerable ache of his throat to say.’

(11) a. ta’roo-wa waka’i o’ngaku-no sense’e-to siria’t-ta

Taro-Top young music-Gen teacher-Acc become acquainted with-Past

‘Taro became acquainted with a young teacher of music.’

b. ta’roo-wa o’ngaku-no waka’i sense’e-to siria’t-ta

‘Taro became acquainted with a young teacher of music.’

(12) a. ta’roo-wa juubu’nna ju’gyoo-no ju’mbi-o suma’se-ta

Taro-Top sufficient lesson-Gen preparation-Acc finish-Past

‘Taro finished sufficient preparation for the lesson.’

b. ta’roo-wa ju’gyoo-no juubu’nna ju’mbi-o suma’se-ta

‘Taro finished sufficient preparation for the lesson.’

(13) a. ta’roo-wa kitana’i ra’gubii-no yu’nifoomu-o mituke-ta

Taro-Top dirty rugby-Gen uniform-Acc find-Past

‘Taro found a dirty uniform of rugby.’

b. ta’roo-wa ra’gubii-no kitana’i yu’nifoomu-o mituke-ta

‘Taro found a dirty uniform of rugby.’

VP case:

(14) a. ta'roo-wa <u>aza'yakani ha'nnin-o su'irisi-ta</u> so'oda

Taro-Top vividly criminal-Acc guess-Past be said-Pres

'Taro is said to have vividly guessed the criminal.'

b. ta'roo-wa <u>ha'nnin-o aza'yakani su'irisi-ta</u> so'oda

'Taro is said to have vividly guessed the criminal.'

(15) a. ta'roo-wa <u>sumi'yakani oku'gaini hi'nansi-ta</u> so'oda

Taro-Top promptly outdoors evacuate-Past be said-Pres

'Taro is said to have promptly evacuated outdoors.'

b. ta'roo-wa <u>oku'gaini sumi'yakani hi'nansi-ta</u> so'oda

'Taro is said to have promptly evacuated outdoors.'

(16) a. ta'roo-wa <u>iso'ide nakama'-o kyu'ujosi-ta</u> so'oda

Taro-Top hastily companion-Acc rescue-Past be said-Pres

'Taro is said to have hastily rescued his companion.'

b. ta'roo-wa <u>nakama'-o iso'ide kyu'ujosi-ta</u> so'oda

'Taro is said to have hastily rescued his companion.'

(17) a. ta'roo-wa <u>nigi'yakani tanjo'obi-o sugo'si-ta</u> so'oda

Taro-Top merrily birthday-Acc pass-Past be said-Pres

'Taro is said to have merrily passed his birthday.'

b. ta'roo-wa <u>tanjo'obi-o nigi'yakani sugo'si-ta</u> so'oda

'Taro is said to have merrily passed his birthday.'

(18) a. ta'roo-wa <u>kokoroyo'ku ka'nji-o hikiu'ke-ta</u> so'oda

Taro-Top willingly organizer-Acc take on-Past be said-Pres

'Taro is said to have willingly taken on the role of the organizer.'

b. ta'roo-wa <u>ka'nji-o kokoroyo'ku hikiu'ke-ta</u> so'oda

'Taro is said to have willingly taken on the role of the organizer.'

(19) a. ta'roo-wa <u>ukka'ri me'gane-o oto'si-ta</u> so'oda

Taro-Top carelessly glasses-Acc drop-Past be said-Pres

'Taro is said to have carelessly dropped his glasses.'

b. ta'roo-wa <u>me'gane-o ukka'ri oto'si-ta</u> so'oda

'Taro is said to have carelessly dropped his glasses.'

The line graphs of the mean F_0 peak values of the successive accented syllables in each case for the five speakers are as follows (adopted from Sugiyama (2002)):

NP case:

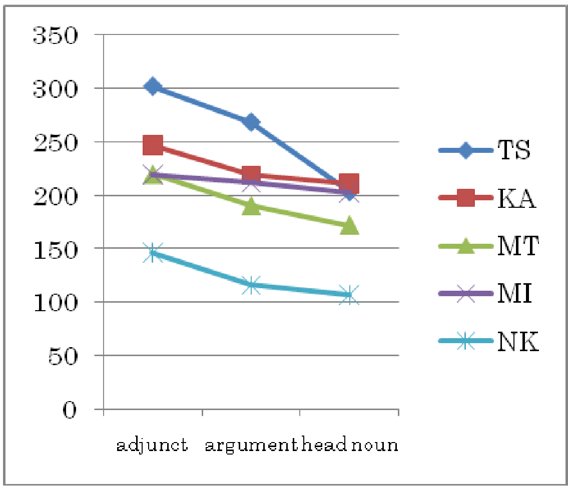


Figure 1: F_0 line graphs of the accented syllables in (8a) for five speakers.

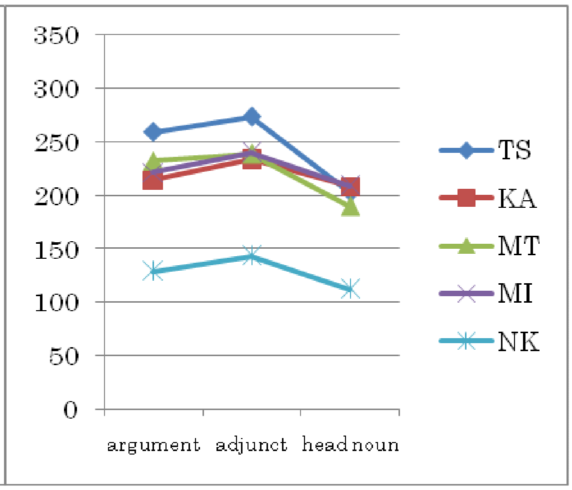


Figure 2: F_0 line graphs of the accented syllables in (8b) for five speakers.

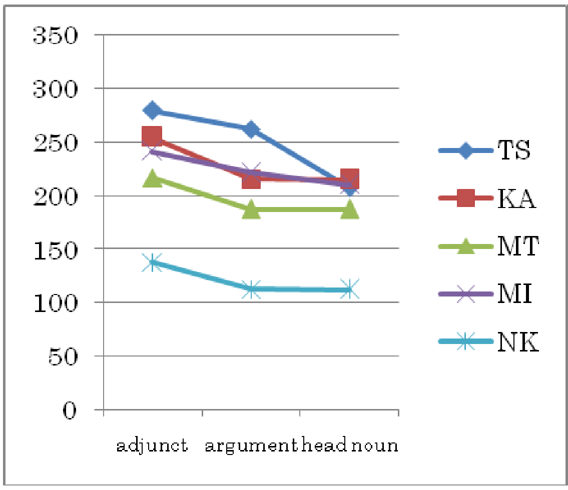


Figure 3: F_0 line graphs of the accented syllables in (9a) for five speakers.

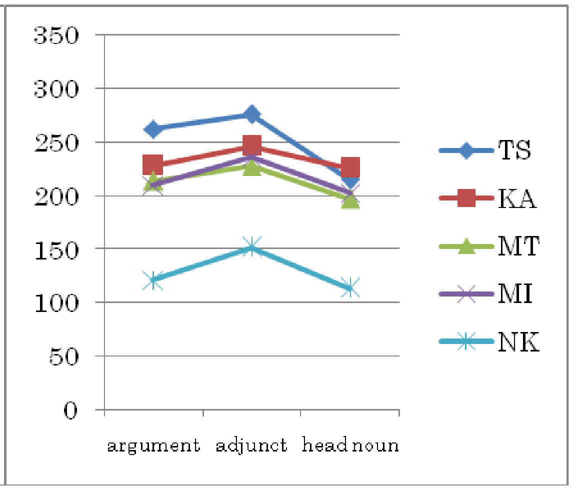


Figure 4: F_0 line graphs of the accented syllables in (9b) for five speakers.

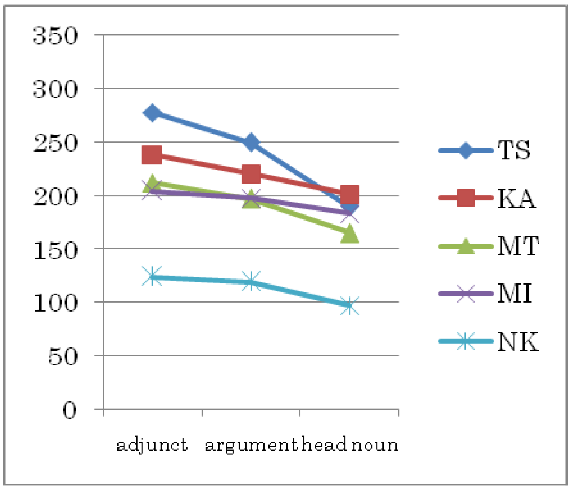


Figure 5: F_0 line graphs of the accented syllables in (10a) for five speakers.

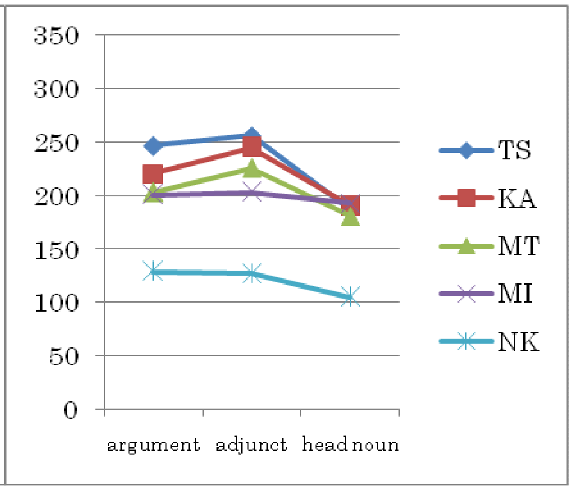


Figure 6: F_0 line graphs of the accented syllables in (10b) for five speakers.

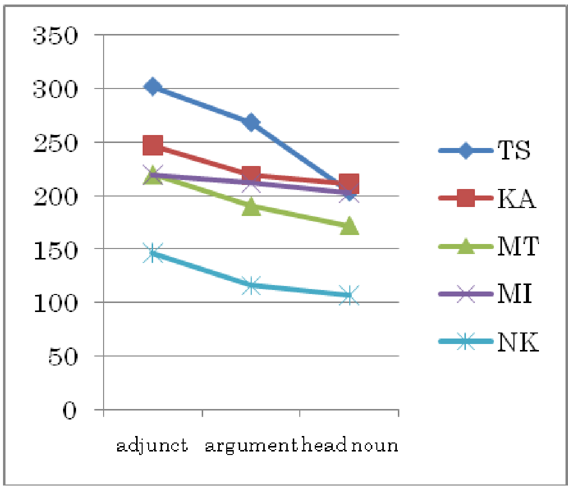


Figure 7: F_0 line graphs of the accented syllables in (11a) for five speakers.

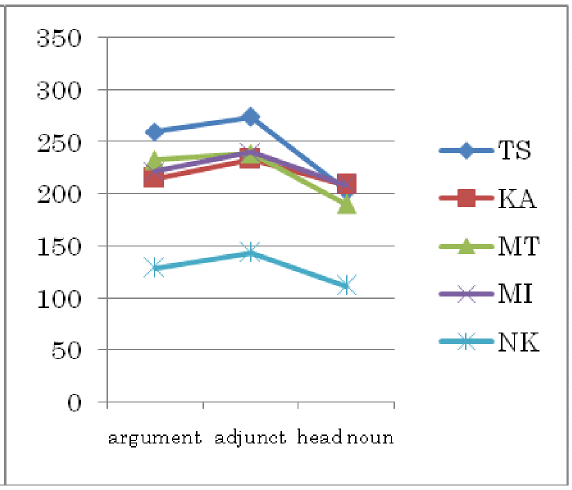


Figure 8: F_0 line graphs of the accented syllables in (11b) for five speakers.

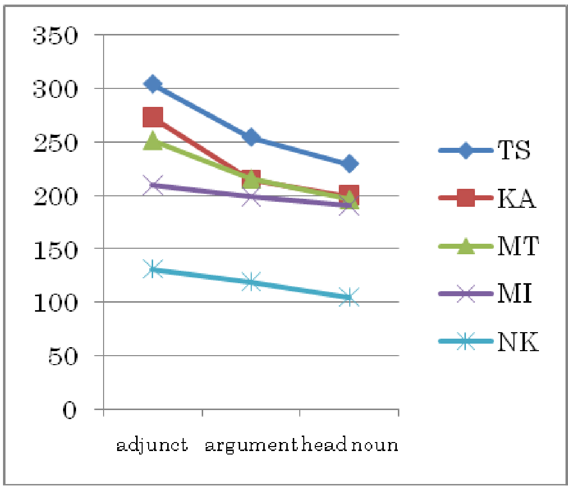


Figure 9: F_0 line graphs of the accented syllables in (12a) for five speakers.

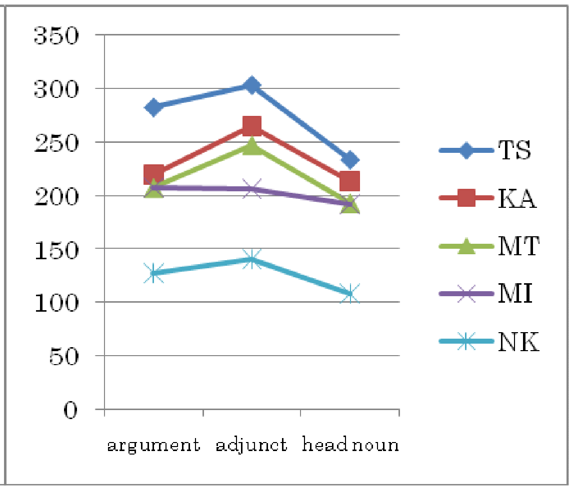


Figure 10: F_0 line graphs of the accented syllables in (12b) for five speakers.

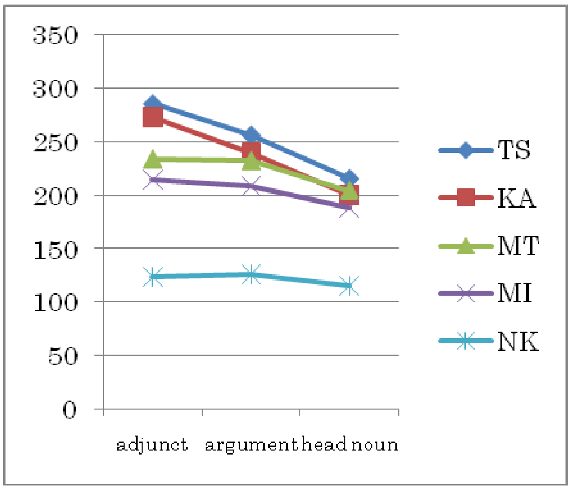


Figure 11: F_0 line graphs of the accented syllables in (13a) for five speakers.

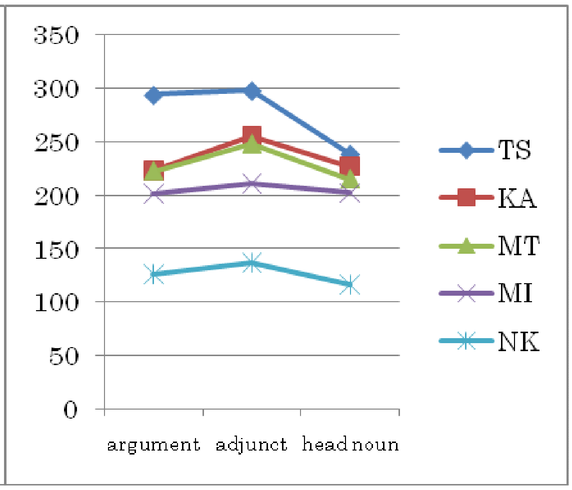


Figure 12: F_0 line graphs of the accented syllables in (13b) for five speakers.

VP case:

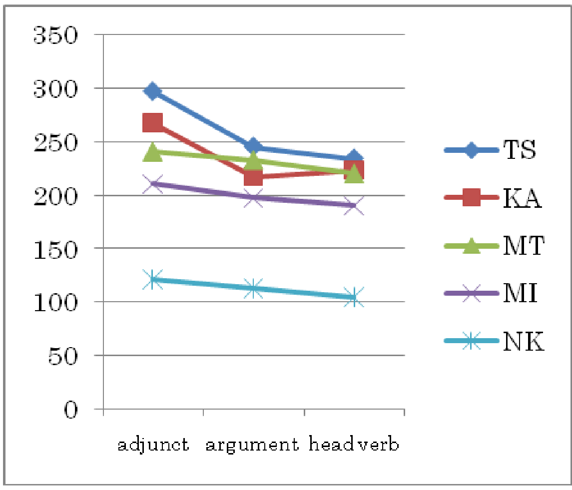


Figure 13: F_0 line graphs of the accented syllables in (14a) for five speakers.

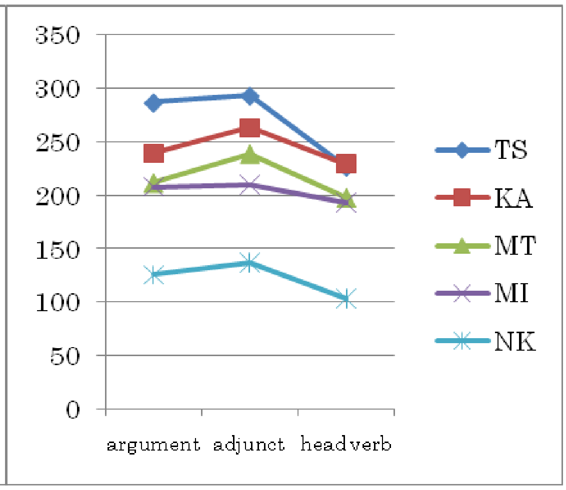


Figure 14: F_0 line graphs of the accented syllables in (14b) for five speakers.

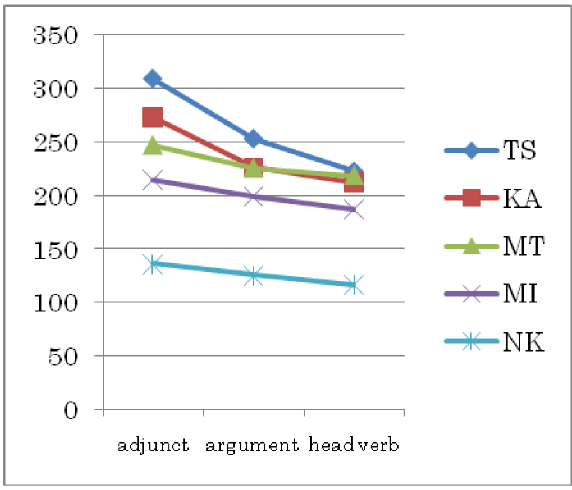


Figure 15: F_0 line graphs of the accented syllables in (15a) for five speakers.

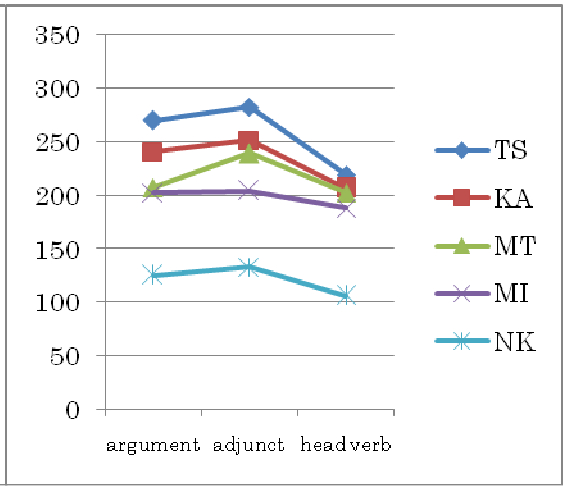


Figure 16: F_0 line graphs of the accented syllables in (15b) for five speakers.

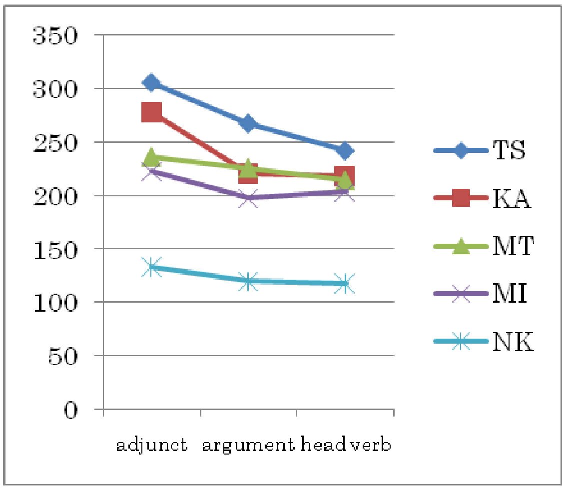


Figure 17: F_0 line graphs of the accented syllables in (16a) for five speakers.

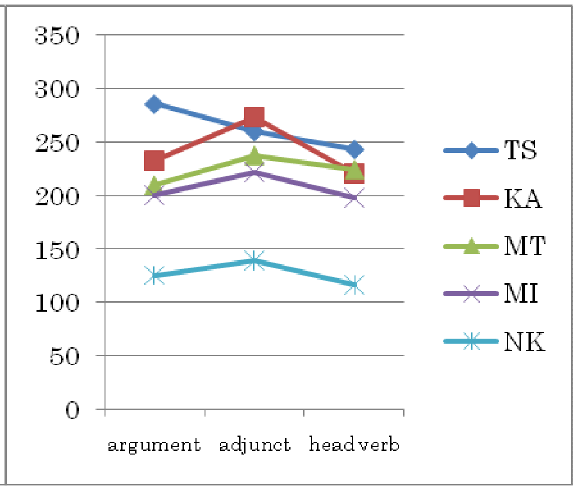


Figure 18: F_0 line graphs of the accented syllables in (16b) for five speakers.

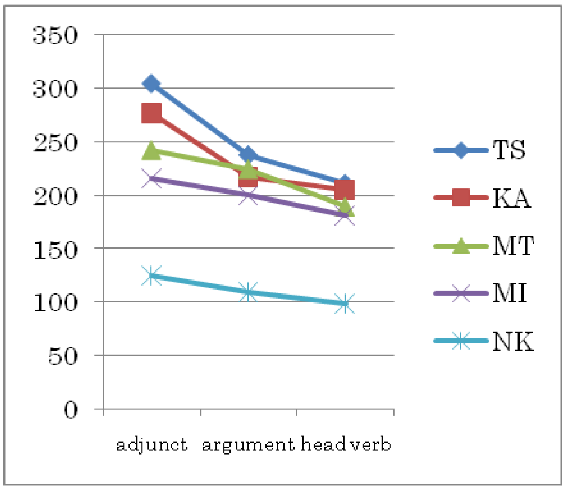


Figure 19: F_0 line graphs of the accented syllables in (17a) for five speakers.

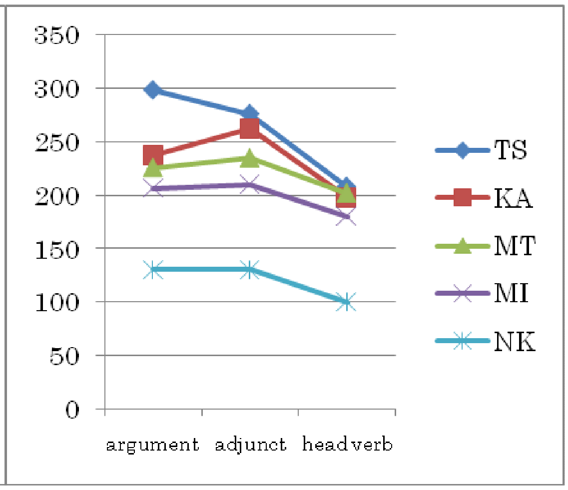


Figure 20: F_0 line graphs of the accented syllables in (17b) for five speakers.

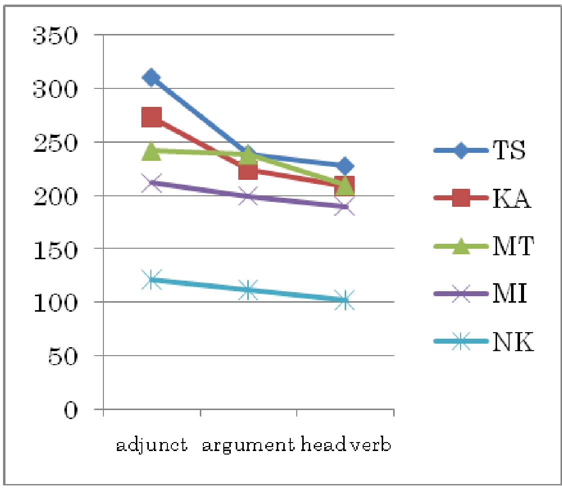


Figure 21: F_0 line graphs of the accented syllables in (18a) for five speakers.

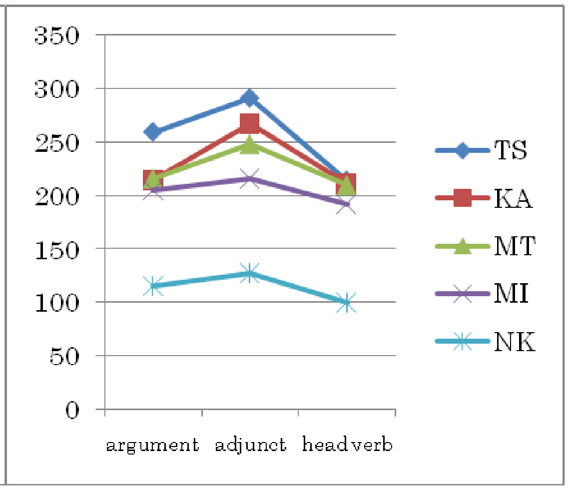


Figure 22: F_0 line graphs of the accented syllables in (18b) for five speakers.

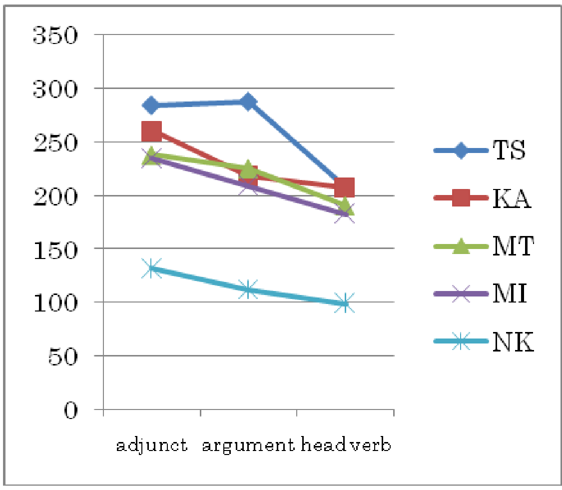


Figure 23: F_0 line graphs of the accented syllables in (19a) for five speakers.

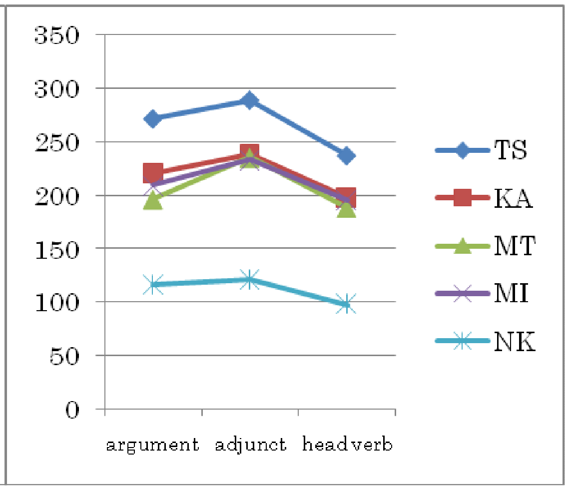


Figure 24: F_0 line graphs of the accented syllables in (19b) for five speakers.

As is clearly shown in the figures, the five speakers all pronounced the adjunct-argument-head strings in such a way that the structures yielded a gradually descending F_0 contour, while they pronounced the argument-adjunct-head strings with higher F_0 values in the adjunct positions than those in the preceding argument positions in almost all of the NP and the VP cases. In other words, we can see the F_0 booting effect on the adjunct positions in the scrambled word order cases.

Although they all showed the statistically significant argument-adjunct asymmetry effect on the manifestation of prosody in all the sentences, there remained a few methodological problems in that study (for the details of the statistics, see Sugiyama (2002)). Some of the sentences used in the experiment include high vowels in the crucial accented syllables, some of which are adjacent to voiceless obstruents, which might cause undesired F_0 boosting effect.

In the next chapter, I will show the result of the experiment to the effect that argument-adjunct asymmetry in prosodic structuring in Japanese reported on Sugiyama (2002) is reproducible. By way of the introduction, I will argue that the seeming argument-adjunct asymmetry effect on the manifestation of prosody can indeed be reduced to the leftward movement operation ‘scrambling’ in general, also with scrambling in double object constructions in mind.

Chapter 2: Visibility of Leftward Movement to Phonological Component in Japanese

2.1. A Check Experiment on Argument-Adjunct Asymmetry in Realization of Prosody in Japanese

2.1.1. The Validity of the Results in Sugiyama (2002)

In the preceding chapter, we saw the seeming argument-adjunct asymmetry effect on the realization of prosody in Japanese. At the same time, it was mentioned that there were a few methodological problems to verify that effect.

For confirmation, I made an experiment about whether the argument-adjunct asymmetry effect reported on Sugiyama (2002) is reproducible or not, by rearranging the test sentences. In particular, the following four points were paid more attention to from a phonetic viewpoint: [1] the number of moras in each Prosodic Word, [2] the position of accented mora in each Prosodic Word, [3] the height of the vowel in accented mora, [4] the adjacent consonants to accented vowel. As for [1] and [2], Kubozono (1993) notes that both the number of moras and the position of accented mora in each Prosodic Word may induce the difference in the peak F_0 values in a Prosodic Word. Whalen and Levitt (1995) mention that the higher a vowel is in vowel space, the higher its F_0 value is. Therefore, for criterion [3], I did not use the high vowels in the crucial accented positions. With regard to [4], it is widely accepted that obstruents may cause the F_0 boosting (what Laver (1994) calls ‘microprosodic perturbation’), and so I used as many sonorants in onsets of the accented syllables and in consonants immediately following them as possible.

One subject (YK, female) read the pairs of the test sentences concerning argument-adjunct asymmetry in the realization of prosody. As was noted in Introduction, subjects read each test sentence eleven times in total placed in randomized order throughout this thesis. The test sentences including either adjunct-argument-head string or argument-adjunct-head string in NP or VP are the following (the strings in question are underlined and in each pair, (a) is in the normal word order and (b) in the scrambled one):[6]

NP case:

(1) a. ao’yama-wa <u>yowa’musina bare’ebu-no me’mbaa-da</u>

Aoyama-Top timid volleyball club-Gen member-be-Pres

‘Aoyama is a timid member of the volleyball club.’

b. ao’yama-wa <u>bare’ebu-no yowa’musina me’mbaa-da</u>

‘Aoyama is a timid member of the volleyball club.’

(2) a. o’ohara-wa <u>o’oheena ma’nshon-no o’onaa-da</u>

Ohara-Top arrogant condominium-Gen owner-be-Pres

‘Ohara is an arrogant owner of the condominium.’

b. o’ohara-wa <u>ma’nshon-no o’oheena o’onaa-da</u>

‘Ohara is an arrogant owner of the condominium.’

[6] The test sentences involve obstruents adjacent to accented vowels on rare occasion. I gave preference to the naturalness of meaning over the phonetic consideration in such a case. The copula verb /da/ in (1) and (2) is prosodically attached to the preceding noun, which does not affect the overall pitch pattern.

VP case:

(3) a. na’oya-ga <u>ne’muro-de wa’in-o no’n-da</u>

Naoya-Nom Nemuro-Loc wine-Acc drink-Past

‘Naoya drank wine in Nemuro.’

b. na’oya-ga <u>wa’in-o ne’muro-de no’n-da</u>

‘Naoya drank wine in Nemuro.’

(4) a. a’mano-ga <u>mo’rimori go’han-o ta’be-ta</u>

Amano-Nom heartily rice-Acc eat-Past

‘Amano ate heartily.’

b. a’mano-ga <u>go’han-o mo’rimori ta’be-ta</u>

‘Amano ate heartily.’

I list the mean F_0 peak values of accented syllables of those three phrases in question (plus those of the first phrase) in the upper rows and the Standard Deviations (hereafter SD) in the lower rows respectively, and line graphs of the F_0 values of those accented syllables in each sentence are shown below.

	P1	P2	P3	P4
1a	314.0	290.3	270.5	234.3
	8.77	9.24	12.87	6.85
1b	314.5	279.4	285.9	224.7
	6.42	10.25	8.98	15.35

Table 1: Mean peak F_0 values and SDs of the four phrases in (1) for speaker YK.

	P1	P2	P3	P4
2a	307.6	294.5	255.8	233.8
	7.84	8.33	16.61	12.86
2b	307.7	278.7	277.5	224.7
	14.05	11.43	13.81	8.91

Table 2: Mean peak F_0 values and SDs of the four phrases in (2) for speaker YK.

	P1	P2	P3	P4
3a	312.0	286.5	266.8	203.4
	7.99	8.33	16.61	12.86
3b	313.1	268.8	291.7	210.5
	8.97	13.62	10.23	11.14

Table 3: Mean peak F_0 values and SDs of the four phrases in (3) for speaker YK.

	P1	P2	P3	P4
4a	319.5	294.6	248.1	210.0
	9.78	14.19	23.50	10.63
4b	318.9	265.3	292.5	206.3
	10.26	10.51	7.01	8.79

Table 4: Mean peak F_0 values and SDs of the four phrases in (4) for speaker YK.

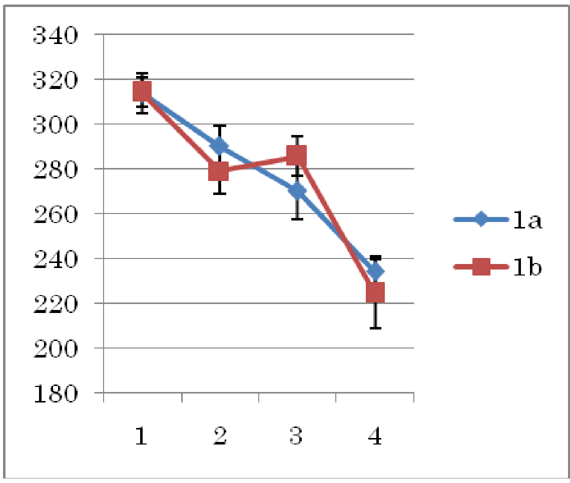


Figure 1: F_0 line graphs of the accented syllables in (1) for speaker YK.

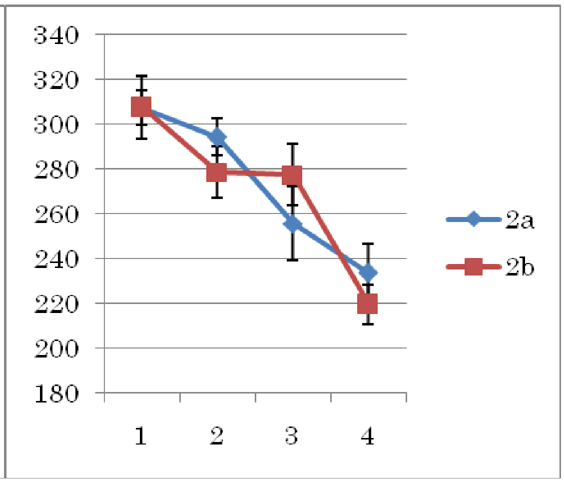


Figure 2: F_0 line graphs of the accented syllables in (2) for speaker YK.

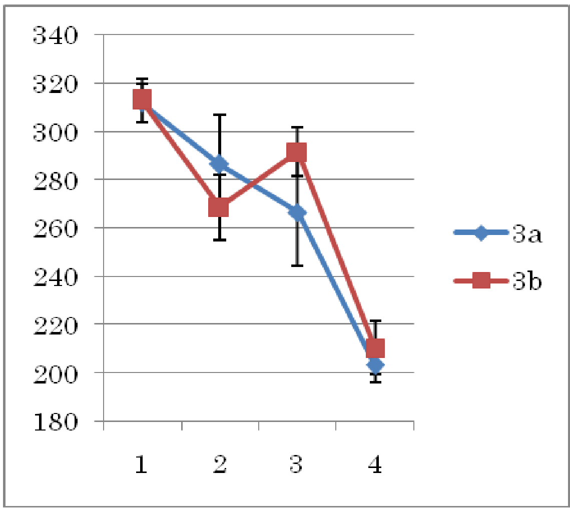


Figure 3: F_0 line graphs of the accented syllables in (3) for speaker YK.

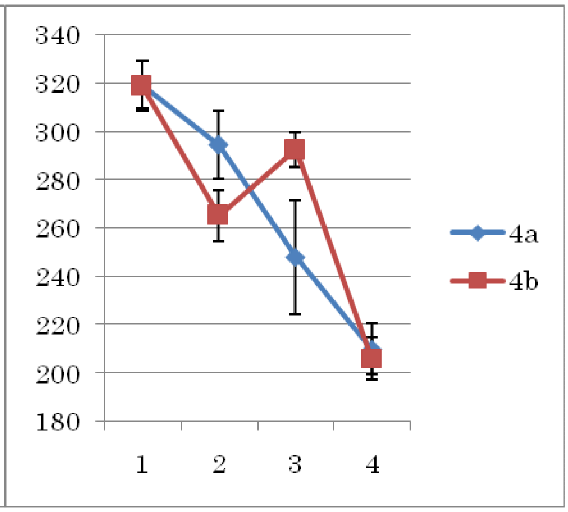


Figure 4: F_0 line graphs of the accented syllables in (4) for speaker YK.

As shown in Figures 1 – 4, in all the pairs, sentence (a) exhibits the gradually descending F_0 pattern, whereas in sentence (b) F_0 boosting occurs consistently in adjunct positions to such an extent that the F_0 value in the adjunct is higher than that in the preceding argument. The differences between the second and the third peaks are all significantly different ((1): p(T= 5.346)<.001, (2): p(T=5.720) <.001, (3): p(T=3.766)<.01, (4): p(T= 8.520)<.001 (all 20 degrees of freedom (hereafter ‘df’))).

It can be concluded that the argument-adjunct asymmetry effect on the realization of prosody in Japanese reported on Sugiyama (2002) is indeed reproducible.

2.2. An Alternative Analysis of the Argument-Adjunct Asymmetry Analysis

2.2.1. Argument-Head String VS Adjunct-Head String

Although we have been able to confirm the apparent argument-adjunct asymmetry effect, an alternative analysis can be found here; note that the F_0 boosting effect observed in adjunct positions in the scrambled word order may in fact be caused by the leftward movement operation of the arguments itself.

To see the validity of the hypothesis, two other experiments were carried out. First, I investigated whether adjuncts induce higher F_0 values in the simple adjunct-head strings than arguments do in the simple argument-head strings, in which no scrambling operation is involved. If there does not exist any difference in the F_0 values between adjuncts and arguments, we cannot say that adjuncts consistently induce F_0 boosting effect.

Three native speakers of Tokyo Japanese referred to in Introduction, YK, AM and SK read the following four pairs of sentences associated with sentences (1) - (4) (in each pair, (a) is the augment-head string, and (b) is the adjunct-head string):

NP case:

(5) (cf. (1)) a. ao’yama-wa <u>bare’ebu-no me’mbaa-da</u>

‘Aoyama is a member of the volleyball club.’

b. ao’yama-wa <u>yowa’musina me’mbaa-da</u>

‘Aoyama is a timid member.’

(6) (cf. (2)) a. o’ohara-wa <u>ma’nshon-no o’onaa-da</u>

‘Ohara is an owner of the condominium.’

b. o’ohara-wa <u>o’oheena o’onaa-da</u>

‘Ohara is an arrogant owner.’

VP case:

(7) (cf. (3)) a. na’oya-ga <u>wa’in-o no’n-da</u>

‘Naoya drank wine.’

b. na’oya-ga <u>ne’muro-de no’n-da</u>

‘Naoya drank in Nemuro.’

(8) (cf. (4)) a. a’mano-ga <u>go’han-o ta’be-ta</u>

‘Amano ate rice.’

b. a’mano-ga <u>mo’rimori ta’be-ta</u>

‘Amano ate heartily.’

According to the speakers, the mean F_0 peak values of accented syllables of those two phrases in question (plus those of the first phrases) are shown in the upper rows and the SDs in the lower rows respectively, together with line graphs of the F_0 values of those accented syllables in each sentence below (to examine whether adjuncts induce F_0 boosting, we will pay attention to the differences in the F_0 values between the first and the second phrases).

YK

	P1	P2	P3
5a	304.7	288.5	236.4
	27.26	14.28	8.38
5b	309.4	293.5	225.2
	7.23	12.60	11.49

Table 5: Mean peak F_0 values and SDs of the three phrases in (5) for speaker YK.

	P1	P2	P3
6a	309.9	287.4	244.7
	10.62	9.58	16.40
6b	310.5	286.5	221.7
	6.96	8.25	7.64

Table 6: Mean peak F_0 values and SDs of the three phrases in (6) for speaker YK.

	P1	P2	P3
7a	312.5	278.5	214.2
	9.74	10.69	8.02
7b	311.7	294.4	205.9
	15.09	14.66	5.43

Table 7: Mean peak F_0 values and SDs of the three phrases in (7) for speaker YK.

	P1	P2	P3
8a	321.4	286.2	214.6
	12.12	19.39	9.94
8b	318.6	294.3	211.0
	11.83	9.05	7.72

Table 8: Mean peak F_0 values and SDs of the three phrases in (8) for speaker YK.

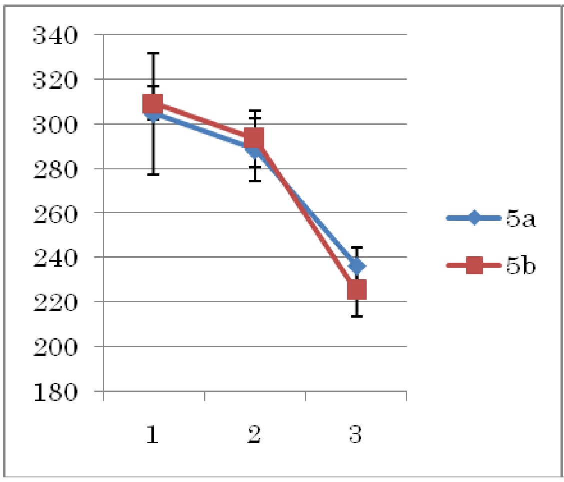


Figure 5: F_0 line graphs of the accented syllables in (5) for speaker YK.

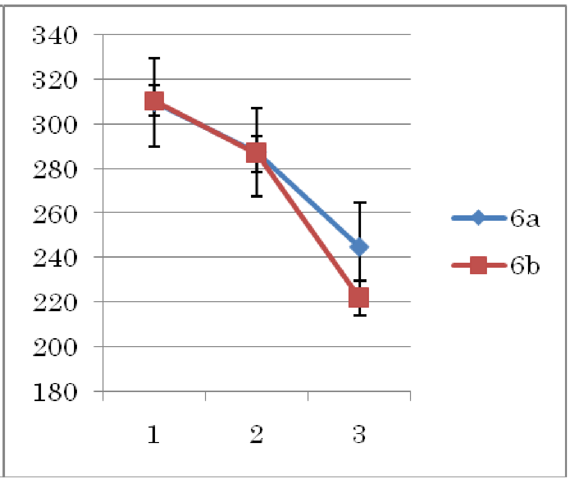


Figure 6: F_0 line graphs of the accented syllables in (6) for speaker YK.

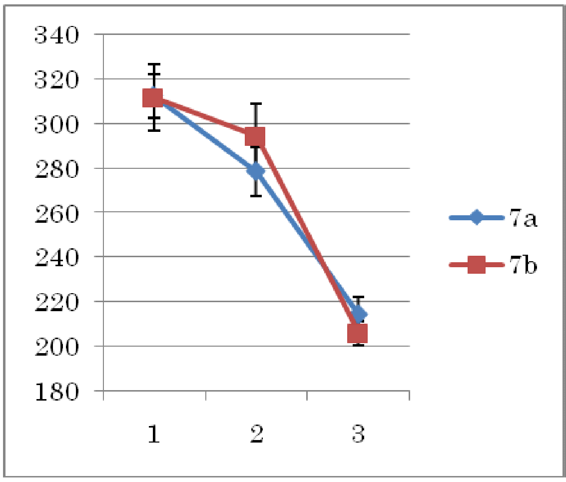


Figure 7: F_0 line graphs of the accented syllables in (7) for speaker YK.

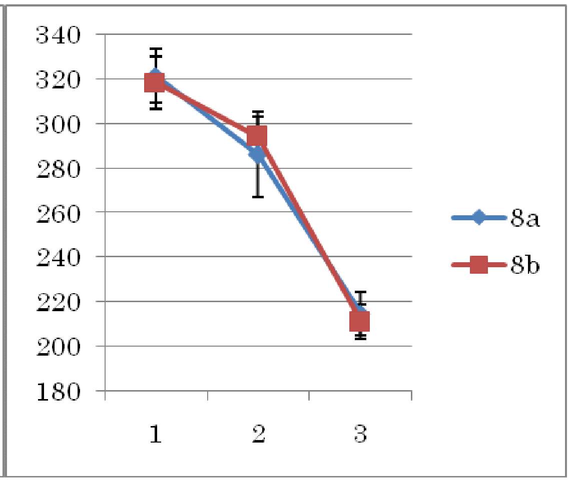


Figure 8: F_0 line graphs of the accented syllables in (8) for speaker YK.

(Among the four cases, only the difference between the first and the second peaks in (7) is significantly different.)

AM

		P1	P2	P3
5a		301.7	274.5	267.3
		13.16	7.86	5.94
5b		283.8	268.4	258.6
		4.90	4.27	4.85

Table 9: Mean peak F_0 values and SDs of the three phrases in (5) for speaker AM.

		P1	P2	P3
6a		303.4	276.7	264.0
		14.62	10.54	7.15
6b		299.6	273.7	256.6
		12.96	7.66	5.61

Table 10: Mean peak F_0 values and SDs of the three phrases in (6) for speaker AM.

		P1	P2	P3
7a		290.5	263.5	259.7
		8.91	5.94	6.78
7b		289.9	264.5	257.0
		7.25	5.61	5.92

Table 11: Mean peak F_0 values and SDs of the three phrases in (7) for speaker AM.

		P1	P2	P3
8a		295.8	273.9	267.7
		8.52	8.47	7.31
8b		292.0	264.8	265.4
		11.81	4.65	6.92

Table 12: Mean peak F_0 values and SDs of the three phrases in (8) for speaker AM.

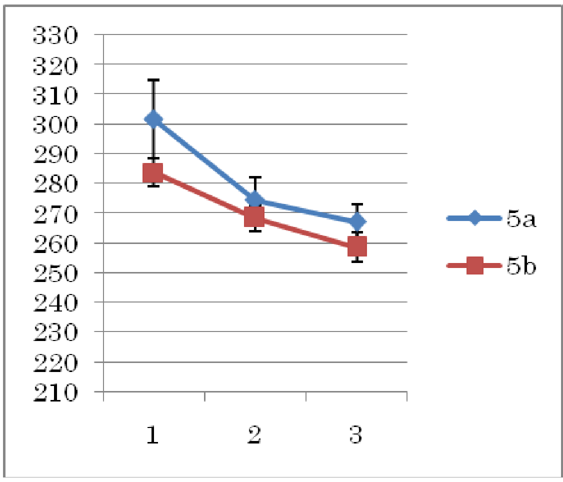


Figure 9: F_0 line graphs of the accented syllables in (5) for speaker AM.

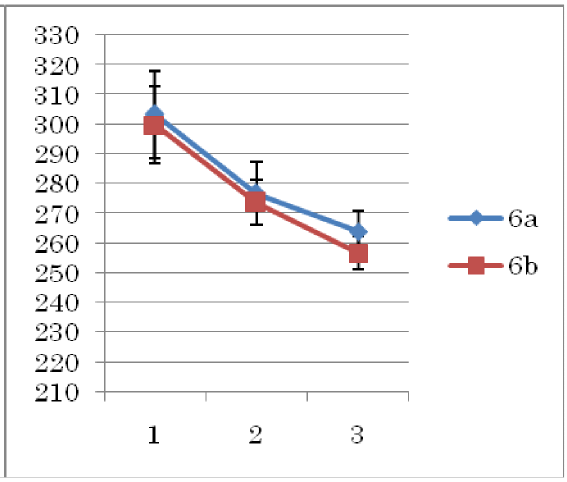


Figure 10: F_0 line graphs of the accented syllables in (6) for speaker AM.

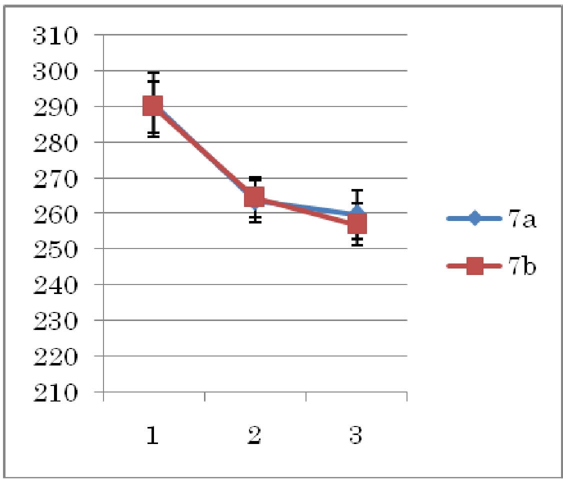


Figure 11: F_0 line graphs of the accented syllables in (7) for speaker AM.

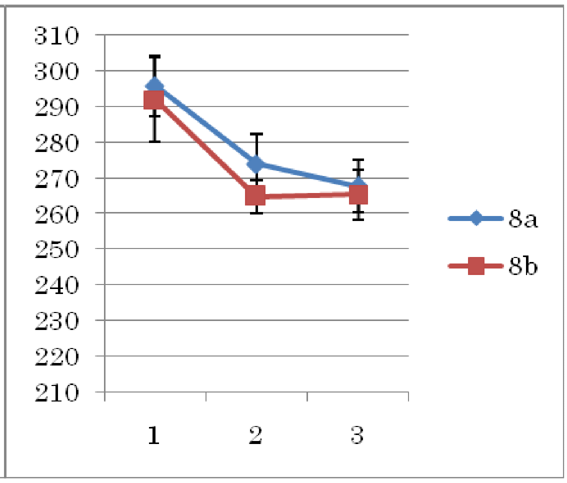


Figure 12: F_0 line graphs of the accented syllables in (8) for speaker AM.

(Among the four cases, only the difference between the first and the second peaks in (5) is significantly different.)

SK

	P1	P2	P3
5a	189.8	169.8	130.1
	7.41	4.06	7.27
5b	180.5	167.0	128.3
	5.47	7.26	8.00

Table 13: Mean peak F_0 values and SDs of the three phrases in (5) for speaker SK.

	P1	P2	P3
6a	182.3	158.5	142.2
	9.56	5.40	5.57
6b	180.0	167.3	146.1
	14.42	6.41	11.06

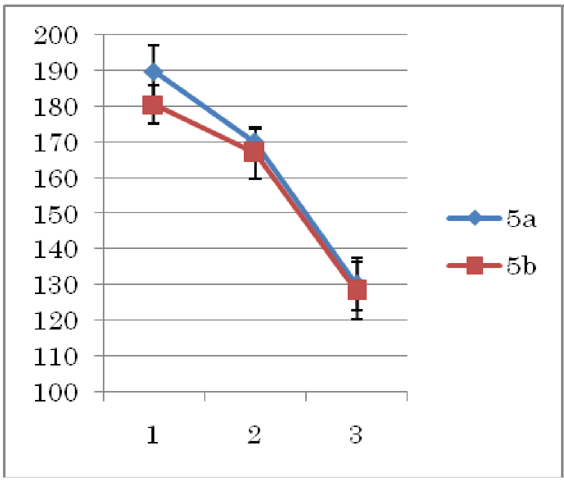
Table 14: Mean peak F_0 values and SDs of the three phrases in (6) for speaker SK.

	P1	P2	P3
7a	179.5	153.2	128.4
	5.00	5.02	9.85
7b	176.7	158.5	139.3
	5.10	7.08	6.54

Table 15: Mean peak F_0 values and SDs of the three phrases in (7) for speaker SK.

	P1	P2	P3
8a	174.8	150.0	140.3
	5.56	5.43	6.98
8b	178.9	160.0	141.3
	9.40	4.77	6.58

Table 16: Mean peak F_0 values and SDs of the three phrases in (8) for speaker SK.



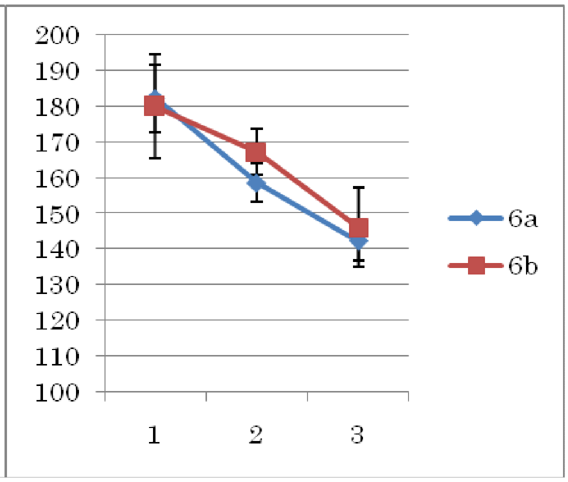
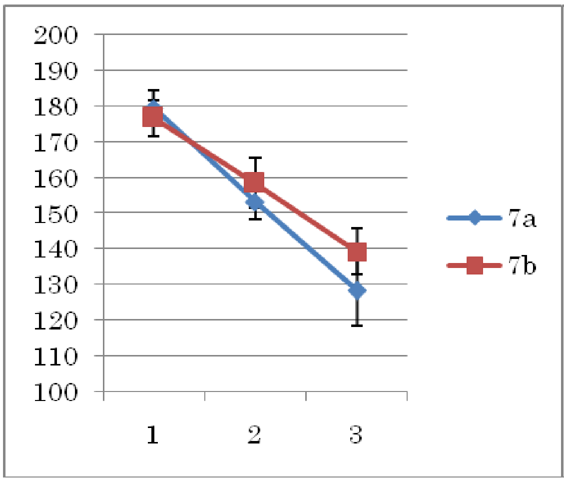


Figure 13: F_0 line graphs of the accented syllables in (5) for speaker SK.

Figure 14: F_0 line graphs of the accented syllables in (6) for speaker SK.



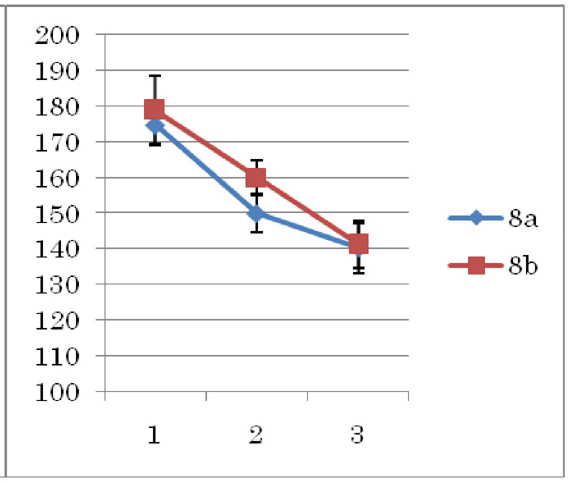


Figure 15: F_0 line graphs of the accented syllables in (7) for speaker SK.

Figure 16: F_0 line graphs of the accented syllables in (8) for speaker SK.

(Among the four cases, only the difference between the first and the second peaks in (7) is significantly different.)

As touched upon above, for each speaker, the differences between the first and the second peaks are significantly different in only one case among the four cases; in (7) for YK, in (5) for AM and in (7) for SK. The precise statistical results are as follows: (YK: (5): $p(T=0.033)>.20$, (6): $p(T=0.297)>.20$, (7): $p(T=2.355)<.05$, (8): $p(T=1.380)>.10$, AM: (5): $p(T=3.649)<.01$, (6): $p(T=0.135)>.20$, (7): $p(T=0.367)>.20$, (8): $p(T=1.150)>.20$, SK: (5): $p(T=2.086)>.05$, (6): $p(T=2.065)>.05$, (7): $p(T=2.575)<.05$, (8): $p(T=1.593)>.10$ (all 20 df)).

As a result, we cannot necessarily say that adjuncts induce F_0 boosting effect, and the alternative hypothesis is worth examining in detail.

2.2.2. The Effect of Scrambling on Realization of F_0 Contours in Double Object Constructions

Another experiment was conducted in which the scrambling operation is involved in double object constructions. The test sentences used in the experiment are the following (in each pair, (a) is in the normal word order and (b) in the scrambled one):[7]

(9) a. o'ono-ga <u>ya'mana-ni no'oto-o ka'esi-ta</u>

Ono-Nom Yamana-Dat notebook-Acc return-Past

'Ono returned Yamana the notebook.'

b. o'ono-ga <u>no'oto-o ya'mana-ni ka'esi-ta</u>

'Ono returned the notebook to Yamana.'

[7] Note that the indirect object precedes the direct object in (9a), whereas the direct object precedes the indirect object in (10a). I chose these sentences for the purpose of examining whether the possible F_0 boosting effect is due to the operation of scrambling or due to the precedence relation between the direct object and the indirect object.

(10) a. se’mmu-ga mo’rino-o ra’nchi-ni mane’i-ta

executive managing director-Nom Morino-Acc lunch-Dat invite-Past

‘The executive managing director invited Morino to lunch.’

b. se’mmu-ga ra’nchi-ni mo’rino-o mane’i-ta

‘The executive managing director invited Morino to lunch.’

The mean F_0 peak values of accented syllables of those three phrases in question (plus those of the first phrases), the SDs and line graphs of the F_0 values of those accented syllables in each sentence are shown according to the speakers below.

YK

	P1	P2	P3	P4
9a	318.5	275.5	254.5	247.5
	12.15	15.43	7.71	13.15
9b	320.1	273.3	262.6	245.7
	12.15	15.43	7.71	13.15

Table 17: Mean peak F_0 values and SDs of the four phrases in (9) for speaker YK.

	P1	P2	P3	P4
10a	322.7	274.4	257.1	244.4
	7.26	16.27	12.81	11.00
10b	326.4	273.9	259.5	244.5
	8.06	11.18	14.47	7.20

Table 18: Mean peak F_0 values and SDs of the four phrases in (10) for speaker YK.

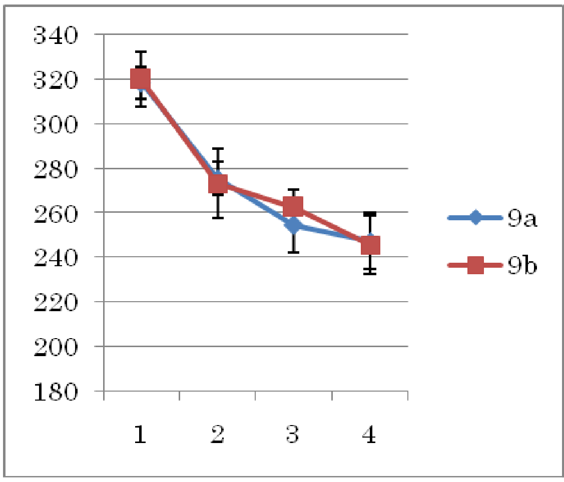


Figure 17: F_0 line graphs of the accented syllables in (9) for speaker YK.

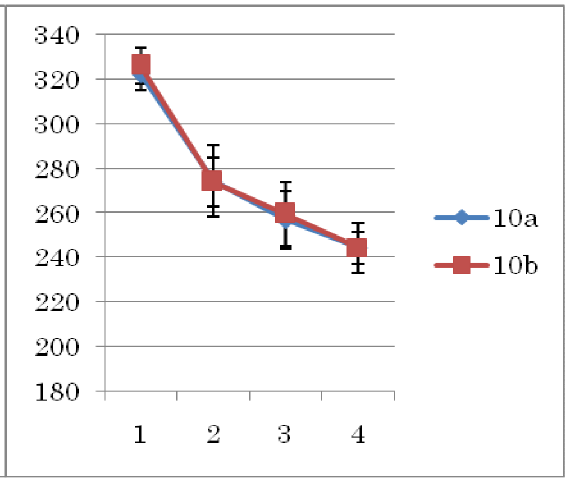


Figure 18: F_0 line graphs of the accented syllables in (10) for speaker YK.

AM

	P1	P2	P3	P4
9a	290.1	247.7	241.9	243.7
	10.89	6.31	3.37	3.36
9b	290.7	245.9	252.5	240.7
	15.06	3.73	6.60	7.24

Table 19: Mean peak F_0 values and SDs of the four phrases in (9) for speaker AM.

	P1	P2	P3	P4
10a	292.2	249.2	241.5	235.5
	14.41	4.76	4.44	4.72
10b	284.3	244.6	246.6	236.3
	11.27	5.42	7.14	6.14

Table 20: Mean peak F_0 values and SDs of the four phrases in (10) for speaker AM.

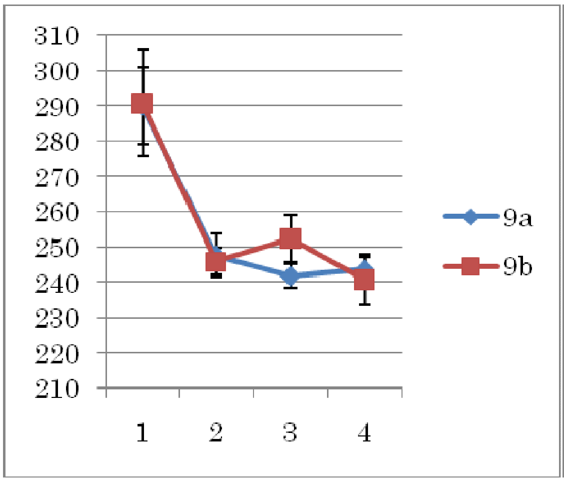


Figure 19: F_0 line graphs of the accented syllables in (9) for speaker AM.

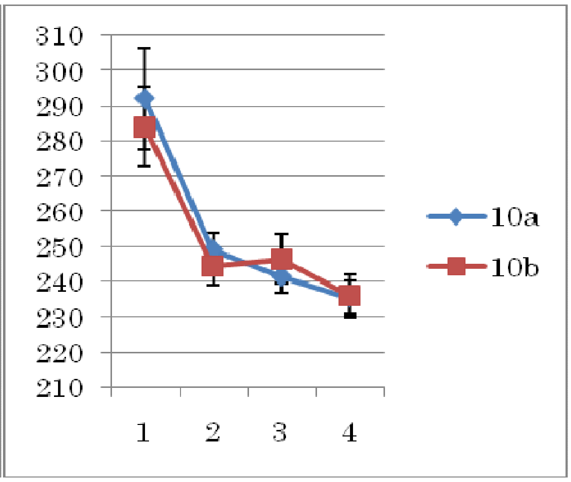


Figure 20: F_0 line graphs of the accented syllables in (10) for speaker AM.

SK

	P1	P2	P3	P4
9a	183.7	157.5	137.7	123.9
	6.86	3.26	9.24	13.84
9b	184.2	155.7	157.7	135.8
	4.80	10.85	5.50	12.63

Table 21: Mean peak F_0 values and SDs of the four phrases in (9) for speaker SK.

	P1	P2	P3	P4
10a	188.9	154.3	145.7	130.5
	6.67	5.72	9.56	10.48
10b	189.6	150.8	156.1	129.0
	6.64	6.46	11.61	8.54

Table 22: Mean peak F_0 values and SDs of the four phrases in (10) for speaker SK.

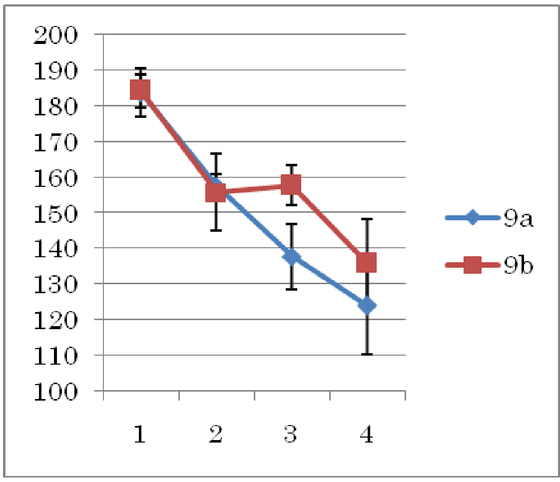


Figure 21: F_0 line graphs of the accented syllables in (9) for speaker SK.

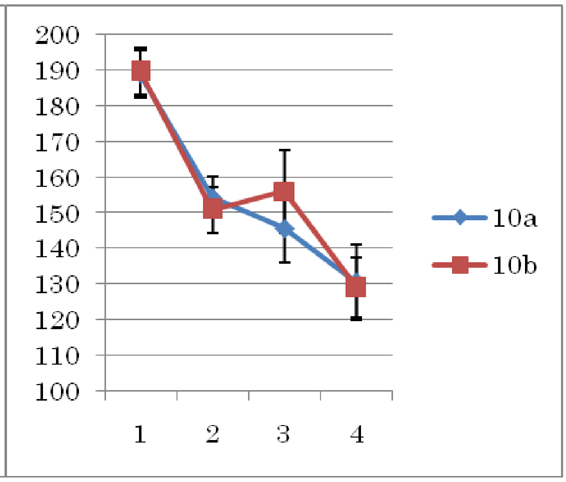


Figure 22: F_0 line graphs of the accented syllables in (10) for speaker SK.

As shown in the figures, we can see the effect of scrambling on the realization of F_0 contours in double object constructions especially for the speakers AM and SK. The differences in the peak F_0 values between the second and the third phrases are significantly different except in (10) for YK; (YK: (9): p(T=2.121)<.05, (10): p(T=0.484)>.20, AM: (9): p(T=5.391)<.001, (10): p(T=4.255)<.001, SK: (9): p(T=4.840)<.001, (10): p(T=3.201)<.01 (all 20 df)).

From the results of the two experiments, it can safely be said that of the two possible analyses, the scrambling analysis covers the wider range of the realization of F_0 contours than the argument-adjunct asymmetry analysis.

We can generalize that leftward movement operation, scrambling, (or traces left behind by the operation) must be visible to phonological component in Japanese in order to produce surface F_0 contours involving the extra F_0 boosting effect. There seems to have been no report that syntactic movement must be visible to phonology in such a systematic manner in any language, as far as I know.

2.3. In Relation to Nuclear Stress Rule

2.3.1. Cinque (1993)

Here I would like to see the results obtained in this chapter from another point of view. Cinque (1993) refers to McCawley's (1977: 273) phrasal accent rule in Japanese; "the rule that the first accent in a constituent predominates is the Japanese analogue to the English 'nuclear stress rule' (Chomsky and Halle 1968), according to which the last accent in a constituent predominates", and reinterprets it as Nuclear Stress Rule in VP in Japanese. At first sight, the result obtained in the previous sections that F_0 boosting is induced by scrambling seems incompatible with the Nuclear Stress Rule account that Cinque (1993) suggests, since the element which receives the F_0 boosting effect is not leftmost in linear order. However, within the Minimalist framework (Chomsky (1995)), Truckenbrodt (1999) proposes that phonological processes refer to the lower segment composing category in adjunction structures. Let us discuss it in detail.

Following Hale and Selkirk (1987), Truckenbrodt (1999) states that in Tohono O'odham, each Phonological Phrase is characterized by a $L_0H_1L_1$ tonal pattern, with zero or more L-toned vowels followed by one or more H-toned vowels, followed, in turn, by one or more L-toned vowels, and that the stretch of H-toned vowels begins with the first vowel which bears word stress in the Phonological Phrase and ends with the last vowel which bears word stress in the Phonological Phrase. Examples are shown in (11) (adopted from Truckenbrodt (1999: 230). Vowels bearing word stress are indicated by bold-type and curly brackets represent Phonological Phrase boundaries).

(11) a. $[_{IP}$ $[_{DP1i}$ $[_{NP1}$ w**a**kial] $[_{I'}$ $[_{I}$ 'at] $[_{VP}$ $[t_i]$ $[_{V'}$ $[_{DP2}$ $[_{D}$ g] $[_{NP2}$ w**i**silo]] $[_{V}$ c**e**pos]]]]]]

cowboy AUX DET calf branded

'The cowboy branded the calf.'

{ H LL}{ L H HH H L }

b. $[_{IP}$ $[_{I}$ na-t] $[_{VP}$ $[_{VP}$ $[_{DP1}$ $[_{D1}$ g] $[_{NP1}$ w**a**kial]] $[_{V'}$ $[t_i]$ $[_{V}$ c**e**pos]]] $[_{DP2i}$ $[_{D2}$ g] $[_{NP2}$ w**i**silo]]]] ?

Q- AUX DET cowboy branded DET calf

'Did the cowboy brand the calf ?'

{ L HHH H L }{ H LL }

Truckenbrodt (1999) argues that first of all, any lexical category such as NP or VP must be contained in a Phonological Phrase and that if this condition is met, the right edge of a lexical XP must correspond to the right edge of a Phonological Phrase in the language. Consider the sentence (11a). NP_1 is contained in the first Phonological Phrase and both NP_2 and VP are contained in the second Phonological Phrase, which means that the first condition is met. On that condition, the right edge of NP_1 corresponds to the right edge of the first Phonological Phrase and the right edge of VP corresponds to the right edge of the second Phonological Phrase, which means that the second condition is met. Note that if the right edge of NP_2 corresponded to the right edge of a Phonological Phrase, the first condition would be violated. Next, consider the sentence (11b), in which the object

NP is right-adjoined to VP. As for the two NPs, NP_1 and NP_2 are contained in the first and the second Phonological Phrases, respectively. What about VP? We find that there are two VP nodes caused by the adjunction of NP_2. Truckenbrodt (1999) maintains that only the lower VP node is relevant to the syntax-phonology mapping in line with Chomsky's proposal (class lectures, fall 1994) that interface constraints generally refer to syntactic categories, not syntactic segments, with the assumption that the abstract category VP (abstractly) dominates all and only the material that is dominated by both its VP segments, hence the material under the lowest VP node. It is assumed, therefore, that VP is contained in the first Phonological Phrase in (11b), which leads to the satisfaction of the first condition. As for the second condition, the right edge of VP corresponds to the right edge of the first Phonological Phrase and the right edge of NP_2 corresponds to the right edge of the second Phonological Phrase. Again, if the right edge of NP_1 corresponded to the right edge of a Phonological Phrase, the first condition would be violated, and so there is no Phonological Phrase boundary between NP_1 and the verb. The reader is referred to Truckenbrodt (1999) for details.

Note here that Phonological Phrasing in Tohono O'odham is simply due to presence or absence of the distinct $L_0H_1L_1$ tonal pattern, which will be crucial to the discussion of the visibility of syntactic movement to phonological component in Japanese in the last chapter.

Taking these insights together, I propose the following;

(12) Nuclear Stress (to be more specific, Nuclear Accent in a pitch accent language, Japanese) falls on the leftmost constituent (or word) in (lower) VP.

This suggestion is incompatible with Ishihara's (2000) proposal that Nuclear Stress always falls on the constituent immediately preceding the verb in Japanese. As far as the data from this chapter are concerned, it seems that this suggestion goes better with the fact obtained in this chapter than his.

Different directional parameter in English and Japanese (right and left, respectively) may reflect their head parameter (initial and final, respectively).[8] I will return to the two approaches in detail later.

In connection with the directional parameter, Donegan and Stampe (1983), typologically comparing the Munda family of languages with the Mon-Khmer family, make an interesting observation that phrase stress correlates with constituent order so that in SOV languages, the Munda family, the stress is placed phrase-initially, while in SVO languages, the Mon-Khmer family, the stress is placed phrase-finally. Furthermore, following Dezsö's (1974, 1977, 1982) typological studies on theme-rheme structure and sentence stress, Kim (1988) makes an extensive research, in which the unmarked sentence stress falls on the constituent immediately preceding the verb in rigid verb-final languages from Telugu, Laccadive Malayalam, Tamil of the Dravidian family, Dogri, Bengali, Gujarati, Hindi-Urdu of the Indo-European family, Sherpa of the Sino-Tibetan family, Mongolian and Turkish of the Altaic family through Japanese and Korean. As for Japanese, however, Kim's (1988) observation may be incompatible with Cinque's (1993) suggestion and the result obtained in this chapter.

Here I cannot help pointing out a clear contradiction found in Cinque's (1993) Null Theory of Phrase Stress. On the one hand, he implicitly states that Nuclear Stress falls on the leftmost element in VP in Japanese. On the other hand, the main point of his theory is that a phrase's main stress (or accent) is located on its most deeply embedded constituent possibly across languages.[9] There is no doubt that the F_0 pattern observed in non-scrambled right-branching structure contradicts the claim, since F_0 does descend in such a case as we have seen in the previous sections. In other

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[8] As we will see in Chapter 5, Tokizaki (1999) points out the correlation between directional parameter and head parameter in Phonological Phrasing in various languages.

[9] His theory uses the device of Halle and Vergnaud's (1987) metrical grid theory stemming from Liberman and Prince (1977), which is irrelevant here.

words, the phrasal prominence is not located on the most deeply embedded constituent in that case. Cinque's (1993) Null Theory is straightforward, but due to its simplicity, it seems to have several problems.

2.3.2. Ishihara (2000)

Here, let us return to the two approaches concerning phrasal prominence in Japanese. Ishihara (2000) insists that the main stress of the sentence falls on the phrase that immediately precedes the verb by quoting the following examples (adopted from Ishihara (2000: 96). Underlines indicate what he claims bears Nuclear Stress).

(13) a. ta'roo-ga ho'n-o kat-ta

Taro-Nom book-Acc buy-Past

'Taro bought a book.'

b. ta'roo-ga kyo'o hon'-o kat-ta

Taro-Nom today book-Acc buy-Past

'Taro bought a book today.'

(14) a. [ho'n-o]$_i$ ta'roo-ga [t_i] kat-ta

book-Acc Taro-Nom *t* buy-Past

'Taro bought a book.'

b. [ho'n-o]$_i$ ta'roo-ga <u>kyo'o</u> [t_i] kat-ta

book-Acc Taro-Nom today *t* buy-Past

'Taro bought a book today.'

Although Ishihara (2000) does not exhibit experimental evidence there, as for the scrambling case in (14), my impression about the pitch patterns accords with his claim. In (14b), the adverb bears main prominence, which can be predicted by both approaches. In (14a), on the other hand, the subject bears main prominence, which at first sight could not be predicted by the hypothesis (12). Compared with Nuclear Stress Rule in English, however, Japanese analogue which Ishihara (2000) claims predicts that Nuclear Stress may fall on the subject as in (14a), that is, outside the VP, which is usually not the case in English. As for (13), the prominence pattern in (13b) claimed by Ishihara (2000) is crucially incompatible with the patterns obtained in (3a), (4a), (9a) and (10a) above, where the phrasal prominence consistently falls on the leftmost element in right-branching structure. Perhaps the most plausible account of the prominence pattern in Japanese, I believe, is that the prominence falls on the constituent immediately preceding the one which undergoes scrambling operation in right-branching structure made up of three words (or phrases), independently of the suggestion about Nuclear Stress in (12). Returning to the pitch pattern in (14a), I interpret that the prominence on subject NP is induced by scrambling operation, not by Nuclear Stress Rule, and that Nuclear Stress falls on the verb, which itself is leftmost in VP according to (12).

See, in passing, the Focus Rule (15) that Ishihara (2000) proposes.

(15) The focus of IP (Intonational Phrase) is a(ny) constituent containing the main stress of IP, as determined by the (nuclear) stress rule.

According to the Focus Rule, when the Nuclear Stress is the main stress of the sentence, any constituent including the stressed element can be the focus of the sentence. He calls the constituents containing the main stress of IP 'Focus Set' and states that the Focus Rule is applicable whether a constituent in a sentence is subject to scrambling or not. He takes the following scrambled sentence for instance (his (25b). Underline indicates stressed constituent).

(16) [$_{IP2}$ ho'n-o$_i$ [$_{IP1}$ ta'roo-ga [$_{VP2}$ [$_{ADV}$ <u>kyo'o</u> [$_{VP1}$ *t*$_i$ kat-ta]]]

book-Acc Taro-Nom today buy-Past

'Taro bought a book today.'

Focus Set: {ADV, VP2, IP1, IP2} {not VP1}

Meanwhile, he lists the following question-answer pairs (his (26)), in which the scrambled answer sentence is different from the scrambled sentence (16) in that the answer sentence in (17) lacks the adverb *kyo'o* 'today'.

(17) a. <u>Focus domain = IP</u>

na'ni-ga a't-ta no?

what-Nom happen-Past Q

'What happened?'

[$_{IP2}$ ho'n-o$_i$ <u>ta'roo-ga</u> *t*$_i$ kat-ta] no

book-Acc Taro-Nom buy-Past

'Taro bought a book.'

b. <u>Focus domain = VP</u>

ta’roo-ga na’ni-o si-ta no?

Taro-Nom what-Acc do-Past Q

‘What did Taro do?’

ho’n-o$_i$ <u>ta’roo-ga</u> [$_{VP}$ t_i kat-ta] no

c. <u>Focus domain = the object DP</u>

ta’roo-ga na’ni-o kat-ta no?

Taro-Nom what-Acc buy-Past Q

‘What did Taro buy?’

[$_{DP}$ ho’n-o$_i$] <u>ta’roo-ga</u> t_i kat-ta no

d. <u>Focus domain =V</u>

ta’roo-ga ho’n-o yo’n-da no?

Taro-Nom book-Acc read-Past Q

‘Did Taro read a book?’

ho’n-o$_i$ <u>ta’roo-ga</u> t_i [$_V$ kat-ta] no

e. <u>Focus domain = the subject DP</u>

da’re-ga ho’n-o kat-ta no?

who-Nom book-Acc buy-Past Q

‘Who bought a book?’

ho’n-o$_i$ [$_{DP}$ <u>ta’roo-ga</u>] t_i kat-ta no

For lack of the adverb *kyo’o* in the scrambled answer sentence in (17), the subject *ta’roo-ga* bears the stress. In addition, the lack of the adverb in the scrambled answer sentence in (17) causes the lack of the distinction between VP2 and VP1, which does exist in sentence (16). Let us use the sentence (16) as the answer sentence for the following question sentences.

(18) a. <u>Focus domain = VP2</u>

ta’roo-ga na’ni-o si-ta no?

‘What did Taro do?’

ho’n-o$_i$ ta’roo-ga [$_{VP2}$ <u>kyo’o</u> t_i kat-ta] no

b. <u>Focus domain = VP1</u>

ta’roo-ga kyo’o na’ni-o si-ta no?

‘What did Taro do today?’

ho’n-o$_i$ ta’roo-ga <u>kyo’o</u> [$_{VP1}$ t_i kat-ta] no

Note that the Focus Rule (15) predicts that the answer sentence in (18a) is an appropriate one for the question sentence since the answer sentence contains the main stress in VP2. However, none of my ten informants judged the answer sentence as an appropriate one for the question sentence. Then I replaced the adverb in the answer sentence with the postpositional phrase *e'ki-de* 'at the station', but only two out of ten informants judged the answer sentence as an appropriate one for the question sentence. Therefore, it can be concluded that the Focus Rule (15) is not problem-free in Japanese, since scrambling can alter the Focus Set, with the constituent immediately preceding the trace being focused, which causes a mismatch between the Focus Set that the Focus Rule predicts and the actual focus constituents.[10]

2.3.3. Zubizarreta (1998)

Zubizarreta (1998) argues that prosodically motivated movement (p-movement) of the defocalized phrase leaves the focused phrase in a position to receive Nuclear Stress via the C-Nuclear Stress Rule. Here 'C' means asymmetric c-command ordering, with focused phrase ending up as the lowest constituent in the asymmetric c-command ordering. The example sentences in Spanish are as follows (underlines indicate focused words):

(19) (Who ate an apple?)

Comió una manzana$_i$ <u>Juan</u> t_i.

Ate an apple Juan

'Juan ate an apple.'

[10] In Chapter 5, we will deal with the relevance of traces to pitch contours in Minimalist framework.

(20) (What did María put on the table?)

María puso sobre la mesa$_i$ el libro t_i

María put on the table the book

'María put the book on the table.'

She claims that p-movement can also affect the relative order of an adverb and an argument as show in (21).

(21) a. (What did Juan do?)

Juan plantó un rosal en el jardín.

'Juan planted a rose-bush in the garden.'

b. (What did Juan plant in the garden?)

'Juan plantó en al Jardín$_i$ un rosal.t$_i$.'

However, it seems that 'en el jardín' is also the argument of the verb 'plantó'. By these sentences alone, she mentions that p-movement affects the relative order of an adverb and an argument. Her claim concerning argument and adjunct seems to have room to reconsider.[11]

To summarize, Zubizarreta's (1998) assertion is that prosody motivates syntactic movement, along with the change of focus structure, whereas my assertion is that syntactic movement (in VPs and NPs) is visible to phonological component in Japanese with the change of prosody.[12]

[11] Note that Zubizarreta (1998) does not deal with scrambling in NPs like this study.

[12] She argues that defocalized and anaphoric constituents are metrically invisible for the NSR in English, in German, and in French, for whose details the reader is referred to Zubizarreta (1998).

In this chapter, we have seen the cases where scrambling operation must be visible to phonological component in Japanese in order to produce surface F_0 contours. In the next chapter, we will see that similar observation can be found in relative clause constructions in Japanese.

Chapter 3: The Visibility of the Internal Structure of Relative Clause to Phonological Component in Japanese

3.1. Internal Structure of Relative Clause

In Chapter 2, we observed that phonological component must refer to scrambling operation in order to produce surface pitch contours. We will see that similar observation can be found in relative clause constructions in Japanese in this chapter.

The internal structure of relative clause in Japanese has long been a matter of debate. For comparison, first let us see the internal structure of relative clause in English, and then turn to that in Japanese in more detail.

3.1.1. Relative Clauses in English

There are three types of relative pronouns in English, *wh-*, *that*, and *zero*, and it is generally thought that the distinction between these types is a stylistic problem (we ignore the stylistic problem here). Haegeman and Guéron (1999), for example, argue that wh-relative pronoun such as, *which*, moves from its base position to SpecCP, adjoining to the head noun. In SpecCP, the relative pronoun is co-indexed with its antecedent as in (1) (where we omit the precise details for ease of explanation).

(1) $[_{NP} [_{NP}$ the book$]_i$ $[_{CP}$ which$_i$ John $[_{VP}$ read $[_{NP}$ $t_i]]]]$

They discuss that *that* relative pronoun (to be more precise, *that* complementizer, in their terminology) is dominated by C and empty operator (empty category, in their terminology) moves to SpecCP exactly like wh-pronoun shown above (in (2), 'ec' stands for empty category).

(2) $[_{NP}$ $[_{NP}$ the book$]_i$ $[_{CP}$ ec$_i$ $[_C$ that] John $[_{VP}$ read $[_{NP}$ t_i]]]]

In such a case, they assume that *that* relative pronoun optionally appears in C and so if *that* does not appear, the construction involves zero relative pronoun as in (3).

(3) $[_{NP}$ $[_{NP}$ the book$]_i$ $[_{CP}$ ec$_i$ John $[_{VP}$ read $[_{NP}$ t_i]]]]

Although relative clause construction in English is not uncontroversial, we do not discuss it any further here (for more details about this issue, see McCawley (1998)).

3.1.2. Relative Clauses in Japanese

Japanese lacks any overt relative pronoun, which makes matters more complex. Here we take up the two representative approaches to relative clause construction in Japanese.

Some (Hasegawa (1985), Imai (1987), among others) claim that there exists zero relative pronoun in Japanese as in English. For instance, Hasegawa (1985) argues that empty operator moves to SpecCP, adjoining to the head noun. As in English, in SpecCP it is co-indexed with its antecedent.

(4) $[_{NP}$ $[_{CP}$ eo$_i$ $[_{IP}$ $[_{NP}$ ta'roo-ga] $[_{VP}$ $[_{NP}$ i_i] yo'n-da]]]$[_{NP}$ ho'n$_i$]]

empty operator Taro-Nom read-Past book

'the book Taro read'

This analysis captures parallelism between English and Japanese and had been one of the most popular analyses of relative clause in Japanese until 1980's. However, Mihara (1994) points out a problem with this approach. He takes up the following example against empty operator approach

(Mihara (1994:220)).

(5) [$_{NP}$ [$_{IP}$ [$_{NP}$ watasi-ga] [$_{VP}$ [$_{NP}$ sono'-hito$_i$-ni] [$_{NP}$ okane-o] watasi-wasu're-ta]] [$_{NP}$ okyaku$_i$]]

I-Nom the-person-Dat money-Acc give-forget-Past customer

'the customer, to whom I forgot to give money'

Sentence (5) is acceptable for most of the native Japanese speakers. The crucial problem with empty operator approach to this sentence lies in the fact that the position from which empty operator would move (to SpecCP) has already been occupied by the overt NP (or PP) *sono'-hito-ni* 'to the person'.

Then Mihara (1994) proposes that there exists zero pronoun '*pro*' in gap position in relative clause instead of assuming empty operator analysis. According to this approach, the internal structure of sentence (4) is as follows:

(4)' [$_{NP}$ [$_{CP}$ [$_{IP}$ [$_{NP}$ ta'roo-ga] [$_{VP}$ [$_{NP}$ pro$_i$] yo'n-da]]][$_{NP}$ ho'n$_i$]]

'the book Taro read'

As Mihara (1994) admits, however, this approach is not totally problem-free either. Since the strict nature of the relative clause is beyond the scope of this study, the reader is referred to Mihara (1992, 1994), Murasugi (2000), Mihara and Hiraiwa (2006), among others, for more details.

3.2. Pitch Patterns in Relative Clause Constructions in Japanese

3.2.1. Pitch Patterns in Left- and Right-Branching Structures

In Japanese, accents in phrases trigger the global downward shift of pitch register, 'downstep', the phonetic realization rule which stems from McCawley (1968). Since McCawley's

(1968) impressionistic observation of downstep, several researchers had confirmed the existence of the rule from the point of view of experimental phonology. Among those are Poser (1984), Beckman and Pierrehumbert (1986), Pierrehumbert and Beckman (1988), Kubozono (1989, 1992, 1993) and Selkirk and Tateishi (1991). Traditionally, the domain of downstep is assumed to be the Major Phrase (aka Intermediate Phrase) by those researchers.[13] According to Poser (1984), the *phonological* definition of downstep is that the pitch level of words (or phrases) is lower when they follow an accented word (or phrase) than when they follow an unaccented word (or phrase). In this respect, Kubozono (1993) explicitly states that whether syntactic structure is left-branching or right-branching has much to do with downstep in Japanese. In syntactic terms, Japanese is a left-branching language, as Kuno (1973) indicates. He claims that Japanese takes the left-branching structure in a variety of syntactic constructions such as relative clause constructions. On the other hand, right-branching structure is regarded as marked structure in syntactic terms in the language. Kubozono (1993) argues that among the three accented phrases (to be more accurate, Minor Phrases (aka Accentual Phrases)) in left-branching structure, the second phrase is downstepped with respect to the first, and the third with respect to the second in a cumulative way.[14] He also claims that among three accented phrases in syntactically marked right-branching structure, downstep is observed between the first and the second phrases and between the second and the third phrases, although the degree of downstepping in the second phrase in right-branching structure is less than that in the second phrase in left-branching structure.

As mentioned above, relative clause forms left-branching structure in Japanese, which predicts that among the three phrases which constitute relative clause, the degree of downstepping in the second phrase is larger than that in the second phrase in the corresponding right-branching

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[13] Pierrehumbert and Beckman (1988) use the term ‘Intermediate Phrase’, which corresponds to ‘Major Phrase’.

[14] The definition of Minor Phrase will be discussed later. Also here, Pierrehumbert and Beckman (1988) use the term ‘Accentual Phrase’ instead of ‘Minor Phrase’.

structure.

In the next subsection, we will observe the pitch patterns in relative clause consisting of three words (or phrases) in Japanese.

3.2.2. Pitch Patterns in Relative Clauses Consisting of Three Accented Words

3.2.2.1. Previous Studies

To begin with, let us see the pitch pattern in relative clause reported on Sugiyama (2002). The relevant sentence is the same as that in (4) repeated here as (6).

(6) ta’roo-ga yo’n-da ho’n

Taro-Nom read-Past book

‘the book Taro read’

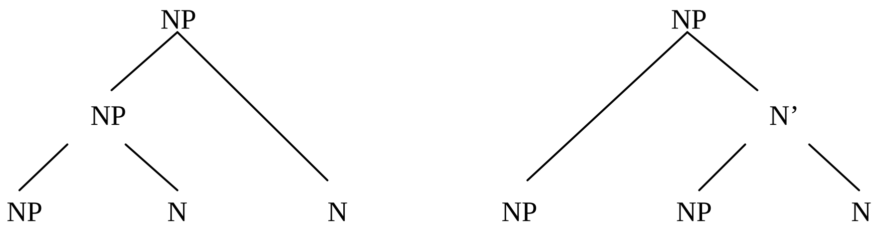
Sugiyama (2002) also carries out a check experiment for Selkirk and Tateishi’s (1991) original one. Selkirk and Tateishi (1991: 523) use the following ambiguous sentence in (7) in order to confirm the effect of syntactic branching structure on pitch contours. The purpose of the check experiment is that in ambiguous sentences, speakers may put focus on some elements to disambiguate the sentences.

(7) ao’yama-no yama’guchi-no ani’yome-ga inai

Aoyama-Gen Yamaguchi-Gen sister-in-law-Nom not-be-Pres

The subject of this sentence *Ao’yama-no Yama’guchi-no ani’yome* is disambiguated into left- and right-branching structures as the following tree diagrams show:

(7) a. left-branching structure (7) b. right-branching structure



ao'yama-no yama'guchi-no ani'yome ao'yama-no yama'guchi-no ani'yome

'the sister-in-law of Mr. Yamaguchi from Aoyama' 'Mr. Yamaguchi's sister-in-law from Aoyama'

In Selkirk and Tateishi's (1991) experiment, four native speakers of Tokyo Japanese read the sentence (7) according to the meanings. They argue that in the left-branching case, the speakers all read the sentence in such a way that the second phrase is downstepped with respect to the first phrase, whereas in the right-branching case, there exists no downstepping between the first and the second phrases for all the speakers, and especially for the two speakers, the peak F_0 value of the second phrase is larger than that of the first phrase.

In fact, Sugiyama (2002) uses a fragment of the sentence (7), that is, *Ao'yama-no Yama'guchi-no ani'yome*, for if we used the original sentence, the rhythmic effect might operate in the case of (7a) (the effect was indeed observed in Selkirk and Tateishi (1991)). Kubozono (1989, 1993) claims that uniformly left-branching structures made up of four accented phrases (or more) are subject to the 'Principle of Rhythmic Alternation' in such a way that otherwise monotonously descending pitch pattern is converted into the alternating rhythmic pattern of High-Low-High-Low (…) sequence ('Rhythmic Boost' in Kubozono's (1989, 1993) terminology). This is why Sugiyama (2002) uses the fragment of the sentence (7).

For comparison, I list the line graphs of the F_0 values of those accented syllables in sentences (6) and (7) for the five speakers below (adopted from Sugiyama (2002)).

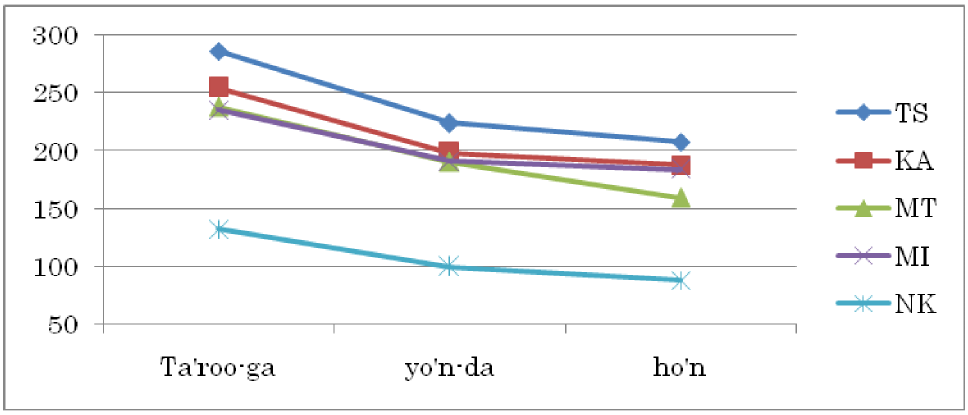


Figure 1: F_0 line graphs of the accented syllables in (6) for five speakers.

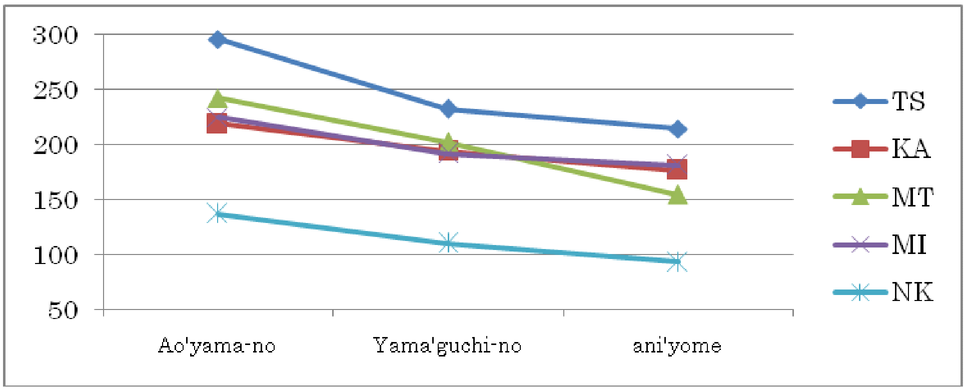


Figure 2: F_0 line graphs of the accented syllables in (7a) for five speakers.

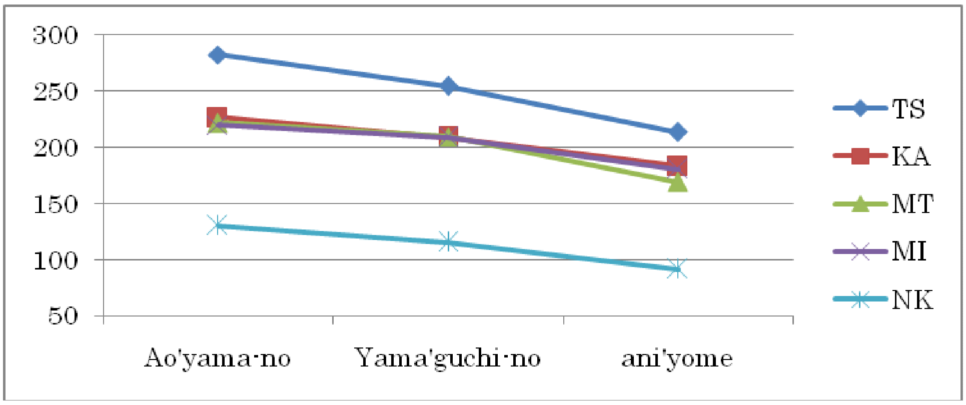


Figure 3: F_0 line graphs of the accented syllables in (7b) for five speakers.

The three figures have a feature in common; F_0 descends in the course of utterance. This result is incompatible with Selkirk and Tateishi's (1991). It seems that in the case of (7a) the rhythmic effect might operate, whereas in the case of (7b) the focus effect might operate in Selkirk and Tateishi's (1991) experiment.

Comparing Figure 1 with Figure 2, we seem to find no difference in pitch patterns between the relative clause structure and the regular left-branching structure. Comparison of (7a) and (7b) suggests that even in syntactically marked right-branching structure, downstep is observed between the first and the second phrases, although the degree of downstepping in the second phrase in right-branching structure is less than that in the second phrase in left-branching structure as Kubozono (1993) claims.

As mentioned above, the use of the ambiguous sentence such as (7) is unfavorable, because it may induce undesired F_0 boosting effect. In the next subsection, we will show the result of an experiment in which no ambiguity effect is found.

3.2.2.2. Pitch Patterns in Relative Clauses in Comparison with Those in Regular Left-Branching Structures

In response to an investigation by Sugiyama (2002), an experiment was conducted in which the F_0 values in two left-branching phrases, one with relative clause structure, and the other with regular left-branching one, were measured. The test sentences are as follows:

(8) a. [[na'o-ga [ec_i] yo'n-da] no'oto$_i$]

Nao-Nom read-Past notebook

'the notebook which Nao read'

b. [[na'o-no a'ni-no] no'oto]

Nao-Gen brother-Gen notebook

'Nao' s brother's notebook'

The mean F_0 peak values of accented syllables of those three words, the SDs and line graphs of the F_0 values of those accented syllables in each sentence are shown according to the speakers below.

YK

	P1	P2	P3
8a	310.2	218.6	226.2
	10.98	10.66	0.14
8b	312.8	224.8	226.1
	9.52	6.09	6.95

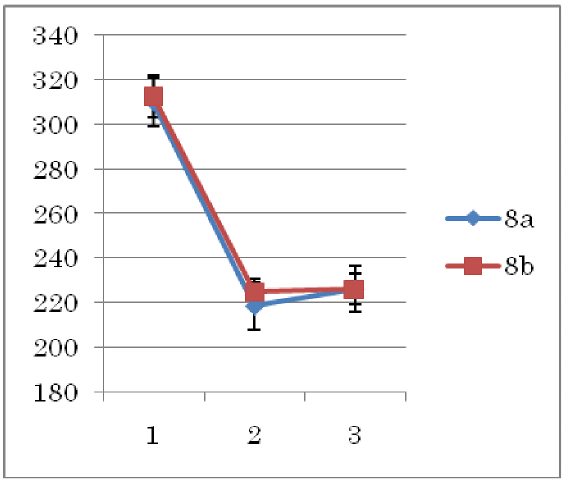


Table 1: Mean peak F_0 values and SDs of the three phrases in (8) for speaker YK.

Figure 4: F_0 line graphs of the accented syllables in (8) for speaker YK.

AM

	P1	P2	P3
8a	269.6	238.2	246.8
	6.79	5.06	6.36
8b	274.8	238.7	243.4
	12.22	5.19	4.72

Table 2: Mean peak F_0 values and SDs of the three phrases in (8) for speaker AM.

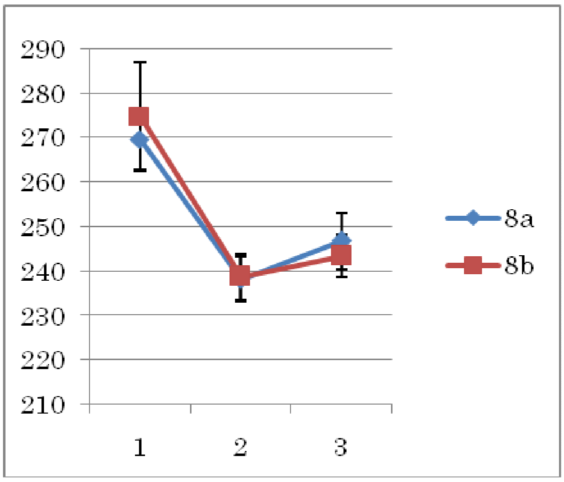


Figure 5: F_0 line graphs of the accented syllables in (8) for speaker AM.

SK

	P1	P2	P3
8a	180.3	135.6	131.6
	7.41	13.16	13.08
8b	181.5	160.7	117.9
	6.54	12.47	5.74

Table 3: Mean peak F_0 values and SDs of the three phrases in (8) for speaker SK.

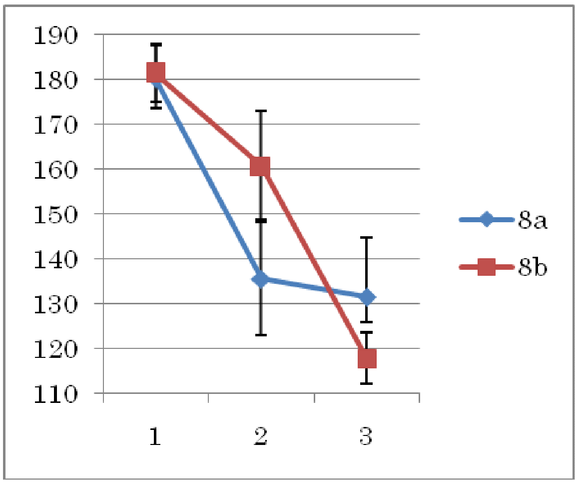


Figure 6: F_0 line graphs of the accented syllables in (8) for speaker SK.

For speakers YK and AM, neither the differences between the first and the second phrases nor the differences between the second and the third phrases reach statistical significance, whereas for speaker SK, both the differences between the first and the second phrases and the differences between the second and the third phrases reach statistical significance (YK: P1-P2: $p(T=0.535)>.20$, P2-P3: $p(T=1.305)>.20$, AM: P1-P2: $p(T=1.164)>.20$, P2-P3: $p(T=2.040)>.05$, SK: P1-P2: $p(T=4.745)<.001$, P2-P3: $p(T=5.582)<.001$ (all 20 df)).

Note that for YK and AM, the peak F_0 values of the third phrases are higher than those of the second phrases which would cause downstepping of the third phrases in both the relative clause structure and the regular left-branching structure as opposed to the result obtained in Sugiyama (2002) as we have seen in the preceding subsection. A plausible interpretation of this is that even left-branching phrases consisting of three accented words may be subject to the Principle of Rhythmic Alternation according to both speakers and sentences.

3.3. The Principle of Rhythmic Alternation

3.3.1. The Effects of Principle of Rhythmic Alternation on Phonological Processes in Japanese

As I mentioned in the preceding section, Kubozono (1989, 1993) argues that uniformly left-branching structures made up of four phrases (or more) are subject to the ‘Principle of Rhythmic Alternation’, whereby yielding an alternating pattern out of otherwise monotonous sequences of linguistic elements. This is not limited to the process of downstep. Kubozono (1993) claims that in compound formation process in Japanese, besides a monophrasal pattern, where the whole compound expression is fused into one accentual unit (what he calls ‘accentual phrase’, which is a different unit from what Pierrehumbert and Beckman (1988) call accentual phrase, for whom the phrase level in question corresponds to Minor Phrase, the definition of which will be shown soon), a uniformly left-branching structure made up of four elements may exhibit a bipartite pattern, whereby the whole compound expression is phrased into two subgroups of two as in (9) (Kubozono (1993: 55)).

(9) [[[toonan a'zia] syo'koku] rengoo]

south-east Asia nations union

'The Association of Southeast Asian Nations (ASEAN)'

→ a. toonanaziasyokokure'ngoo (monophrasal)

→ b. toonana'zia syokokure'ngoo (biphrasal)

Note that Kubozono (1993) points out that the first three component words of those compounds such as (9) invariably yield one accentual unit when they stand by themselves as in (10), suggesting that the optional accentual split in (9b) is triggered by the addition of a forth element (Kubozono (1993: 55)).

(10) [[toonan a'zia] syo'koku]

'Southeast Asian nations'

→ a. toonanaziasyo'koku

→ b. *toonana'zia syo'koku

Moreover, Kubozono (1993) argues that the effect of the Principle of Rhythmic Alternation can be found in Minor Phrase formation as well. The definition of Minor Phrase is that a phrase-initial Low-High sequence ('Initial Lowering' in Haraguchi's (1977) terminology) and at most one accent

(H*+L) is realized in the domain.[15] In Kubozono's (1993) data, a phrase made up of four unaccented words such as (11) is never phrased into one Minor Phrase, but is realized in two or three Minor Phrases (Kubozono (1993: 165)).

(11) [[[naomi-no oi-no] yome-no] yunomi]
Naomi-Gen nephew-Gen wife-Gen teacup
'Naomi's nephew's wife's teacup'

→ a. naomino oino yomeno yunomi (6 times)
→ b. naomino oino yomeno yunomi (3 times)
→ c. naomino oino yomeno yunomi (2 times)
→ d. *naomino oino yomeno yunomi (zero)

According to Kubozono (1993), the single subject read the sentence (11) eleven times, and showed the pattern (a), (b) and (c), six times, three times and twice respectively. He concludes that the process of Minor Phrase formation may be subject to the Principle of Rhythmic Alternation just like the processes of downstep and compound formation, regarding the principle as a constraint whose effects may be found in Japanese Phonology in general.

3.3.2. Pitch Patterns in Uniformly Left-Branching Structures in Kubozono (1989, 1993)

In this subsection, we will take a closer look at the pitch patterns in uniformly left-branching structures consisting of four accented words reported on Kubozono (1989, 1993). The relevant sentences used in Kubozono (1989, 1993) are the following two.

[15] Japanese has a single pitch accent 'H*+L', the location of which is basically specified in lexicon, except, for example, the case of compound formation.

(12) [[[ma’riko-ga no’n-da] wa’in-no] nio’i]

Mariko-Nom drink-Past wine-Gen smell

‘the smell of the wine which Mariko drank’

(13) [[[a’iko-ga a’n-da] eri’maki-no] iromo’yoo]

Aiko-Nom knit-Past muffler-Gen design

‘the design of the muffler which Aiko knit’

According to Kubozono (1989, 1993), these two phrases exhibited the same pitch pattern such that otherwise monotonously descending pitch pattern was converted into the alternating rhythmic pattern of High-Low-High-Low sequence, with the F_0 level of the third word boosted by the application of the Principle of Rhythmic Alternation. In this respect, Kubozono (1989, 1993) claims that uniformly left-branching structure is intonationally neutralized with symmetrically branching structure made up of four accented words as a whole such as (14) (from Kubozono (1989: 61)) and attributes the effect of neutralization to what he calls ‘metrical restructuring’, whereby a single phonetic realization rule “Metrical Boost”, which responds to any right-branching structure, applies to both originally symmetrically branching structures and restructured ones, generating the same F_0 patterns in both cases.

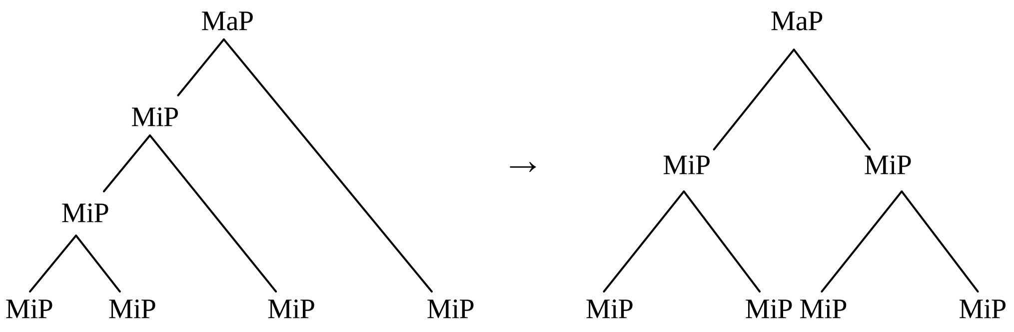
(14) [[a’iko-no ne’esan-no] [u’uru-no eri’maki]]

Aiko-Gen sister-Gen wool-Gen muffler

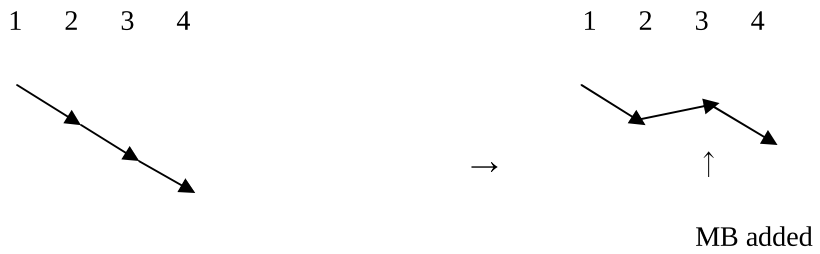
‘Aiko’s sister’s woolen muffler’

The metrical restructuring together with the change of pitch pattern is illustrated in (15) (adopted from Kubozono (1989: 63). "MaP", "MiP" and "MB" stand for Major Phrase, Minor Phrase and Metrical Boost respectively).

(15) a. metrical restructuring



b. change of pitch pattern



Note that Kubozono (1989, 1993) assumes binary-branching recursive mechanism of Minor Phrases in prosodic representation, which we will discuss in detail later.

Noticing the two sentences (12) and (13), we can find that they have a structure in common. They involve relative clause structure, in which the antecedents stand in the third position in those sentences. Kubozono (1989, 1993) does not use those sentences which do not involve relative clause structure. Here a possibility emerges that the relative clause structure in question may induce the apparent intonational neutralization between originally symmetrically branching structures and restructured ones. In addition, there are several problems which might affect pitch patterns in sentences (12) – (14). In those sentences, some of the accented syllables include high vowel, and the number of moras in each word is inconsistent, which, Kubozono (1993) himself argues, might affect pitch patterns.

And so the result of an experiment will be shown which controls the relevant effects in the next subsection.

3.3.3. The Interaction of Relative Clause Structures with the Principle of Rhythmic Alternation

3.3.3.1. Accented Sequences

First, we compare the pitch patterns in relative clause structures made up of four accented words in which the position of the antecedent differs. In sentences (16) – (19), the sentence (a) involves an antecedent in the third position, whereas the sentence (b) involves an antecedent in the fourth position. A pair of sentences in (16) differs from the others in that the number of moras in each word in the pair is smaller. Among the subjects of the (b) sentences in (17) – (19), (17) involves coordinated structure, (18) genitive structure, and (19) adjective phrase (in sentences (18a) and (19a), the fourth elements do not have accent in favor of the naturalness of meaning).

(16) a. [[[ma'ri-ga [ec$_i$] no'n-da] ro'ze$_i$-no] ryo'o]

Mari-Nom ec drink-Past vins rose-Gen amount

'the amount of the vins rose that Mari drank'

b. [[[ma'ri-no a'ni-ga] [ec$_i$] no'n-da] ro'ze$_i$]

Mari-Gen brother-Nom ec drink-Past vins rose

'the vins rose that Mari's brother drank'

(17) a. [[[a'raki-ga [ec$_i$] tano'n-da] dora'i$_i$-no] nio'i]

A'raki-Nom ec order-Past dry stout-Gen smell

'the smell of the dry stout that Araki ordered'

b. [[[a'raki-to ya'mano-ga] [ec$_i$] tano'n-da] dora'i$_i$]

Araki-Conj Yamano-Nom ec order-Past dry stout

'the dry stout that Araki and Yamano ordered'

(18) a. [[[a'mano-ga [ec$_i$] a'isi-ta] yo'ojo$_i$-no] namae]

Amano-Nom ec love-Past little girl-Gen name

'the name of the little girl that Amano loved'

b. [[[a'mano-no o'nsi-ga] [ec$_i$] a'isi-ta] yo'ojo$_i$]

Amano-Gen former teacher-Nom ec love-Past little girl

'the little girl that Amano's former teacher loved'

(19) a. [[[yo'oji-ga [ec$_i$] era'n-da] omo'cha$_i$-no] namae]

little child-Nom ec choose-Past toy-Gen name

'the name of the toy that the little child chose'

b. [[[ge'nkina yo'oji-ga] [ec$_i$] era'n-da] omo'cha$_i$]

cheerful little child-Nom ec choose-Past toy

'the toy that the cheerful little child chose'

The mean F_0 peak values of those four phrases, the SDs and line graphs of the peak F_0 values of those four phrases in each sentence are shown according to the speakers below.

YK

	P1	P2	P3	P4
16a	316.1	229.7	263.1	215.4
	14.39	9.07	12.98	12.19
16b	315.8	235.1	231.6	237.5
	9.29	6.22	9.64	12.10

Table 4: Mean peak F_0 values and SDs of the four phrases in (16) for speaker YK.

	P1	P2	P3	P4
17a	315.7	227.5	262.7	220.5
	12.84	7.30	14.70	13.47
17b	316.8	243.8	253.3	230.9
	9.93	13.84	10.86	17.41

Table 5: Mean peak F_0 values and SDs of the four phrases in (17) for speaker YK.

	P1	P2	P3	P4
18a	318.1	225.0	262.1	212.9
	14.76	17.37	13.51	11.02
18b	325.5	225.8	243.1	225.7
	14.62	11.11	17.13	11.73

Table 6: Mean peak F_0 values and SDs of the four phrases in (18) for speaker YK.

	P1	P2	P3	P4
19a	315.2	232.4	276.4	190.8
	8.70	15.63	9.62	14.50
19b	319.3	228.4	264.8	218.6
	12.14	14.94	15.09	19.62

Table 7: Mean peak F_0 values and SDs of the four phrases in (19) for speaker YK.

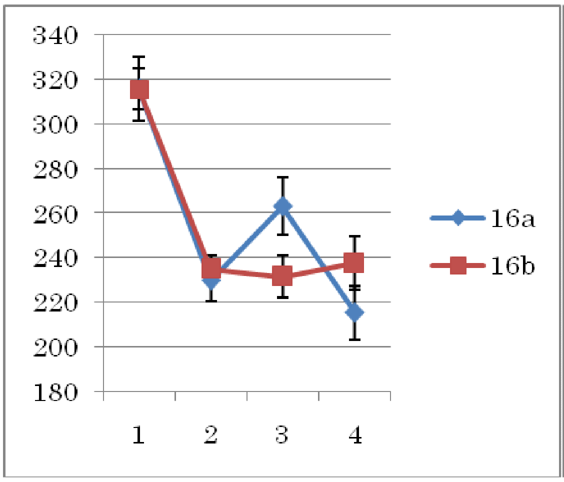


Figure 7: Peak F_0 line graphs of the four phrases in (16) for speaker YK.

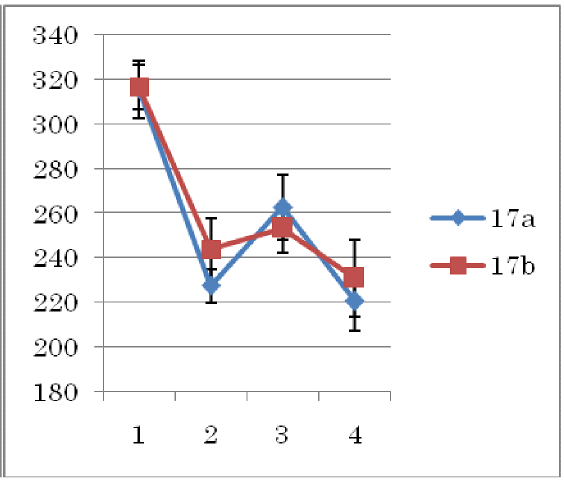


Figure 8: Peak F_0 line graphs of the four phrases in (17) for speaker YK.

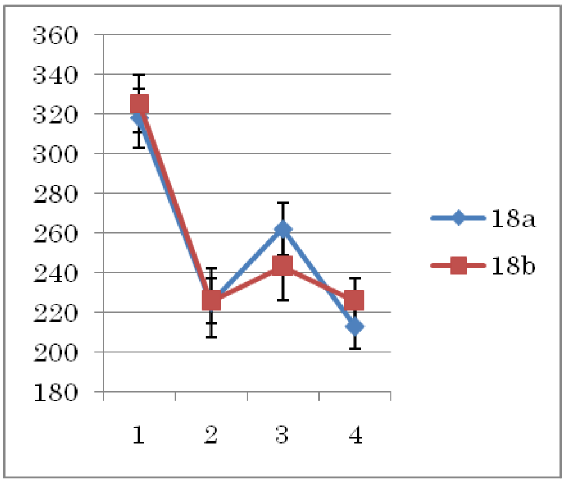


Figure 9: Peak F_0 line graphs of the four phrases in (18) for speaker YK.

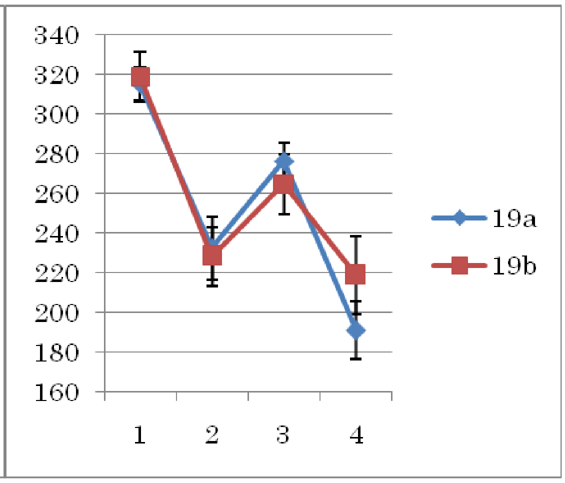


Figure 10: Peak F_0 line graphs of the four phrases in (19) for speaker YK.

AM

	P1	P2	P3	P4
16a	279.2	237.5	246.9	239.6
	11.27	5.47	10.26	5.97
16b	279	239.7	236.1	242.2
	11.92	4.97	6.50	6.34

Table 8: Mean peak F_0 values and SDs of the four phrases in (16) for speaker AM.

	P1	P2	P3	P4
17a	289.2	240.1	241.9	237.9
	14.21	4.83	7.63	4.42
17b	284.0	251.2	240.6	243.8
	13.58	7.68	5.69	5.02

Table 9: Mean peak F_0 values and SDs of the four phrases in (17) for speaker AM.

	P1	P2	P3	P4
18a	280.4	236.3	245.8	218.4
	7.56	9.62	6.49	5.05
18b	285.6	241.5	238.9	243.5
	14.13	7.50	4.08	4.21

Table 10: Mean peak F_0 values and SDs of the four phrases in (18) for speaker AM.

	P1	P2	P3	P4
19a	282.7	240.3	246.5	214.3
	10.53	5.94	8.28	5.67
19b	276.1	243.2	233.7	240.1
	11.46	2.52	3.91	5.16

Table 11: Mean peak F_0 values and SDs of the four phrases in (19) for speaker AM.

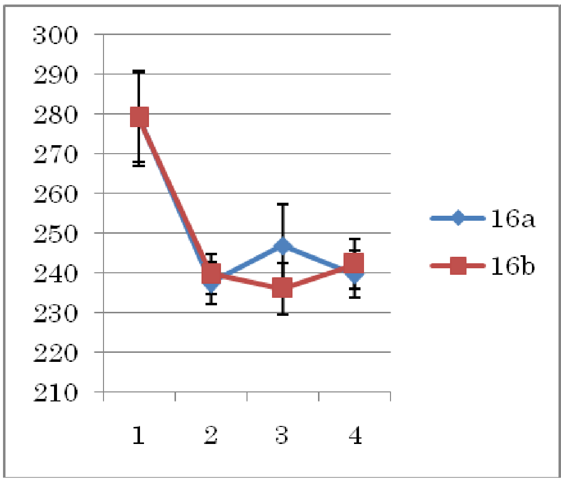


Figure 11: Peak F_0 line graphs of the four phrases in (16) for speaker AM.

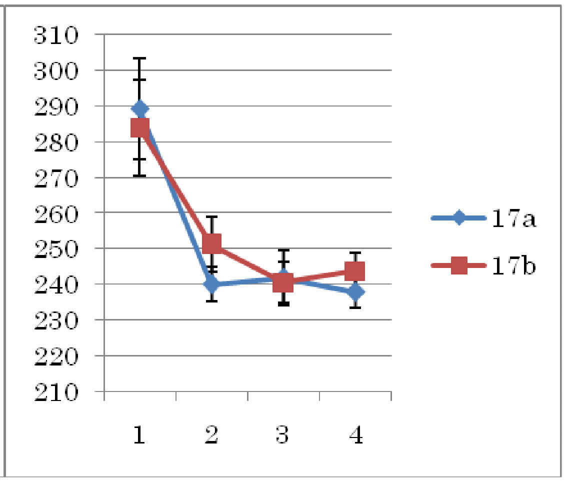


Figure 12: Peak F_0 line graphs of the four phrases in (17) for speaker AM.

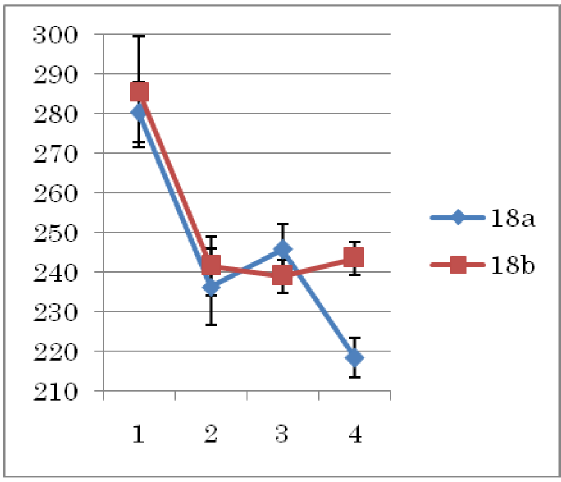


Figure 13: Peak F_0 line graphs of the four phrases in (18) for speaker AM.

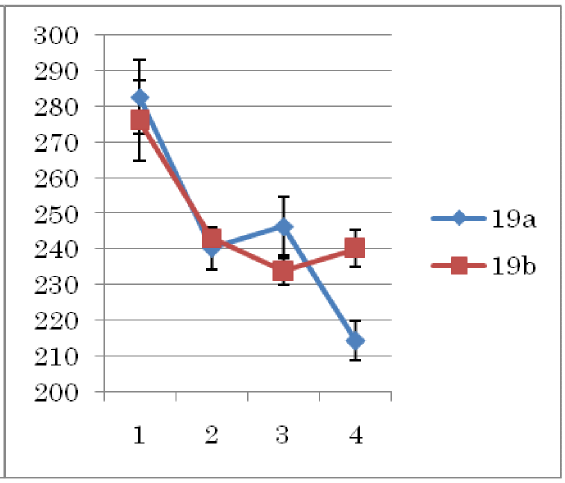


Figure 14: Peak F_0 line graphs of the four phrases in (19) for speaker AM.

SK

	P1	P2	P3	P4
16a	178.7	130.0	142.0	119.7
	4.41	6.66	8.86	6.15
16b	180.1	164.8	123.2	127.5
	3.45	6.98	6.12	13.96

Table 12: Mean peak F_0 values and SDs of the four phrases in (16) for speaker SK.

	P1	P2	P3	P4
17a	187.4	124.2	150.5	116.9
	4.75	4.93	10.66	10.44
17b	186.2	149.3	149.3	129.5
	8.44	6.31	10.55	10.46

Table 13: Mean peak F_0 values and SDs of the four phrases in (17) for speaker SK.

	P1	P2	P3	P4
18a	181.5	137.2	142.5	124.2
	3.80	8.77	9.10	5.98
18b	180.8	144.8	133.5	118.5
	6.24	11.21	11.10	9.21

Table 14: Mean peak F_0 values and SDs of the four phrases in (18) for speaker SK.

	P1	P2	P3	P4
19a	183.2	133.8	143.7	120.1
	3.35	6.12	8.19	6.92
19b	187.0	144.5	133.5	122.2
	3.59	12.69	8.54	5.10

Table 15: Mean peak F_0 values and SDs of the four phrases in (19) for speaker SK.

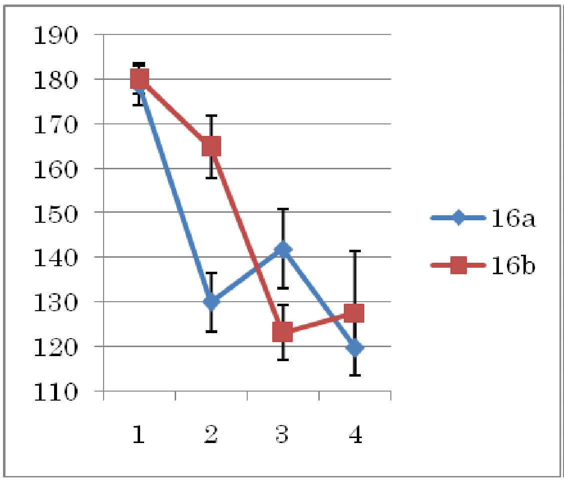


Figure 15: Peak F_0 line graphs of the four phrases in (16) for speaker SK.

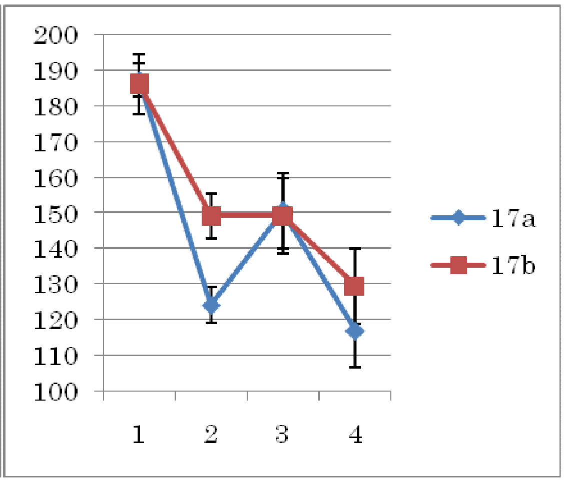


Figure 16: Peak F_0 line graphs of the four phrases in (17) for speaker SK.

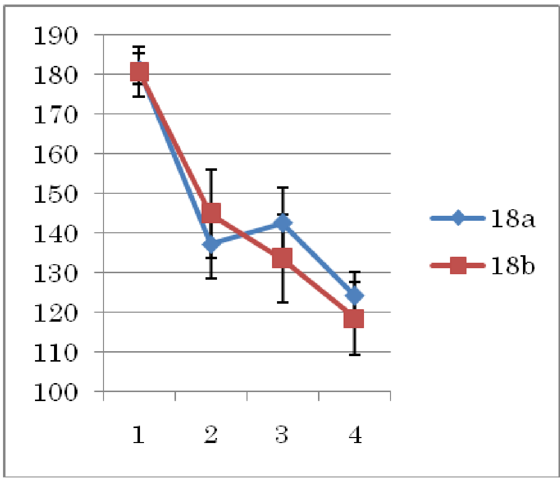


Figure 17: Peak F_0 line graphs of the four phrases in (18) for speaker SK.

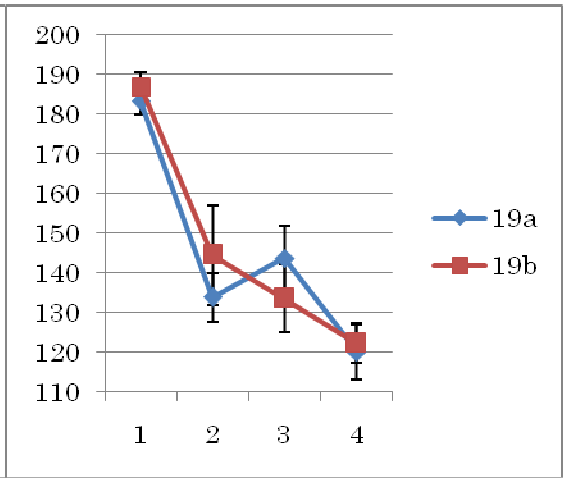


Figure 18: Peak F_0 line graphs of the four phrases in (19) for speaker SK.

As seen from the figures, those pairs show remarkable difference in realization of pitch patterns. For all the speakers, the sentences in (a), which involve an antecedent in the third position, seem to be all subject to the Principle of Rhythmic Alternation in such a way that the obtained pitch contours show the rhythmic pattern of High-Low-High-Low sequence. Meanwhile, we can find inter-speaker variation in sentences (b). YK tends to show the rhythmic pattern in sentences (b) as well. From AM's data in sentences (b), we cannot find the effect of the Principle of Rhythmic Alternation at all, with the result that F_0 levels of the fourth words, that is, the antecedents, are consistently boosted. It seems that SK tends to read the sentences in (b) such that the F_0 contours gradually descend in the course of utterance.

As for F_0 boosting between the second and the third words, only the pair of sentences in (19) for speaker YK does not show significant difference (YK: (16): p（T=7.868）<.001, (17): p（T=3.769）<.01, (18): p（T=2.479）<.05, (19): p（T= 0.952）>.20, AM: (16): p（T=4.977）<.001, (17): p（T=3.874）<.001, (18): p（T=3.418）<.001, (19): p（T=7.584）<.001, SK: (16): p（T=13.505）<.001, (17): p（T=4.866）<.001, (18): p（T=3.065）<.01, (19): p（T=3.916）<.001 (all 20 df)). For later discussion, I point out here that as for F_0 boosting between the first and the second words, significant differences were observed in (17) for YK, in (17) and (19) for AM and in (16) and (17) for SK (YK: (16): p(T=1.220) >.20, (17): p(T=2.704) <.05, (18): p(T=0.786) >.20, (19): p(T=1.026) >.20, AM: (16): p(T=0.621) >.20, (17): p(T=3.603) <.01, (18): p(T=0) =1, (19): p(T=2.210) <.05, SK: (16): p(T=11.717) <.001, (17): p(T=7.188) <.001, (18): p(T=1.732) >.05, (19): p(T=1.824) >.05 (all 20 df)).

Next, we compare the pitch patterns in (16a) and (18a) with the patterns in (20) and (21), respectively. Neither sentence (20) nor sentence (21) involves relative clause structure (we did not use the counterparts to the sentences (17a) and (19a) because it was rather difficult to make such sentences as involve coordinated subject or adjective phrase in a natural way. Basically the same is true of the counterparts to the (b) sentences in (16) – (19)).

(20) [[[ma’ri-no a’ni-no] ro’ze-no] ryo’o]

Mari-Gen brother-Gen vins rose-Gen amount

‘the amount of Mari’s brother’s vins rose’

(21) [[[a’mano-no o’nsi-no] yo’ojo-no] namae]

Amano-Gen former teacher-Gen little girl-Gen name

‘the name of Amano’s former teacher’s little girl’

I list the mean F_0 peak values of those four phrases and the SDs, and line graphs of the peak F_0 values of those four phrases in each sentence are shown with those in sentences (16a) and (18a) for comparison, according to the speakers below.

YK

	P1	P2	P3	P4
(16a)	316.1	229.7	263.1	215.4
	14.39	9.07	12.98	12.19
20	316.5	226.0	252.5	206.2
	10.56	9.23	11.06	12.74

Table 16: Mean peak F_0 values and SDs of the four phrases in (16a) and (20) for speaker YK.

	P1	P2	P3	P4
(18a)	318.1	225.0	262.1	212.9
	14.76	17.37	13.51	11.02
21	318.1	227.7	263.3	224.0
	8.77	10.93	14.19	14.37

Table 17: Mean peak F_0 values and SDs of the four phrases in (18a) and (21) for speaker YK.

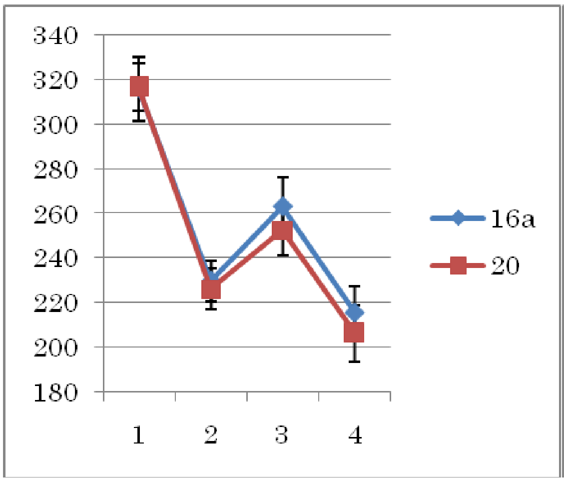


Figure 19: Peak F_0 line graphs of the four phrases in (16a) and (20) for speaker YK.

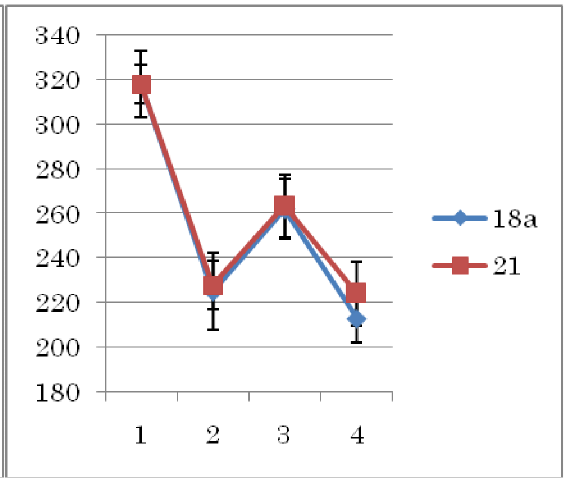


Figure 20: Peak F_0 line graphs of the four phrases in (18a) and (21) for speaker YK.

AM

	P1	P2	P3	P4
(16a)	279.2	237.5	246.9	239.6
	11.27	5.47	10.26	5.97
20	275.9	240.5	241.3	243.2
	12.09	8.77	7.03	6.41

Table 18: Mean peak F_0 values and SDs of the four phrases in (16a) and (20) for speaker AM.

	P1	P2	P3	P4
(18a)	280.4	236.3	245.8	218.4
	7.56	9.62	6.49	5.05
21	285.6	241.5	238.9	243.5
	14.13	7.50	4.08	4.21

Table 19: Mean peak F_0 values and SDs of the four phrases in (18a) and (21) for speaker AM.

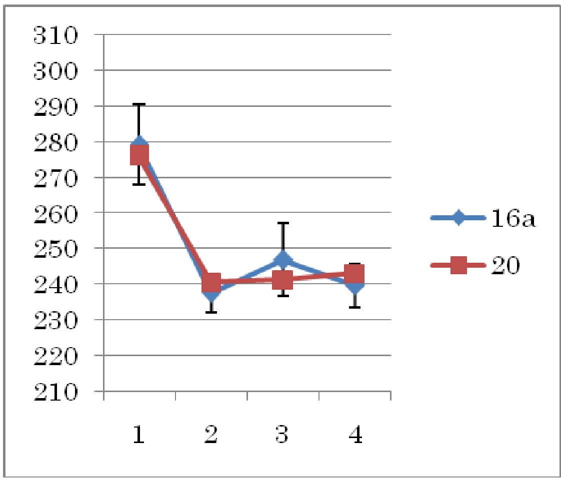


Figure 21: Peak F_0 line graphs of the four phrases in (16a) and (20) for speaker AM.

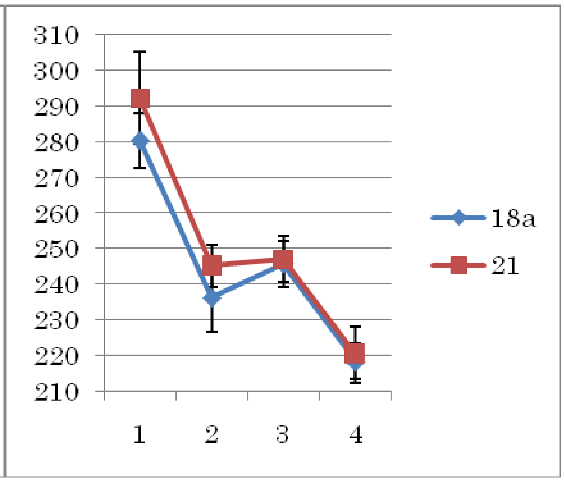


Figure 22: Peak F_0 line graphs of the four phrases in (18a) and (21) for speaker AM.

SK

	P1	P2	P3	P4
(16a)	178.7	130.0	142.0	119.7
	4.41	6.66	8.86	6.15
20	177.9	168.5	130.4	113.9
	2.74	7.73	9.82	3.92

Table 20: Mean peak F_0 values and SDs of the four phrases in (16a) and (20) for speaker SK.

	P1	P2	P3	P4
(18a)	181.5	137.2	142.5	124.2
	3.80	8.77	9.10	5.98
21	179.5	152.3	140.3	124.1
	6.76	7.20	13.96	6.96

Table 21: Mean peak F_0 values and SDs of the four phrases in (18a) and (21) for speaker SK.

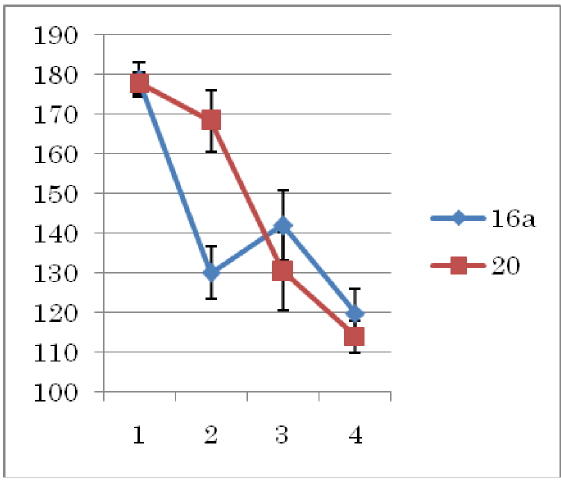


Figure 23: Peak F_0 line graphs of the four phrases in (16a) and (20) for speaker SK.

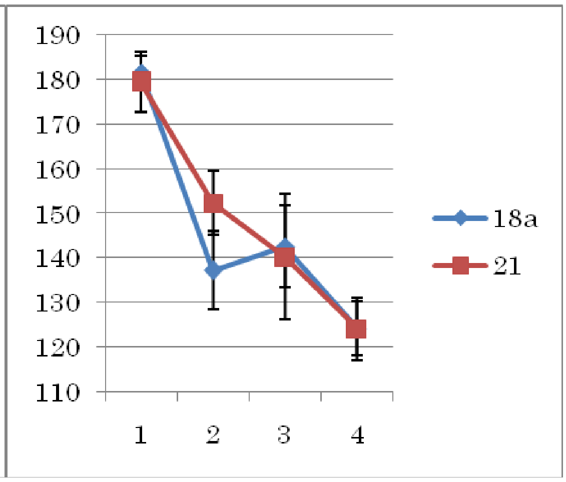


Figure 24: Peak F_0 line graphs of the four phrases in (18a) and (21) for speaker SK.

We can observe inter-speaker variation from the figures also here. YK does not show any difference in the degree of F_0 boosting between the second and the third words in the two cases, whereas AM and SK show differences in the degree of F_0 boosting between the second and the third words in both cases (YK: (16a) vs (20): $p(T=1.611)>.10$, (18a) vs (21): $p(T=0.190)>.10$, AM: (16a) vs (20): $p(T=2.855)<.01$, (18a) vs (21): $p(T=2.094)<.05$, SK: (16a) vs (20): $p(T=12.998)<.001$, (18a) vs (21): $p(T=3.339)<.01$ (all 20 df)). As shown in Figures 19 and 20, YK does not show any difference among the major parameters in both cases, except for the peak values in the fourth words between (18a) and (21). AM shows different pitch patterns between (20) and (21) as shown in Figures 21 and 22. SK shows gradually descending pitch contours also here as in (b) sentences in (16) - (19). For later discussion, I point out that as for F_0 boosting between the first and the second words, significant differences were observed only for SK in both cases (YK: (16a) vs (20): $p(T=0.927)>.20$, (18a) vs (21): $p(T=0.327)>.20$, AM: (16a) vs (20): $p(T=1.673)>.10$, (18a) vs (21): $p(T=0.682)>.20$, SK: (16a) vs (20): $p(T=12.404)<.001$, (18a) vs (21): $p(T=4.600)<.001$ (all 20 df)).

It has been reported that Phonological Phrasing favors eurhythmic parsing in a variety of languages to the effect that a string is ideally parsed into units of the same length (Ghini (1993), Selkirk (2000), Sandalo and Truckenbrodt (2002), among others). Since Kubozono (1989, 1993) deals with the data from only a single subject, we cannot see inter-speaker variation from his data. For inter-speaker variation on Phonological Phrasing in Japanese, Sugiyama (2006) independently reports that based on Implicit Prosody Hypothesis (Fodor (1998), Bader (1998)), in silent reading of an ambiguous phrase in (22), which can be interpreted as five different meanings according to the maximal five tree structures, 20 subjects, who regularly participate in musical activities interpreted the phrase as the eurhythmic {*uma'i a'yu-to*} {*u'ni-no na'be*} pattern more significantly than 20 subjects, who do not participate in such activities at all.

(22) uma'i a'yu-to u'ni-no na'be

delicious sweetfish-Conj sea urchin-Gen winter cuisine served in the pot

a [[[uma'i a'yu-to] u'ni-no] na'be]

'winter cuisine with delicious sweetfish and sea urchin served in the pot'

b [[uma'i [a'yu-to u'ni-no]] na'be]

'winter cuisine with delicious sweetfish and delicious sea urchin served in the pot'

→ c [[uma'i a'yu-to] [u'ni-no na'be]]

'delicious sweetfish, and winter cuisine with sea urchin served in the pot'

d [uma'i [[a'yu-to u'ni-no] na'be]]

'delicious winter cuisine with sweetfish and sea urchin served in the pot' e [uma’i [a’yu-to [u’ni-no na’be]]]

‘delicious sweetfish, and delicious winter cuisine with sea urchin served in the pot’

Sugiyama (2006) concludes that even in implicit prosody, inter-speaker variation in eurhythmic effect can be found (for more details about implicit prosody in Japanese, see Hirose (1999, 2003)).

Consequently, it is not surprising that in explicit prosody above the word level, speakers are subject to the Principle of Rhythmic Alternation to different degrees from speaker to speaker.

As we have seen from Figures 7 to 18, two different relative clause structures yield different pitch patterns across speakers. For further support for this view, we will investigate the pitch patterns in unaccented sequences involving relative clause structures in the next subsection.

3.3.3.2. Unaccented Sequences

In the related experiment, speakers read the following pair of sentences, both of which consist of four unaccented words and involve relative clause construction. The difference in the structures between the pair lies in the position where the antecedent stands; in sentence (a), the antecedent stands in the third position, whereas in sentence (b), the antecedent stands in the fourth position. The mean F_0 values of peaks and valleys of those four phrases, the SDs and F_0 line graphs of peaks and valleys of those four phrases in each sentence are shown according to the speakers below.

(23) a. [[[ane-ga [ec_i] yon-da] oi_i-no] ame]

elder sister-Nom ec call-Past nephew-Gen candy

‘the candies of my nephew whom my elder sister called’

b. [[[ueno ane-ga] [ec$_i$] yon-da] oi$_i$]

eldest sister-Nom ec call-Past nephew

'my nephew whom my eldest sister called'

YK

	V1	P1	V2	P2	V3	P3	V4	P4	V5
23a	200.9	283.3	271.8	271.8	216.2	240.8	223.7	223.7	208.9
	6.33	5.89	5.56	5.56	25.79	7.40	7.40	7.40	8.85
23b	210.1	277.5	269.2	269.2	249.6	249.6	222.1	223.4	205.1
	6.13	8.09	7.83	7.83	10.23	10.23	6.83	6.98	8.67

Table 22: Mean F_0 values of peaks and valleys and SDs of the four phrases in (23) for speaker YK.

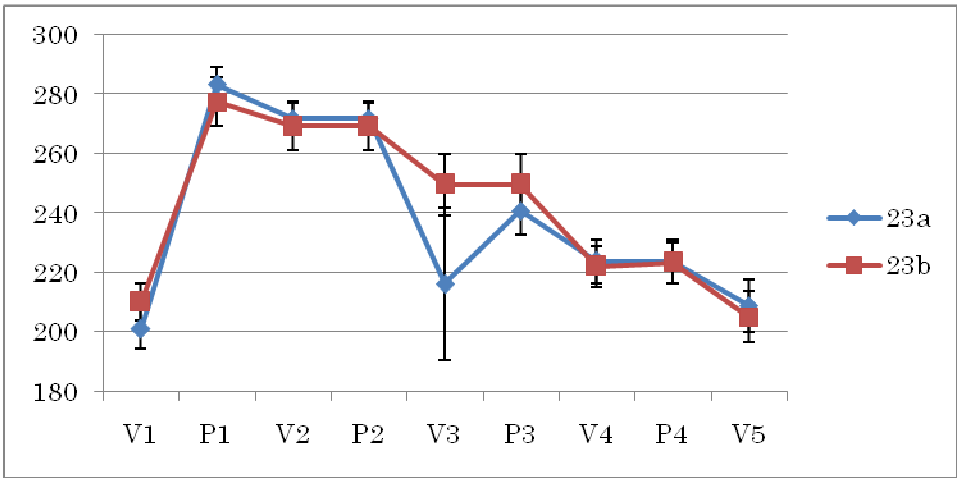


Figure 25: F_0 line graphs of peaks and valleys of the four phrases in (23) for speaker YK.

AM

	V1	P1	V2	P2	V3	P3	V4	P4	V5
23a	219.9	258.7	247.3	247.3	217.4	236.9	231.4	232.3	226.5
	7.54	10.48	6.18	6.18	9.11	6.71	5.77	5.64	6.43
23b	229.5	248.5	241.9	241.9	233.5	236.3	215.8	227.3	225.4
	4.48	3.77	3.75	3.75	7.61	5.28	6.41	5.10	5.84

Table 23: Mean F_0 values of peaks and valleys and SDs of the four phrases in (23) for speaker AM.

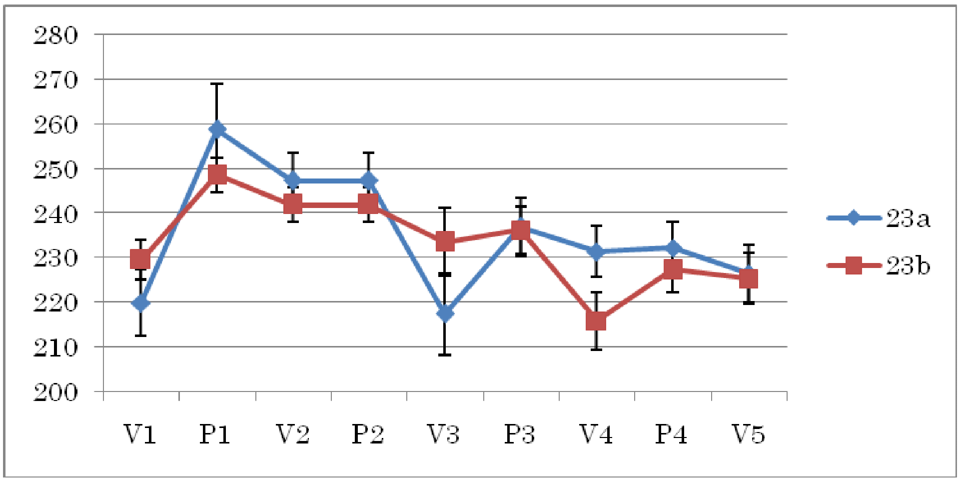


Figure 26: F_0 line graphs of peaks and valleys of the four phrases in (23) for speaker AM.

SK

	V1	P1	V2	P2	V3	P3	V4	P4	V5
23a	135.2	168.4	158.1	159.5	121.3	141.2	125.5	129.5	113.1
	8.18	4.42	7.09	5.77	13.97	8.71	6.99	6.13	9.54
23b	133.8	163.0	143.7	151.7	133.5	136.7	114.2	121.4	110.4
	4.53	6.85	7.20	6.43	7.60	7.65	6.71	4.81	5.00

Table 24: Mean F_0 values of peaks and valleys and SDs of the four phrases in (23) for speaker SK.

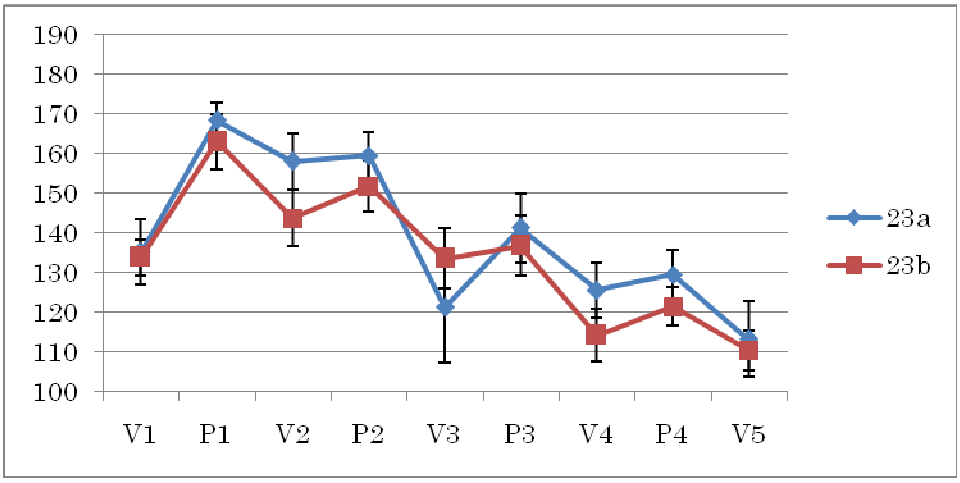


Figure 27: F_0 line graphs of peaks and valleys of the four phrases in (23) for speaker SK.

Minor Phrasing determined by presence of Initial Lowering in each sentence out of eleven utterances is shown according to the speakers below ("MiP" stands for Minor Phrase here).

YK

(23) a. $_{\text{MiP}}$(anega yonda)$_{\text{MiP}}$ $_{\text{MiP}}$(oino ame)$_{\text{MiP}}$ (9 times) ←

$_{\text{MiP}}$(anega yonda oino ame)$_{\text{MiP}}$ (2 times)

b. $_{\text{MiP}}$(ueno anega yonda oi)$_{\text{MiP}}$ (9 times) ←

$_{\text{MiP}}$(ueno anega yonda)$_{\text{MiP}}$ $_{\text{MiP}}$(oi)$_{\text{MiP}}$ (2 times)

AM

(23) a. $_{\text{MiP}}$(anega yonda)$_{\text{MiP}}$ $_{\text{MiP}}$(oino ame)$_{\text{MiP}}$ (10 times) ←

$_{\text{MiP}}$(anega yonda oino)$_{\text{MiP}}$ $_{\text{MiP}}$(ame)$_{\text{MiP}}$ (1 time)

b. $_{\text{MiP}}$(ueno anega yonda)$_{\text{MiP}}$ $_{\text{MiP}}$(oi)$_{\text{MiP}}$ (7 times) ←

$_{\text{MiP}}$(ueno anega)$_{\text{MiP}}$ $_{\text{MiP}}$(yonda)$_{\text{MiP}}$ $_{\text{MiP}}$(oi)$_{\text{MiP}}$ (3 times)

$_{\text{MiP}}$(ueno anega)$_{\text{MiP}}$ $_{\text{MiP}}$(yonda oi)$_{\text{MiP}}$ (1 time)

SK

(23) a. $_{\text{MiP}}$(anega yonda)$_{\text{MiP}}$ $_{\text{MiP}}$(oino ame)$_{\text{MiP}}$ (7 times) ←

$_{\text{MiP}}$(anega yonda)$_{\text{MiP}}$ $_{\text{MiP}}$(oino)$_{\text{MiP}}$ $_{\text{MiP}}$(ame)$_{\text{MiP}}$ (3 times)

$_{\text{MiP}}$(anega)$_{\text{MiP}}$ $_{\text{MiP}}$(yonda oino)$_{\text{MiP}}$ $_{\text{MiP}}$(ame)$_{\text{MiP}}$ (1 time)

b. $_{\text{MiP}}$(ueno)$_{\text{MiP}}$ $_{\text{MiP}}$(anega yonda)$_{\text{MiP}}$ $_{\text{MiP}}$(oi)$_{\text{MiP}}$ (4 times) ←

$_{\text{MiP}}$(ueno anega yonda)$_{\text{MiP}}$ $_{\text{MiP}}$(oi)$_{\text{MiP}}$ (2 times) (←)

$_{\text{MiP}}$(ueno anega yonda oi)$_{\text{MiP}}$ (2 times)

$_{\text{MiP}}$(ueno)$_{\text{MiP}}$ $_{\text{MiP}}$(anega)$_{\text{MiP}}$ $_{\text{MiP}}$(yonda)$_{\text{MiP}}$ $_{\text{MiP}}$(oi)$_{\text{MiP}}$ (1 time) (←)

$_{\text{MiP}}$(ueno)$_{\text{MiP}}$ $_{\text{MiP}}$(anega yonda oi)$_{\text{MiP}}$ (1 time)

$_{\text{MiP}}$(ueno)$_{\text{MiP}}$ $_{\text{MiP}}$(anega)$_{\text{MiP}}$ $_{\text{MiP}}$(yonda oi)$_{\text{MiP}}$ (1 time)

For comparison, we show the relevant data in (11) above from Kubozono (1993) repeated in (24).

(24) [[[naomi-no oi-no] yome-no] yunomi]

A: $_{MiP}$(naomino oino)$_{MiP}$ $_{MiP}$(yomeno yunomi)$_{MiP}$ (6 times) ←

B: $_{MiP}$(naomino)$_{MiP}$ $_{MiP}$(oino yomeno yunomi)$_{MiP}$ (3 times)

C: $_{MiP}$(naomino)$_{MiP}$ $_{MiP}$(oino)$_{MiP}$ $_{MiP}$(yomeno yunomi)$_{MiP}$ (2 times)

D: $_{MiP}$(naomino oino yomeno yunomi)$_{MiP}$ (zero)

As for Initial Lowering, we can find inter-speaker variation. YK shows significant differences in the first and the third words. AM shows significant differences except in the second words. SK shows significant differences in the second and the third words (YK: P1-V1: $p(T=3.763)<.01$, P2-V2: $p(T=0)=1$, P3-V3: $p(T=4.155)<.001$, P4-V4: $p(T=1.544)>.10$, AM: P1-V1: $p(T=6.916)<.001$, P2-V2: $p(T=0)=1$, P3-V3: $p(T=6.112)<.001$, P4-V4: $p(T=5.364)<.001$, SK: P1-V1: $p(T=1.074)>.20$, P2-V2: $p(T=2.675)<.05$, P3-V3: $p(T=4.245)<.001$, P4-V4: $p(T=1.213)>.20$ (all 20 df)).

We can also find several important points here. First, as indicated by "←", each speaker seems to have default phrasing according to the sentences except for (23b) for SK. As for (23a), the default phrasing is the same across speakers, that is, eurhythmic 2-2 pattern, the one which was observed most frequently in (24) from Kubozono (1993). As for (23b), however, speakers use the different phrasing strategies. YK's default phrasing is the one in which no Initial Lowering was observed except for sentence-initial position, the pattern which was never observed in Kubozono's (1993) data. In this connection, Selkirk and Tateishi (1988: 330) propose a constraint that "a Minor Phrase may consist of at most three Prosodic Words" ('ternary branching condition on Minor Phrasing' in their terminology). Clearly YK's default phrasing in (23b) does not obey the constraint because four unaccented Prosodic Words constitute a single Minor Phrase. Therefore it can be said that ternary branching condition on Minor Phrasing is not absolute, but violable in

Optimality-Theoretic terms. AM tends to insert a Minor Phrase boundary between the third and the forth Prosodic Words in (23b). SK shows no less than six phrasing patterns in (23b) and does not seem to have default phrasing for (23b). However, as indicated by "←" and "(←)", it seems that he tends to insert a Minor Phrase boundary between the third and the fourth Prosodic Words.

Through the observation of the data, it can safely be said that speakers prefer to insert a Minor Phrase boundary between the relative clause and its antecedent in uniformly left-branching structure made up of four unaccented words especially in the case where the antecedent stands in the third position. To put it differently, Minor Phrasing is sensitive to the internal structure of relative clause construction.

For comparison with the accented case above, let us see the pitch patterns of those sentences which consist of three unaccented phrases, with and without relative clause structure in sentence (25a) and (25b) respectively.

(25) a. [[oi-ga [ec_i] mon-da] $momo_i$]

nephew-Nom ec rub-Past peach

'the peach that my nephew rubbed'

b. [[oi-no yome-no] momo]

nephew-Gen wife-Gen peach

'my nephew's wife's peach'

The mean F_0 values of peaks and valleys of those three phrases, the SDs and F_0 line graphs of peaks and valleys of those three phrases in each sentence are shown according to the speakers below.

YK

	V1	P1	V2	P2	V3	P3	V4
25a	218.5	285.3	269.2	269.2	235.4	235.4	195.2
	19.77	10.47	9.49	9.49	8.64	8.64	14.22
25b	218.7	284.5	269.5	269.5	231.5	231.5	195.9
	17.06	8.00	6.87	6.87	5.76	5.76	13.23

Table 25: Mean F_0 values of peaks and valleys and SDs of the three phrases in (25) for speaker YK.

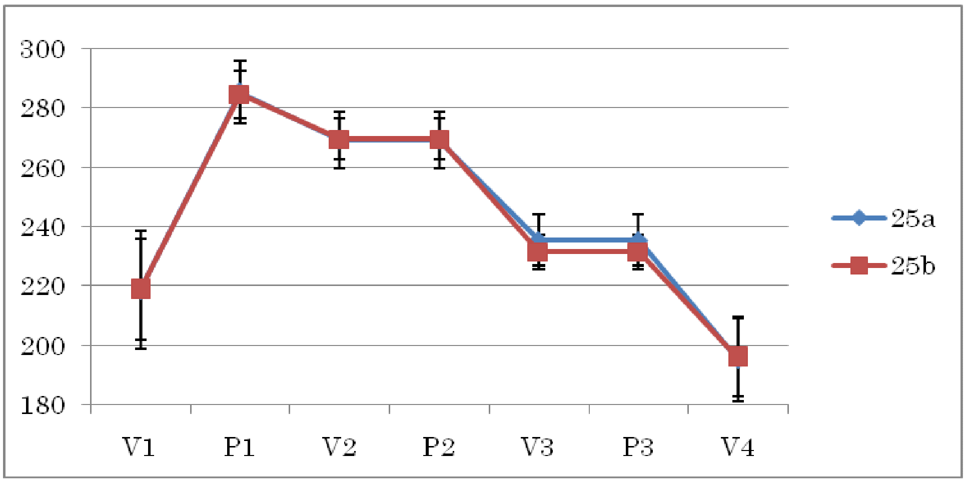


Figure 28: F_0 line graphs of peaks and valleys of the three phrases in (25) for speaker YK.

AM

	V1	P1	V2	P2	V3	P3	V4
25a	223.5	258.2	244.7	244.7	217.3	231.3	227.8
	7.15	7.18	3.91	3.91	7.05	3.72	4.24
25b	228.1	254.0	248.3	248.3	215.7	229.2	226.0
	6.57	7.94	6.78	6.78	9.54	6.01	5.26

Table 26: Mean F_0 values of peaks and valleys and SDs of the three phrases in (25) for speaker AM.

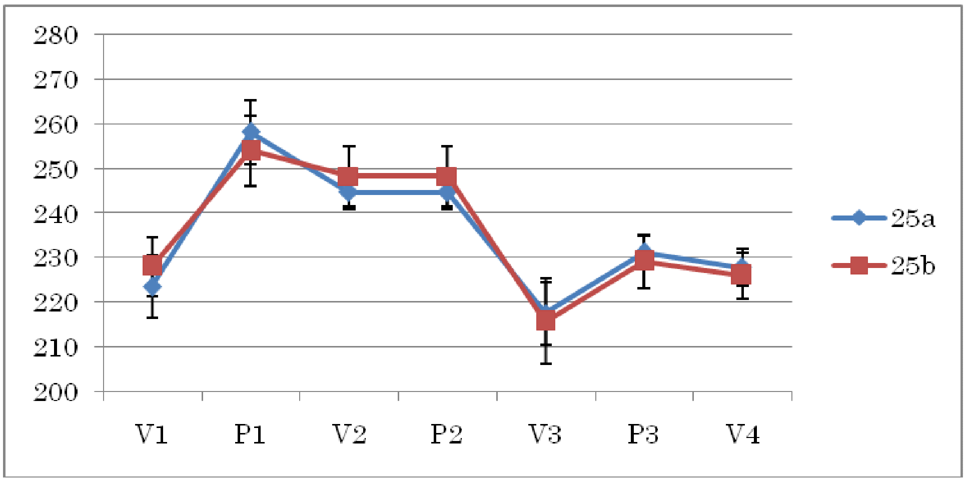


Figure 29: F_0 line graphs of peaks and valleys of the three phrases in (25) for speaker AM.

SK

	V1	P1	V2	P2	V3	P3	V4
25a	141.7	162.8	151.5	152.8	117.0	135.7	124.8
	9.95	4.41	4.29	4.09	4.99	8.36	7.21
25b	137.8	165.0	154.6	154.6	123.0	142.2	134.3
	19.87	7.97	9.09	9.09	9.90	7.42	9.59

Table 27: Mean F_0 values of peaks and valleys and SDs of the three phrases in (25) for speaker SK.

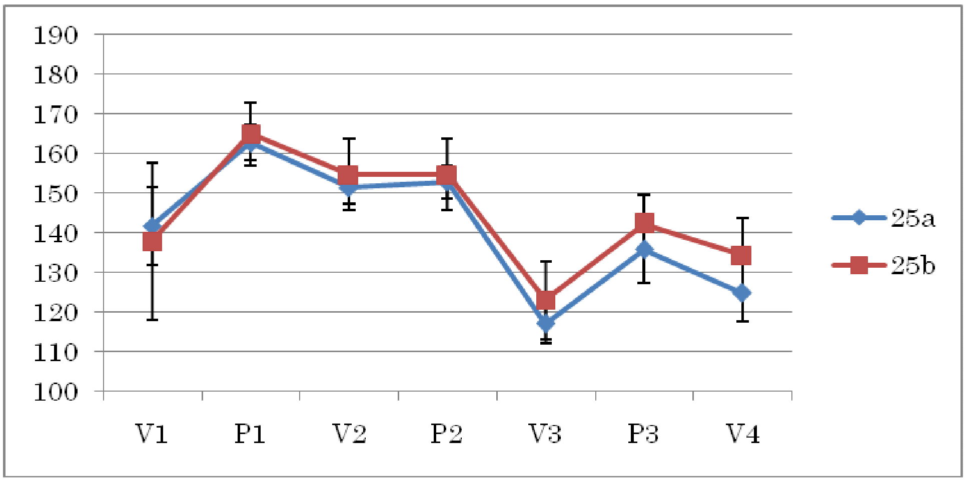


Figure 30: F_0 line graphs of peaks and valleys of the three phrases in (25) for speaker SK.

As for Initial Lowering, only the differences between the V1 and the P1 for AM are significantly different (YK: P1-V1: p(T=0.121)>.20, P2-V2: p(T=0)=1, P3-V3: p(T=0)=1, AM: P1-V1: p (T=2.492)<.05, P2-V2: p(T=0)=1, P3-V3: p(T=0.105)>.20, SK: P1-V1: p(T=1.105)>.20, P2-V2: p(T=1.049)>.20, P3-V3: p(T=0.116)>.20 (all 20 df)). Minor Phrasing in each sentence out of eleven utterances is shown according to the speakers below.

YK

(25) a. $_{MiP}$(oiga monda momo)$_{MiP}$ (11 times) ←

b. $_{MiP}$(oino yomeno momo)$_{MiP}$ (11 times) ←

AM

(25) a. $_{MiP}$(oiga monda)$_{MiP}$ $_{MiP}$(momo)$_{MiP}$ (9 times) ←

$_{MiP}$(oiga monda momo)$_{MiP}$ (2 times)

b. $_{MiP}$(oino yomeno)$_{MiP}$ $_{MiP}$(momo)$_{MiP}$ (10 times) ←

$_{MiP}$(oino yomeno momo)$_{MiP}$ (1 time)

SK

(25) a. $_{MiP}$(oiga monda)$_{MiP}$ $_{MiP}$(momo)$_{MiP}$ (10 times) ←

$_{MiP}$(oiga)$_{MiP}$ $_{MiP}$(monda)$_{MiP}$ $_{MiP}$(momo)$_{MiP}$ (1 time)

b. $_{MiP}$(oino yomeno)$_{MiP}$ $_{MiP}$(momo)$_{MiP}$ (10 times) ←

$_{MiP}$(oino yomeno momo)$_{MiP}$ (1 time)

We can find inter-speaker variation in Minor Phrasing also here as in uniformly left-branching structure made up of four phrases in (23) (default phrasing is indicated by "←"). Speaker YK shows no Initial Lowering except in the first Prosodic Word for all the utterances in (25). For AM and SK, on the other hand, default phrasing is the one in which a Minor Phrase boundary is inserted before the head noun *momo* 'peach' both in (25a) and in (25b). For each speaker, Minor Phrasing in (25a) and (25b) can be said to be (almost) the same, which means that the effect of relative clause structure on Minor Phrasing, which was found in uniformly left-branching structure made up of four phrases, is not observed in left-branching structure made up of three words.

3.4. The Interpretation of the Different Pitch Patterns in the Two Different Relative Clause Structures

As we have seen above, in uniformly left-branching structures consisting of four accented words which involve relative clause structure, when the antecedent stands in the third position, where the effect of the Principle of Rhythmic Alternation is expected, it is subject to the principle as expected, or even more than expected, from speaker to speaker. Even if the antecedent stands in the fourth position, where the effect of the Principle of Rhythmic Alternation is not expected, the F_0 boosting effect may be observed in the third position depending on speakers. Moreover, even in left-branching structures made up of three accented words, the principle can work according to both speakers and sentences, irrespective of presence or absence of relative clause structure.

Likewise, in uniformly left-branching structures consisting of four unaccented words which involve relative clause structure, when the antecedent stands in the third position, it is highly likely that a Minor Phrase boundary is inserted before the antecedent, resulting in the eurhythmic 2-2 pattern. On the other hand, when the antecedent stands in the fourth position, a Minor Phrase boundary may or may not be inserted before the antecedent.

Seen from the data in this chapter, it can be concluded that Phonological Phrasing is sensitive to the internal structure of relative clause construction. In other words, empty category of some sort (empty operator, *pro* or something) in relative clause construction must be visible to phonological component in Japanese on a given condition in order to generate surface pitch contours. We will discuss the matter of visibility of empty category or movement operation to phonological component in more detail in the last chapter.

In the next chapter, we will discuss how to make prosodic representations on the basis of the data obtained in this and previous chapters so as to yield surface pitch contours.

Chapter 4: Representation of Prosodic Structures in Japanese

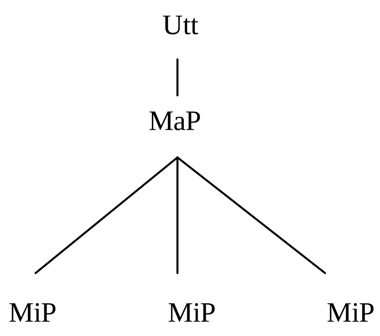
Based on the data thus far, let us see prosodic structuring mainly above the Prosodic Word and below the Intonational Phrase levels in Japanese in this chapter in order to produce surface F_0 contours.

4.1. Previous Studies on Prosodic Representations in Japanese

4.1.1. N-ary Branching Prosodic Structures

It has been a matter of debate whether prosodic structure in Japanese is n-ary branching or binary branching.[16] For example, Poser (1984) and Pierrehumbert and Beckman (1988) assume n-ary branching prosodic structure as in (1) ("Utt", "MaP", "MiP" stand for Utterance, Major Phrase, Minor Phrase respectively).

(1) n-ary branching prosodic structure

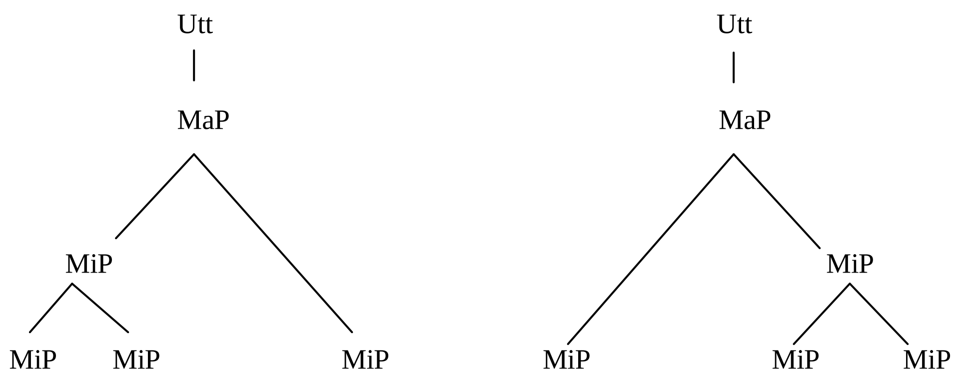


In this model, downstep, which is triggered by an accent in a Minor Phrase, iteratively occurs within a Major Phrase. On the other hand, Kubozono (1989) found that there is difference in the degree of downstepping between left-branching structure and right-branching structure such that the degree of

[16] In the Minimalist Program (Chomsky (1995)), the assumption that syntactic structure is binary branching is a consequence of the fundamental operation Merge.

downstepping in the second Minor Phrase in right-branching structure is less than that in the second Minor Phrase in left-branching structure. As mentioned in Chapter 3, Kubozono (1989) proposes a phonetic realization rule, Metrical Boost, which responds to any right-branching structure and causes upward pitch register shift. He therefore claims that n-ary branching model cannot account for the difference in the degree of downstepping between left- and right-branching structures. In other words, n-ary branching model does not reflect syntactic information which can affect the pitch patterns. And so Kubozono (1989) proposes the binary branching recursive mechanism of prosodic structure, which was originally proposed by Ladd (1986) for English, as in (2).

(2) binary branching prosodic structure



Kubozono (1989) successfully explains the difference in the degree of downstepping between left-branching structure and right-branching structure with prosodic structure very directly related to syntactic constituency. In his model, the input to syntax-phonology mapping seems to be surface syntactic structure, because the sentences (3) and (4), which are slightly revised from the sentences (12) and (13) in Chapter 3 respectively, are regarded as uniformly left-branching structures (the revised portion is underlined).

(3) [[[ma'riko-ga [ec_i] no'n-da] wa'in$_i$-no] nio'i]

Mariko-Nom ec drink-Past wine-Gen smell

'the smell of the wine which Mariko drank'

(4) [[[a'iko-ga [ec_i] a'n-da] eri'maki$_i$-no] iromo'yoo]

Aiko-Nom ec knit-Past muffler-Gen design

'the design of the muffler which Aiko knit'

That is to say, empty categories are assumed not to be involved in syntax-phonology mapping in his model.

However, Sugiyama (2002) points out a problem with Kubozono's (1989) binary branching recursive mechanism of prosodic structure. As we have seen in Chapters 1 and 2, right-branching structures with or without scrambling operation yield different pitch patterns (see Figures 1 – 4 in Chapter 2, among others) since it is assumed that traces left behind by scrambling do not participate in syntax-phonology mapping in Kubozono's (1989) model. For example, the sentences (5) and (6), which are slightly revised from the sentences (1) and (3) in Chapter 2 respectively for ease of exposition, are all expected to have the same prosodic structure in Kubozono's (1989) model.

(5) a. [$_{NP}$ yowa'musina [$_{N'}$ bare'ebu-no me'mbaa]]

timid volleyball club-Gen member

'a timid member of the volleyball club'

b. $[_{NP}$ bare'ebu-no$_i$ $[_{NP}$ yowa'musina $[_{N'}$ $[t_i]$ me'mbaa]]]

‘a timid member of the volleyball club’

(6) a. $[_{VP}$ ne'muro-de $[_{V'}$ wa'in-o no'n-da]]

Nemuro-Loc wine-Acc drink-Past

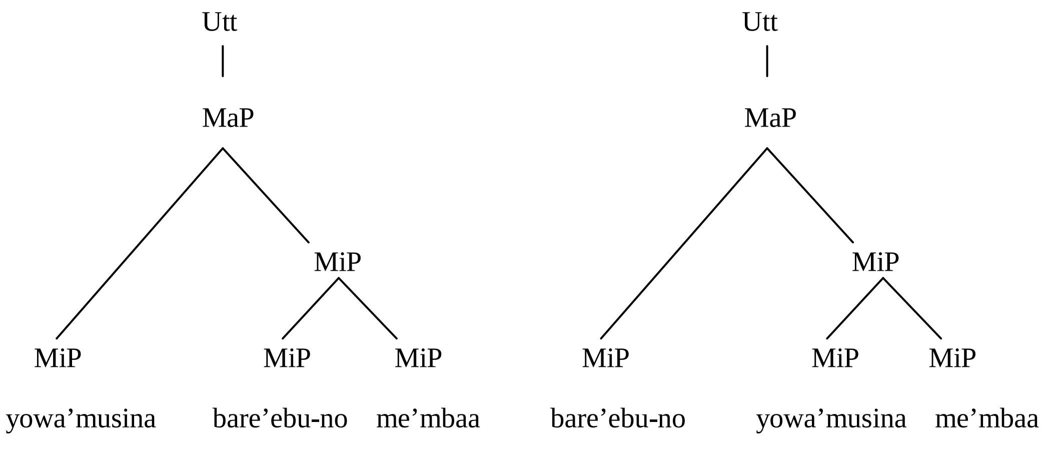
‘(Someone) drank wine in Nemuro.’

b. $[_{NP}$ wa'in-o$_i$ $[_{NP}$ ne'muro-de $[_{N'}$ $[t_i]$ no'n-da]]]

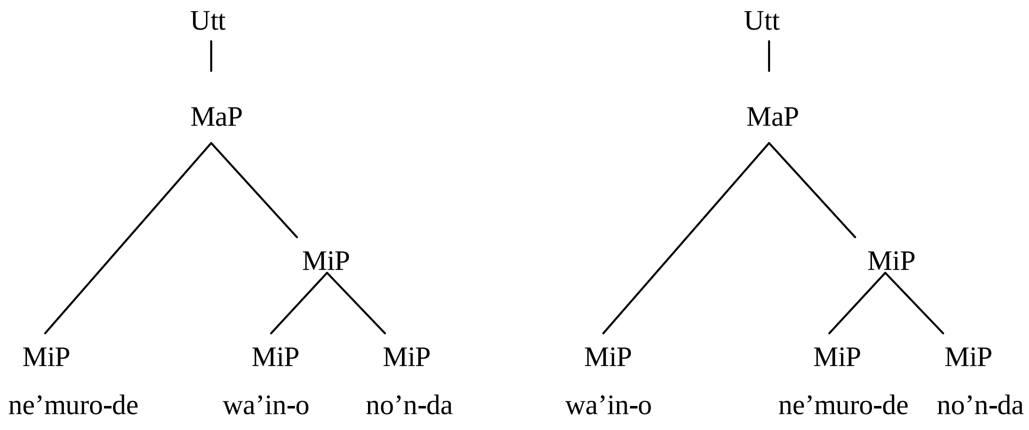
‘(Someone) drank wine in Nemuro.’

Each prosodic structure is shown below according to Kubozono’s (1989) model.

(5)' a. b.



(6)' a. b.

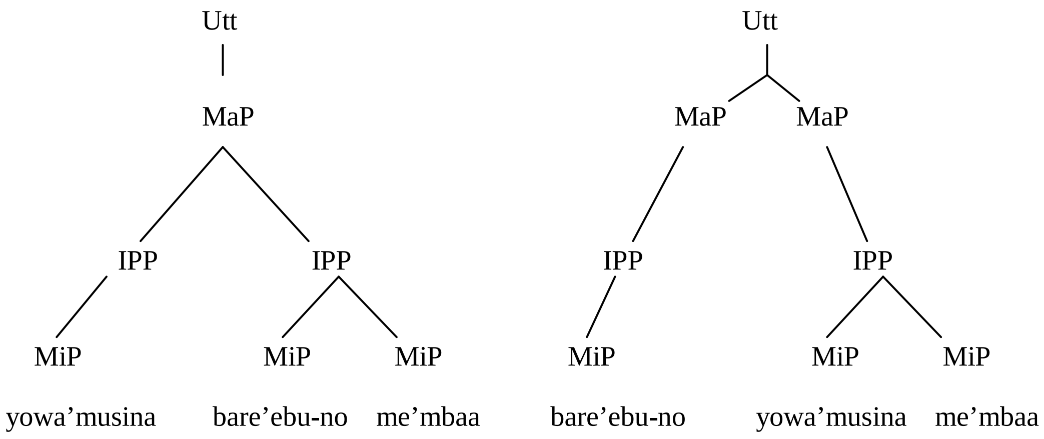


Clearly Kubozono's (1989) binary branching recursive mechanism of prosodic structure cannot account for the difference in the pitch patterns between the non-scrambled right-branching structure and the scrambled one.

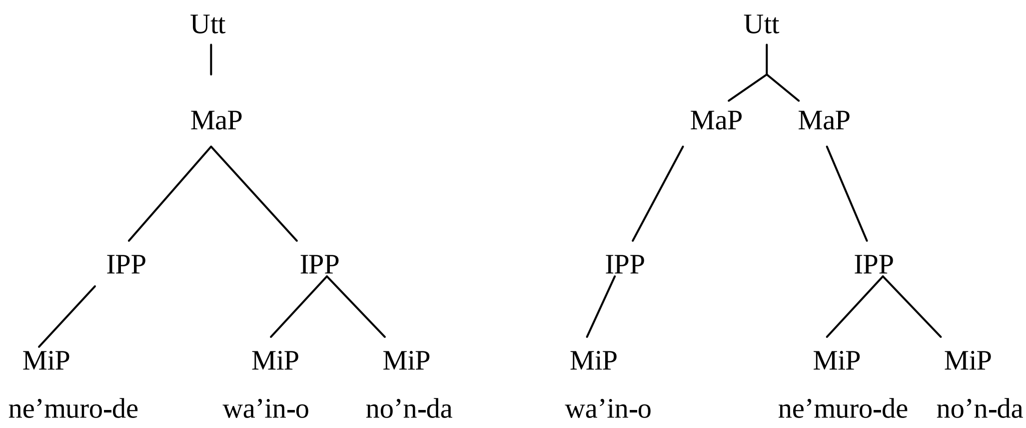
And so Sugiyama (2002) proposes a prosodic category between Major Phrase and Minor Phrase, 'Intermediate Phonological Phrase', which is a domain of Metrical Boost.[17] As a result, prosodic structures of the sentences (5) and (6) are as follows ("IPP" stands for Intermediate Phonological Phrase):

[17] Note that Intermediate Phonological Phrase proposed by Sugiyama (2002) is different from Pierrehumbert and Beckman's (1988) 'Intermediate Phrase', which corresponds to 'Major Phrase'.

(5)” a. b.



(6)” a. b.



It follows, then, that Sugiyama (2002) takes an n-ary branching approach.

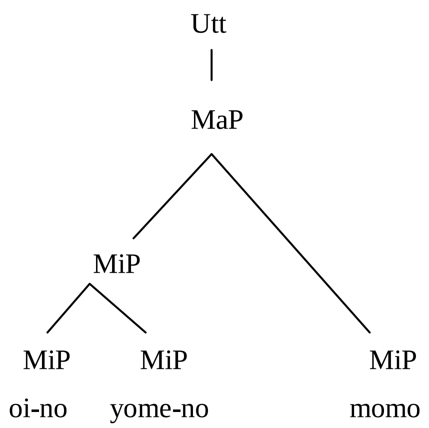
In fact, Kubozono’s (1989) binary branching model has another problem. As mentioned above, his model of prosodic structure is very directly related to syntactic constituency. As long as each Prosodic Word has an accent, his model may still work out. However, when each Prosodic Word does not have an accent, his model wrongly predicts prosodic representations. For example, his model predicts the following prosodic representation as to the left-branching phrase in (25b) in Chapter 3, repeated here in (7).

(7) [[oi-no yome-no] momo]

nephew-Gen wife-Gen peach

'my nephew's wife's peach'

(7)' prosodic representation predicted from Kubozono's (1989) binary branching recursive mechanism



As we have seen in Chapter 3, actual Minor Phrasing patterns are the following two:

(7)'' a. $_{\mathrm{MiP}}$(oino yomeno momo)$_{\mathrm{MiP}}$

b. $_{\mathrm{MiP}}$(oino yomeno)$_{\mathrm{MiP}}$ $_{\mathrm{MiP}}$(momo)$_{\mathrm{MiP}}$

None of the speakers divided the sentence into three Minor Phrases. According to Yokoyama's (1979) statistical survey, unaccented words account for about half of the words in the lexicon of Tokyo Japanese. Therefore it can be said that Kubozono's (1989) binary branching recursive mechanism has at least two serious problems.

4.1.2. The Existence of Intonational Phrase in Japanese

It has also been a matter of debate whether there exists Intonational Phrase level in Japanese or not. Existence of Intonational Phrase is motivated by various processes in various languages. Among those are English (Beckman and Pierrehumbert (1986), Ladd (1986), Nespor and Vogel (1986)), Spanish (Nespor and Vogel (1986)), Tuscan dialect of Italian (Nespor and Vogel (1986)), Hungarian (Vogel and Kenesei (1987)), Chicheŵa (Kanerva (1990)), Kinande (Hyman (1990)), Kinyambo (Bickmore (1990)), Luganda (Hyman (1990)), Korean (Jun (1993)), German (Baumann et al. (2001), Féry and Hartmann (2005)) and Greek (Arvatini and Baltazani (2005)).

As for Japanese, Kawahara and Shinya (2004) claim that there does exist Intonational Phrase level in prosodic hierarchy above the Major Phrase and below the Utterance levels. They investigated multiple-clause constructions, gapping and coordination, as follows (adopted from Kawahara and Shinya (2004: 2)):

(8) gapping

mura’sugi-wa nama’uni-o muna’kata-wa mame’mochi-o mori’mura-wa

Murasugi-Top sea urchin-Acc Munakata-Top bean rice cake-Acc Morimura-Top

ae’mono-o moritsu’ke-ta

aemono-Acc dish up-Past

‘Murasugi dished up sea urchin, Munakata bean rice cake, and Morimura aemono.’

(9) coordination

mura’sugi-wa nama’uni-o moritsu’ke, muna’kata-wa mame’mochi-o

Murasugi-Top sea urchin-Acc dish up-(Past) Munakata-Top bean rice cake-Acc

moritsu’ke, mori’mura-wa ae’mono-o moritsu’ke-ta

dish up-(Past) Morimura-Top aemono-Acc dish up-Past

‘Murasugi dished up sea urchin, Munakata dished up bean rice cake, and Morimura dished up aemono.’

In the production experiment, native Japanese speakers pronounced those sentences such that they showed such phonetic characteristics as clause-final creakiness, clause-final pause, clause-final lowering, larger initial rise than in a Major Phrase and more robust pitch reset than in a Major Phrase. Those characteristics are typical of Intonational Phrase. Based on those data, Kawahara and Shinya (2004) conclude that there does exist Intonational Phrase level above the Major Phrase and below the Utterance levels in Japanese. Therefore, in prosodic representations in the previous subsection, Intonational Phrase indeed mediates between Utterance and Major Phrase.

4.2. The Kinds of Phonological Phrases in Japanese

Generally speaking, Japanese is said to have two kinds of Phonological Phrases, that is, Major Phrase and Minor Phrase. It is assumed that Major Phrase is a domain of downstep and Minor Phrase a domain of Initial Lowering. As mentioned in Chapter 3, the phonological definition of downstep is that the pitch level of words (or phrases) is lower when they follow an accented word (or phrase) than when they follow an unaccented word (or phrase). Kubozono (2006) reports a case where focus does not block downstep according to the phonological definition. As a result, it may be possible that the domain of downstep is larger than expected. For consistency, however, I will follow the phonological definition here.[18]

As mentioned in the previous section, Sugiyama (2002) proposes a prosodic category between Major Phrase and Minor Phrase, 'Intermediate Phonological Phrase', which is a domain of Metrical Boost in order to account for the difference in the pitch patterns between the non-scrambled right-branching structure and the scrambled one, which cannot be explained by Kubozono's (1989) binary branching recursive mechanism of prosodic structure. It is possible, however, that whenever we find an unknown phonological process, we must introduce another prosodic category, which is clearly unfavorable. And so it is desirable that we keep the levels of Phonological Phrases to a minimum.

In this connection, Ito and Mester (2007) propose a radical simplification of prosodic hierarchy to the effect that there is only one level above the Prosodic Word and below the Intonational Phrase levels, that is, 'Phonological Phrase'. According to their one Phonological Phrase model, prosodic hierarchy introduced by assuming Minor Phrase and Major Phrase (or recursion of Minor Phrase) can also be introduced by adjoining Phonological Phrases (what they call 'prosodic adjunction').[19] For comparison, we show the two models below ("IP", "PP" and "PWd" stand for Intonational Phrase, Phonological Phrase and Prosodic Word respectively).

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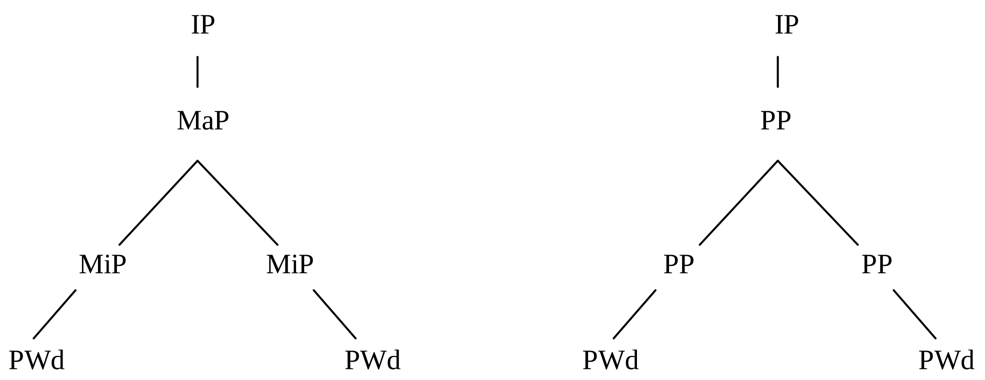
[18] As Kubozono (1989, 1993) implies, the merit of this definition of downstep lies in the fact that the accent-induced F_0 lowering effect is not canceled by the F_0 boosting effect of Metrical Boost in right-branching structure.

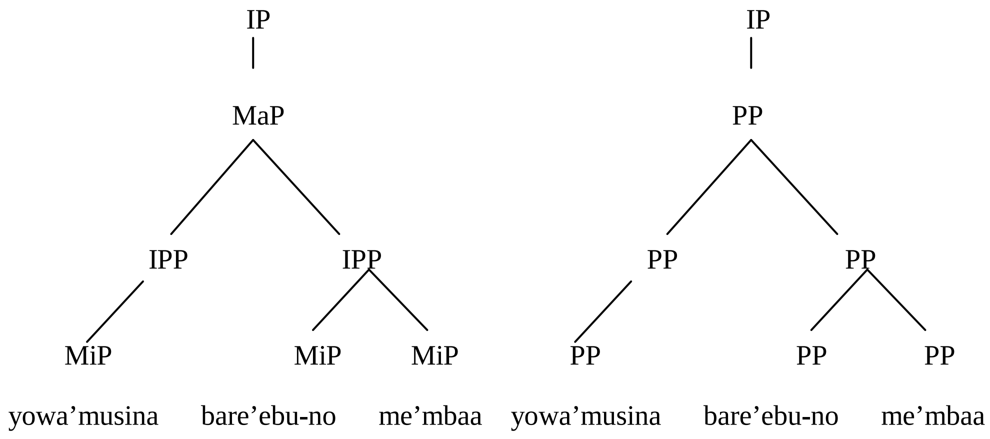
[19] They restrict their model by assuming that there can only be one maximal and one minimal instantiation of every category.

(10) a. Major-Minor Phrase model b. one Phonological Phrase model

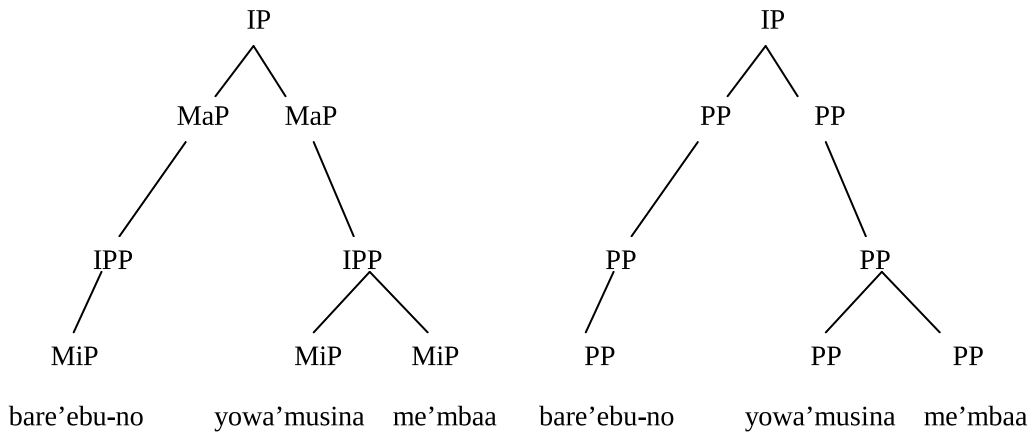


Ito and Mester (2007) assume that in one Phonological Phrase model, downstep applies to every Phonological Phrase. That is to say, in (10b) downstep applies to higher Phonological Phrase and vacuously applies to lower Phonological Phrases. They also assume that Initial Lowering applies to every Phonological Phrase, which reflects that the degree of Initial Lowering is even more extreme at Major Phrase edges, a claim made by Selkirk et al. (2003). With the device of prosodic adjunction, we can dispense with Intermediate Phonological Phrase in sentences (5) and (6) introduced by Sugiyama (2002) as follows:

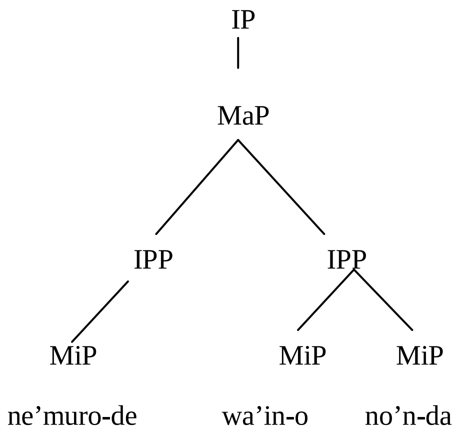
(5)''' a. Intermediate Phonological Phrase model		one Phonological Phrase model

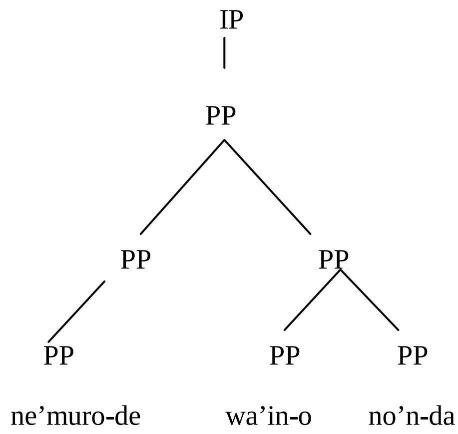


b. Intermediate Phonological Phrase model		one Phonological Phrase model

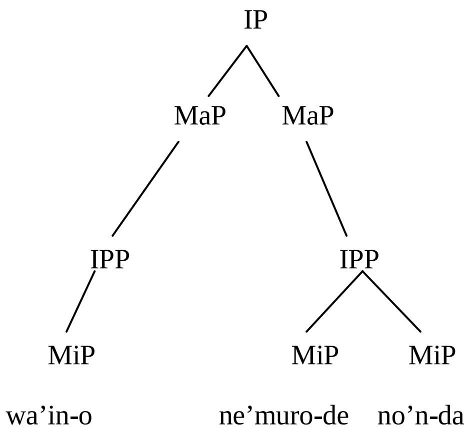


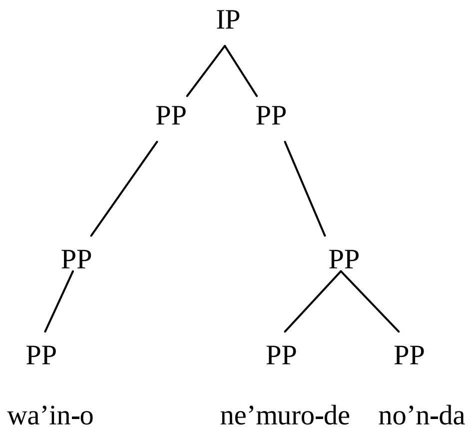
(6)''' a. Intermediate Phonological Phrase model one Phonological Phrase model





b. Intermediate Phonological Phrase model one Phonological Phrase model





At first sight, both models seem to account for the difference in the pitch patterns between the non-scrambled right-branching structure and the scrambled one. In fact, however, the story is not so simple. Sugiyama (2002) argues that in scrambled right-branching structure made up of three accented words, a Major Phrase boundary is inserted between the first and the second words as in (5b)''' and (6b)''' above because considerable F_0 boosting effect was observed in the second word position. However, Sugiyama's (2002) analysis did not follow the phonological definition of downstep. Then an experiment was carried out in which speaker YK read the following pairs of sentences (underline indicates unaccented phrase).[20]

NP case:

(11) a. bare’ebu-no yowa’musina me’mbaa

volleyball club-Gen timid member

‘a timid member of the volleyball club’

b. <u>kyooei-no</u> yowa’musina me’mbaa

swimming club-Gen timid member

‘a timid member of the swimming club.’

(12) a. ma’nshon-no o’oheina o’onaa

condominium-Gen arrogant owner

‘an arrogant owner of the condominium’

b. <u>nooen-no</u> o’oheina o’onaa

ranch-Gen arrogant owner

‘an arrogant owner of the ranch’

20 Only speaker YK participated in this experiment because she alone participated in the relevant check experiment of the previous study, Sugiyama (2002), as we saw in Chapter 2.

VP case:

(13) a. wa’in-o ne’muro-de no’n-da

wine-Acc Nemuro-Loc drink-Past

‘(Someone) drank wine in Nemuro.’

b. <u>osake-o</u> ne’muro-de no’n-da

alcoholic beverage-Acc Nemuro-Loc drink-Past

‘(Someone) drank in Nemuro.’

(14) a. go’han-o mo’rimori ta’be-ta

rice-Acc heartily eat-Past

‘(Someone) ate heartily.’

b. <u>yasai-o</u> mo’rimori ta’be-ta

vegetable-Acc heartily eat-Past

‘(Someone) ate vegetables heartily.’

Following Kubozono (1993), to examine whether downstep does occur in the second phrase in sentences (a) or not, I list the mean F_0 peak and valley values of the second phrases in the upper rows and the SDs in the lower rows respectively. Moreover, line graphs of the F_0 values concerned are shown for these four pairs of sentences below.

YK

	V2	P2	V3
11a	188.6	279.8	179.7
	8.15	10.72	8.61
11b	238.6	303.3	187.0
	14.94	13.40	6.66

Table 1: Mean F_0 peak and valley values and SDs of the second phrases in (11) for speaker YK.

	V2	P2	V3
12a	182.4	291.1	177.6
	12.88	14.99	11.70
12b	205.7	301.0	184.1
	26.00	8.87	10.47

Table 2: Mean F_0 peak and valley values and SDs of the second phrases in (12) for speaker YK.

	V2	P2	V3
13a	197.1	296.7	190.5
	15.81	11.90	15.81
13b	269.0	319.5	190.8
	7.91	7.17	7.91

Table 3: Mean F_0 peak and valley values and SDs of the second phrases in (13) for speaker YK.

	V2	P2	V3
14a	311.9	299.7	207.2
	7.25	13.57	5.36
14b	278.5	314.9	211.4
	12.99	8.25	6.33

Table 4: Mean F_0 peak and valley values and SDs of the second phrases in (14) for speaker YK.

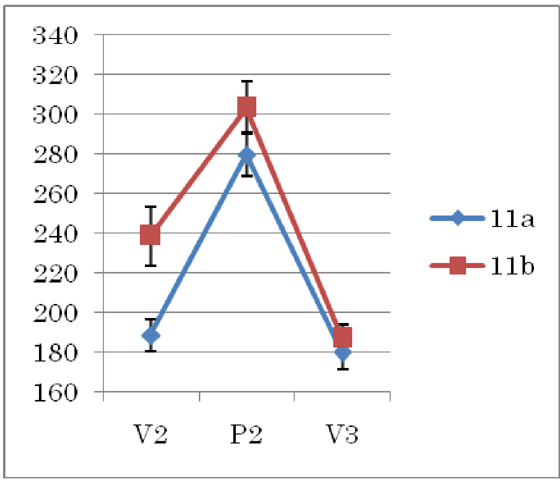


Figure 1: F_0 line graphs of the second phrases in (11) for speaker YK.

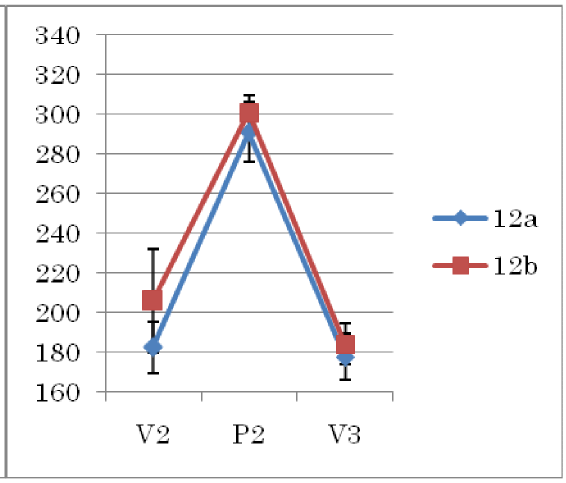


Figure 2: F_0 line graphs of the second phrases in (12) for speaker YK.

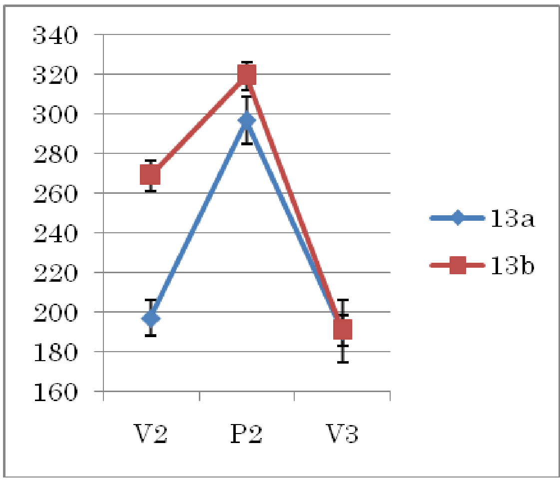


Figure 3: F_0 line graphs of the second phrases in (13) for speaker YK.

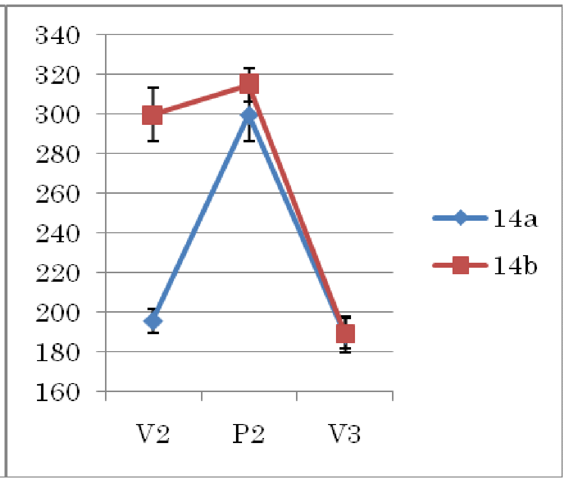


Figure 4: F_0 line graphs of the second phrases in (14) for speaker YK.

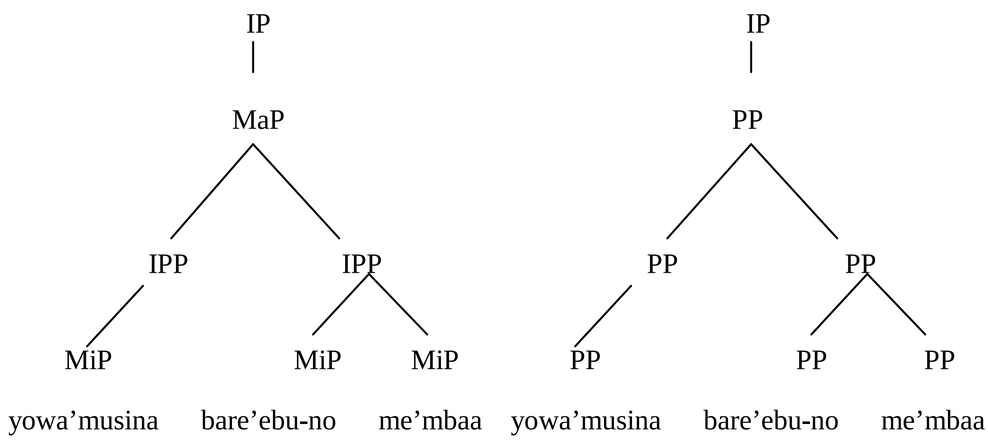
Of the three parameters, V2, P2 and V3, the least important is V2, since the first phrase in sentence (a) involves an accent which causes a sudden drop in pitch.[21] Meanwhile, P2 is more important than V3 because declination effect may make the differences in F_0 values unclear. In fact, the differences

[21] Kubozono (1993) calls a drop in pitch induced by an accent 'accentual fall'.

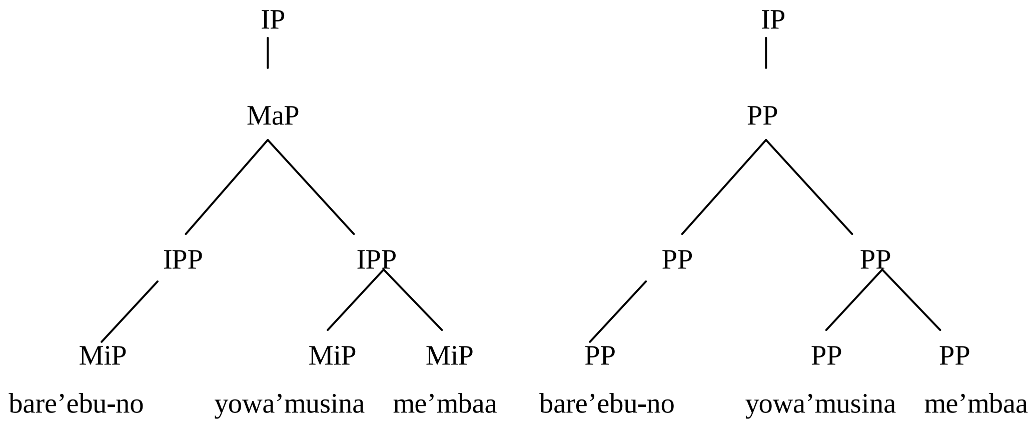
in F_0 values in V2 are all significantly different. As expected, only the difference in F_0 values in V3 for sentences (11) is significantly different. As for P2, only the sentence pair (12) shows no significant difference in F_0 values, although the mean F_0 value for (12a) is lower than that for (12b) ((11): V2: $p(T=9.742)<.001$, P2: $p(T=4.534)<.001$, V3: $p(T=2.215)<.05$, (12): V2: $p(T=2.671)<.05$, P2: $p(T=1.887)>.05$, V3: $p(T=1.364)>.10$, (13): V2: $p(T=19.635)<.001$, P2: $p(T=5.426)<.001$, V3: $p(T=0.051)>.20$, (14): V2: $p(T=23.091)<.001$, P2: $p(T=3.171)<.01$, V3: $p(T=0.125)>.20$, (all 20 df)).

It is possible that downstep occurs in scrambled right-branching structure on phonological definition of it. In other words, there is no Major Phrase boundary within the structure. Consequently, neither Intermediate Phonological Phrase model nor one Phonological Phrase model can account for the difference in pitch patterns between scrambled right-branching structure and non-scrambled one. Like Kubozono's (1989) binary branching recursive mechanism, both two models predict the same prosodic representations for those two structures as in (5)'''' and (6)'''' below.

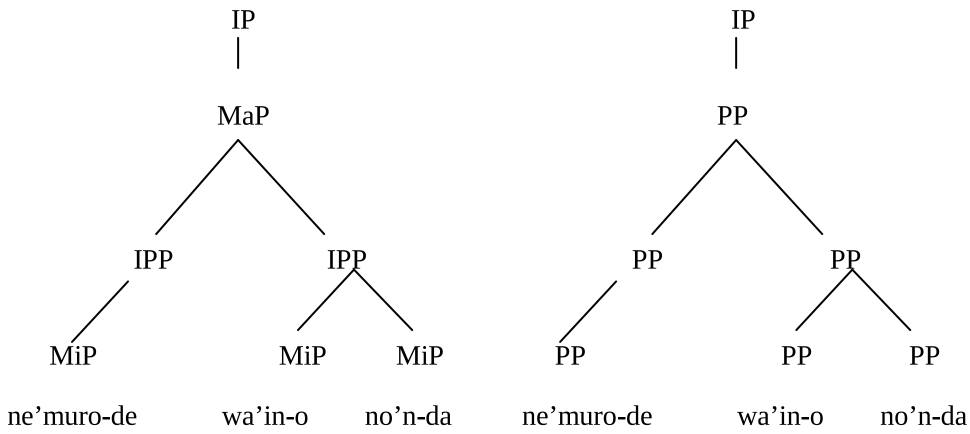
(5)'''' a. Intermediate Phonological Phrase model one Phonological Phrase model



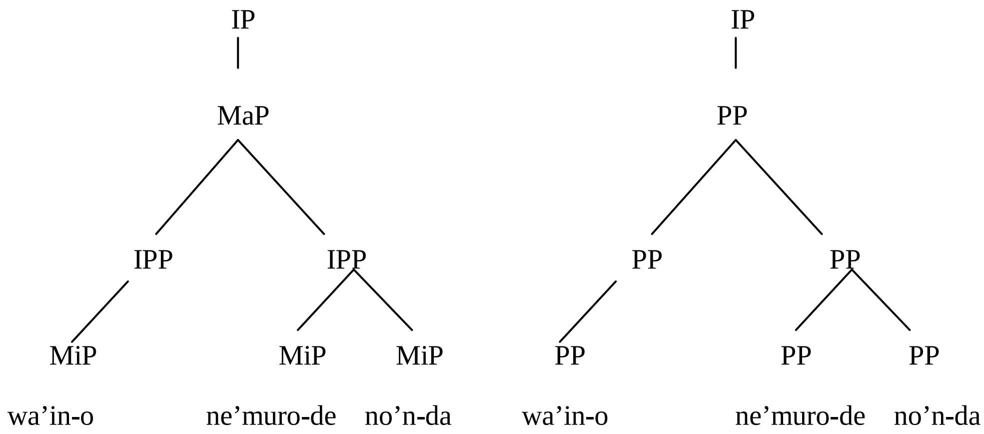
b. Intermediate Phonological Phrase model one Phonological Phrase model



(6)’’’’ a. Intermediate Phonological Phrase model one Phonological Phrase model



b. Intermediate Phonological Phrase model   one Phonological Phrase model



This is because both two models (and Kubozono's (1989) binary branching model) do not reflect adjunction structure in surface syntactic representation. As for adjunction structure, Kabak and Revithiadou (2007) make an interesting proposal that recursive morphosyntactic structures should correspond to recursive phonological structures and vice versa as an interface constraint "MIRROR", based on the fact that recursion is one of the most fundamental characteristics of human communication, although they do not treat adjunction structure induced by movement operation as in this thesis.[22] One of the examples is shown in (15) (Kabak and Revithiadou (2007: 3), originally from Gussenhoven (2005). Bold-type and " ' " indicate secondary accent and primary accent, respectively and curly brackets represent Phonological Phrase boundaries).

(15) {tw**e**nty-six {v**e**ry nice {J**a**panese CD's}}}

In English, Phonological Phrase is a domain of Rhythm Rule. In (15), each of the three constituents,

[22] Selkirk (2011) also proposes a constraint MATCH to the effect that the left and right edges of a constituent of type α in the input syntactic representation must correspond to the left and right edges of a constituent of type π in the output phonological representation and vice versa.

Japanese CDs, *very nice Japanese CDs* and *twenty-six very nice Japanese CDs* can be an NP on its own. We can find that Rhythm Rule iteratively applies in (15). Following Gussenhoven (2005), Kabak and Revithiadou (2007) insist that it is broadly accepted that recursive structure at the Phonological Phrase level results from morphosyntactic recursivity. The reader is referred to Kabak and Revithiadou (2007) for more details about prosodic recursivity.

As mentioned above, we should keep the levels of Phonological Phrases to a minimum. Therefore Intermediate Phonological Phrase should be abandoned. Meanwhile, it seems difficult to keep the level of Phonological Phrase just one, because one Phonological Phrase model is also unlikely to be able to differentiate the prosodic representations with and without scrambling operation in right-branching structures in syntactic component.

Integrating the ideas of Kubozono (1989), Ito and Mester (2007), and Kabak and Revithiadou (2007), I will propose a recursive model of Major and Minor Phrases for prosodic representations in Japanese in the next section.

4.3. The Recursive Model of Major and Minor Phrases for Prosodic Representations

In this section, we will see the actual prosodic representations of the materials so far.

As is also pointed out by Ishihara (2007), the domain of downstep based on phonological definition may possibly be larger than what we generally assume as Major Phrase. A typical example is when subject NP consisting of one Prosodic Word in declarative sentence has an accent. In that case, it is possible that downstep based on phonological definition takes place across VP boundary, where we usually expect that a Major Phrase boundary is inserted. For consistency, I assume here that a Major Phrase boundary is inserted after subject NP in declarative sentence and omit the subject NP in prosodic representation when possible.

First, I show the prosodic representations of those sentences which involve adjunct-argument-head sequence or argument-adjunct head sequence in NP ((16) and (17)) or in VP ((18) and (19)) discussed in Chapter 2.

(16) a. ao’yama-wa yowa’musina bare’ebu-no me’mbaa-da

Aoyama-Top timid volleyball club-Gen member-be-Pres

‘Aoyama is a timid member of the volleyball club.’

b. ao’yama-wa bare’ebu-no yowa’musina me’mbaa-da

‘Aoyama is a timid member of the volleyball club.’

(17) a. o’ohara-wa o’oheena ma’nshon-no o’onaa-da

Ohara-Top arrogant condominium-Gen owner-be-Pres

‘Ohara is an arrogant owner of the condominium.’

b. o’ohara-wa ma’nshon-no o’oheena o’onaa-da

‘Ohara is an arrogant owner of the condominium.’

(18) a. na’oya-ga ne’muro-de wa’in-o no’n-da

Naoya-Nom Nemuro-Loc wine-Acc drink-Past

‘Naoya drank wine in Nemuro.’

b. na’oya-ga wa’in-o ne’muro-de no’n-da

‘Naoya drank wine in Nemuro.’

(19) a. a’mano-ga mo’rimori go’han-o ta’be-ta

Amano-Nom heartily rice-Acc eat-Past

‘Amano ate heartily.’

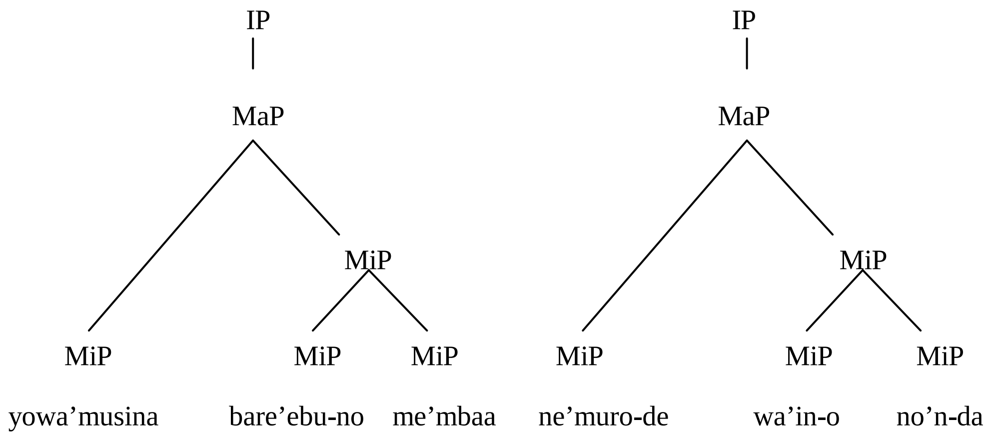
b. a’mano-ga go’han-o mo’rimori ta’be-ta

‘Amano ate heartily.’

The prosodic representations of non-scrambled sentences (a), I assume, are shown in (20) (hereafter I will occasionally show some of the representations as representatives).

(20)

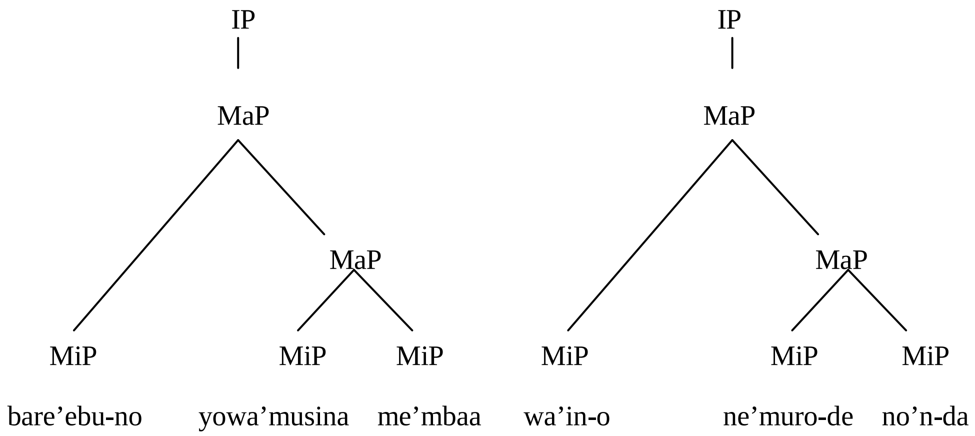
(16a) (18a)



These representations reflect syntactic structures, and so Metrical Boost applies to any right-branching structure as Kubozono (1989) originally proposed. Next, I assume the following prosodic representations as for scrambled sentences (b).

(22)

(17b) (19b)



Note that these representations involve adjunction structure of ‘Major Phrase’, which reflects syntactic adjunction structure, following Kabak and Revithiadou’s (2007) proposal.[23] Note also that these representations reflect the two important facts; (ⅰ) the prosodic constituents within the lower Major Phrase in (22) are subject to the strong F_0 boosting effect caused by scrambling operation, which is much greater than that of Metrical Boost, and (ⅱ) those constituents within the lower Major Phrase are also within the higher Major Phrase, that is, within the domain of downstep caused by the first Minor Phrase. Let us call the boosting effect applicable to the lower Major Phrases, “Scrambling Boost”[24]. Scrambling Boost literally applies to scrambling structure.

Let us consider argument-head sequence and adjunct-head sequence. The relevant sentences are shown repeatedly in (22) – (25).

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[23] In assignment of phrase stress in German, the adjunction structure of Major Phrases, which dominate some Minor Phrases, is proposed by Kratzer and Selkirk (2007), to which I refer the reader for details.

[24] It follows that Ito and Mester’s (2007) one Phonological Phrase model cannot differentiate between the recursion of Minor Phrase (a domain of Metrical Boost) and the recursion of Major Phrase (a domain of Scrambling Boost).

(22) a. ao’yama-wa bare’ebu-no me’mbaa-da

‘Aoyama is a member of the volleyball club.’

b. ao’yama-wa yowa’musina me’mbaa-da

‘Aoyama is a timid member.’

(23) a. o’ohara-wa ma’nshon-no o’onaa-da

‘Ohara is an owner of the condominium.’

b. o’ohara-wa o’oheena o’onaa-da

‘Ohara is an arrogant owner.’

(24) a. na’oya-ga wa’in-o no’n-da

‘Naoya drank wine.’

b. na’oya-ga ne’muro-de no’n-da

‘Naoya drank in Nemuro.’

(25) a. a’mano-ga go’han-o ta’be-ta

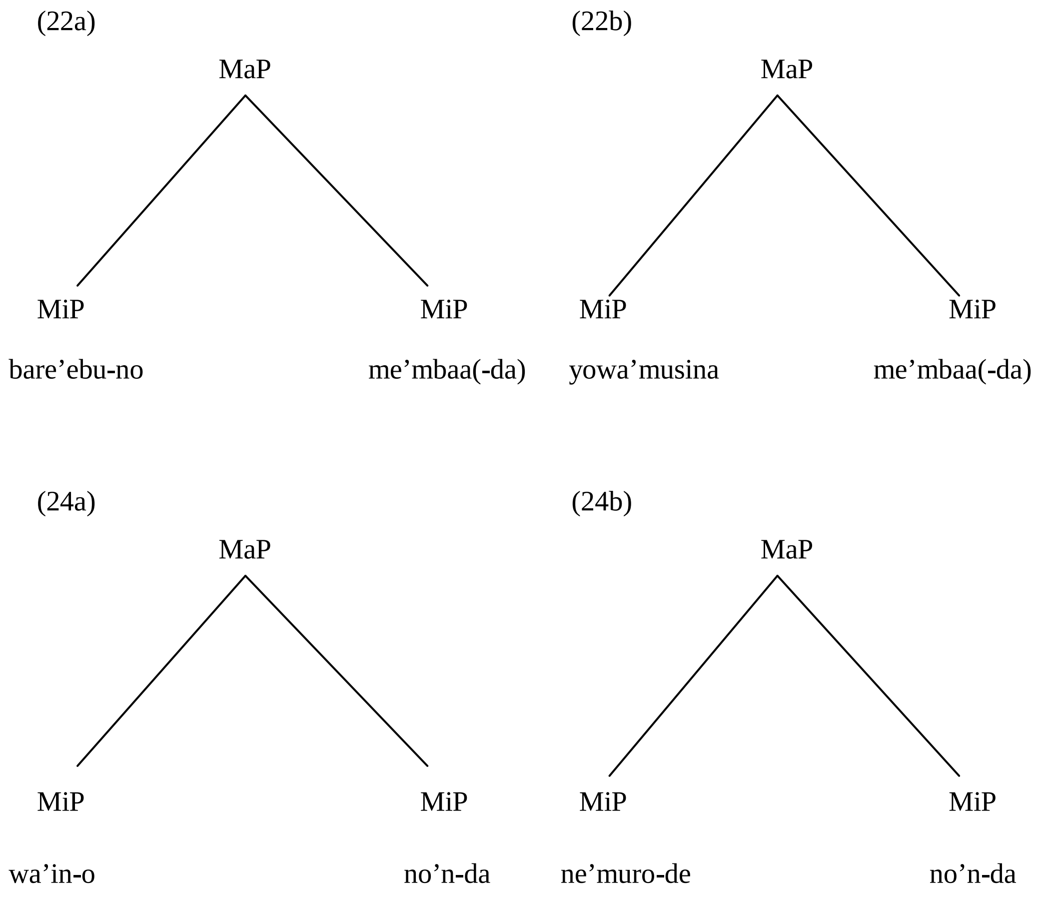
‘Amano ate rice.’

b. a’mano-ga mo’rimori ta’be-ta

‘Amano ate heartily.’

These pairs do not basically show difference in pitch patterns for all the speakers. Therefore I assume the following prosodic representations for these sentences, omitting subject NPs for the reason mentioned above.[25]

(26)



Next, let us turn to double object constructions.

25 As noted in footnote 6 in Chapter 2, the copula verb /da/ in (22) and (23) is prosodically attached to the preceding noun, which does not affect the overall pitch pattern.

(27) a. o’ono-ga <u>ya’mana-ni no’oto-o ka’esi-ta</u>

Ono-Nom Yamana-Dat notebook-Acc return-Past

‘Ono returned Yamana the notebook.’

b. o’ono-ga <u>no’oto-o ya’mana-ni ka’esi-ta</u>

‘Ono returned the notebook to Yamana.’

(28) a. se’mmu-ga <u>mo’rino-o ra’nchi-ni mane’i-ta</u>

executive managing director-Nom Morino-Acc lunch-Dat invite-Past

‘The executive managing director invited Morino to lunch.’

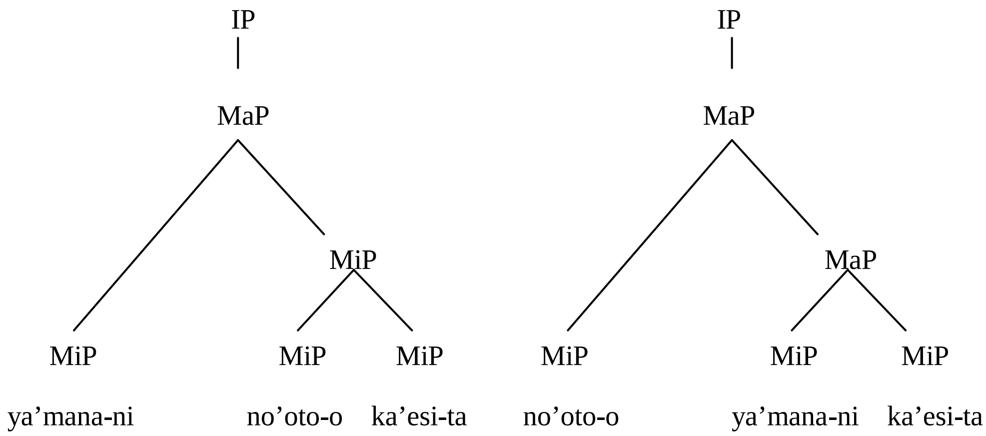
b. se’mmu-ga <u>ra’nchi-ni mo’rino-o mane’i-ta</u>

‘The executive managing director invited Morino to lunch.’

As we saw in Chapter 2, double object constructions showed basically the same pitch patterns as adjunct-argument-head sequence and argument-adjunct-head sequence above. Therefore I assume the following prosodic representations for double object constructions.

(29)

(27a) (27b)



Note also here that the higher Minor Phrase is subject to Metrical Boost in non-scrambled sentences, whereas the lower Major Phrase is subject to Scrambling Boost in scrambled sentences.

Let us see left-branching structures made up of three accented words with and without relative clause construction.

(30) a. [[na'o-ga [ec$_i$] yo'n-da] no'oto$_i$]

Nao-Nom read-Past notebook

'the notebook which Nao read'

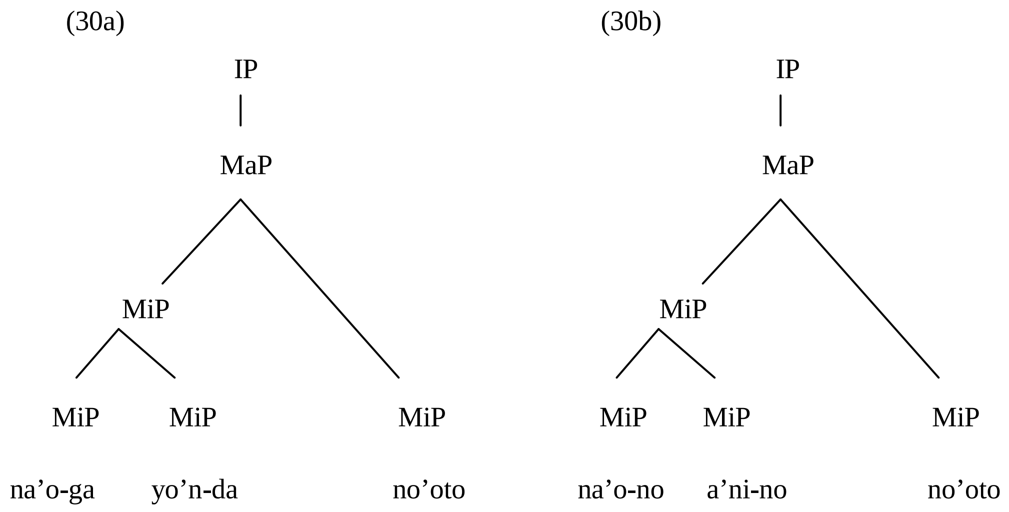
b. [[na'o-no a'ni-no] no'oto]

Nao-Gen brother-Gen notebook

'Nao' s brother's notebook'

In Chapter 3, we observed that speakers YK and AM showed slightly higher F_0 values in the third words than in the preceding second words in both two cases. In this respect, Kubozono (1993) claims that left-branching structure made up of three accented words *generally* yields a gradually descending F_0 contour. As mentioned in Chapter 3, even left-branching phrases consisting of three accented words may be subject to the Principle of Rhythmic Alternation according to both speakers and sentences. Following Kubozono's (1993) claim, however, I assume here that left-branching phrases consisting of three accented words basically exhibit a gradually descending F_0 contour whether they involve relative clause structure or not. Accordingly, the prosodic representations for them are as follows:

(31)



Since there is no right-branching node anywhere in the representation, Metrical Boost does not apply and a descending F_0 contour can be yielded.

Next, let us consider uniformly left-branching structures consisting of four accented words which involve relative clause construction.

(32) a. [[[ma'ri-ga [ec$_i$] no'n-da] ro'ze$_i$-no] ryo'o]

Mari-Nom ec drink-Past vins rose-Gen amount

'the amount of the vins rose that Mari drank'

b. [[[ma'ri-no a'ni-ga] [ec$_i$] no'n-da] ro'ze$_i$]

Mari-Gen brother-Nom ec drink-Past vins rose

'the vins rose that Mari's brother drank'

(33) a. [[[a'raki-ga [ec$_i$] tano'n-da] dora'i$_i$-no] nio'i]

Araki-Nom ec order-Past dry stout-Gen smell

'the smell of the dry stout that Araki ordered'

b. [[[a'raki-to ya'mano-ga] [ec$_i$] tano'n-da] dora'i$_i$]

Araki-Conj Yamano-Nom ec order-Past dry stout

'the dry stout that Araki and Yamano ordered'

(34) a. [[[a'mano-ga [ec$_i$] a'isi-ta] yo'ojo$_i$-no] namae]

Amano-Nom ec love-Past little girl-Gen name

'the name of the little girl that Amano loved'

b. [[[a'mano-no o'nsi-ga] [ec$_i$] a'isi-ta] yo'ojo$_i$]

Amano-Gen former teacher-Nom ec love-Past little girl

'the little girl that Amano's former teacher loved'

(35) a. [[[yo'oji-ga [ec_i] era'n-da] omo'cha$_i$-no] namae]

little child-Nom ec choose-Past toy-Gen name

'the name of the toy that the little child chose'

b. [[[ge'nkina yo'oji-ga] [ec_i] era'n-da] omo'cha$_i$]

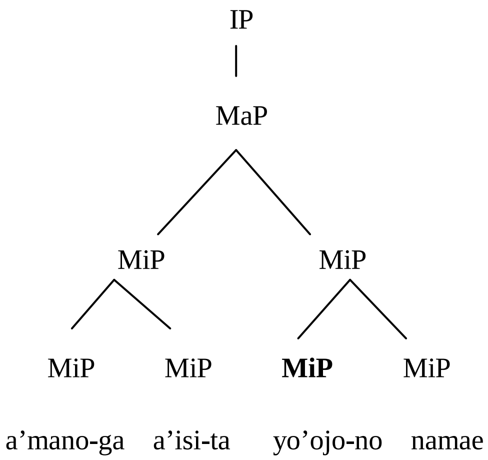
cheerful little child-Nom ec choose-Past toy

'the toy that the cheerful little child chose'

As we have seen in Chapter 3, for sentences (a), in which the antecedent stands in the third position, all the speakers pronounced those sentences in such a way that the F_0 boosting effect was observed in the antecedent position, resulting in the eurhythmic High-Low-High-Low pitch pattern. Furthermore, for speakers AM and SK, the F_0 boosting effect in question was significantly larger than that in uniformly left-branching structure which does not involve relative clause construction. Here I call the F_0 boosting in the antecedent position 'Antecedent Boost', which can be found in uniformly left-branching structure consisting of four accented words (or more) which involves relative clause construction. It seems that the effect of Antecedent Boost is generally larger than that of Rhythmic Boost, which basically applies to uniformly left-branching structure consisting of four accented words (or more) which does not involve relative clause construction. Following Kubozono (1989), I assume the following prosodic representations for sentences (a) above.

(36)

(34a)

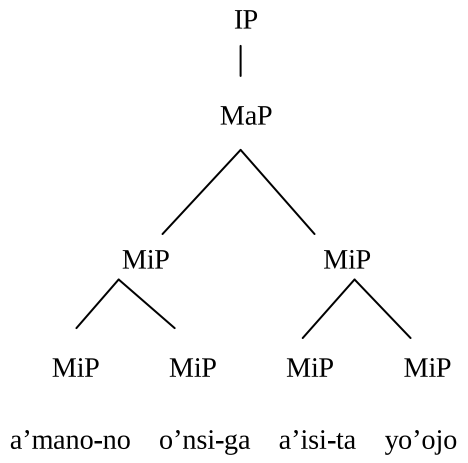


Note that a Minor Phrase *yo’ojo-no* is bold-faced, which means that the Minor Phrase is subject to Antecedent Boost. For Antecedent Boost to apply, phonological component must refer to the relative clause structure at the syntax-phonology mapping stage. I will explain the validity of bold-faced notation later in this chapter.

As for the pitch patterns in sentences (b), in which the antecedent stands in the fourth position, we observed inter-speaker variation. YK basically pronounced those sentences in such a way that the pitch patterns were subject to the Principle of Rhythmic Alternation. Alternatively, we can interpret that prosodic structuring for YK was subject to metrical restructuring mentioned in Chapter 3, whereby Metrical Boost applies to the restructured symmetrically branching phrases. AM’s pitch pattern clearly showed the effect of Antecedent Boost. SK basically yielded gradually descending F_0 contours. That is to say, Antecedent Boost optionally applies, when the antecedent stands in the fourth position. I show the prosodic representations of sentences (b) according to speakers.

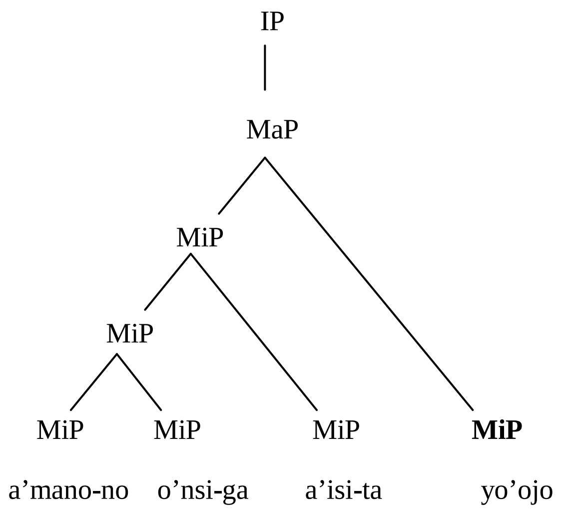
(37) YK:

(34b)



(38) AM:

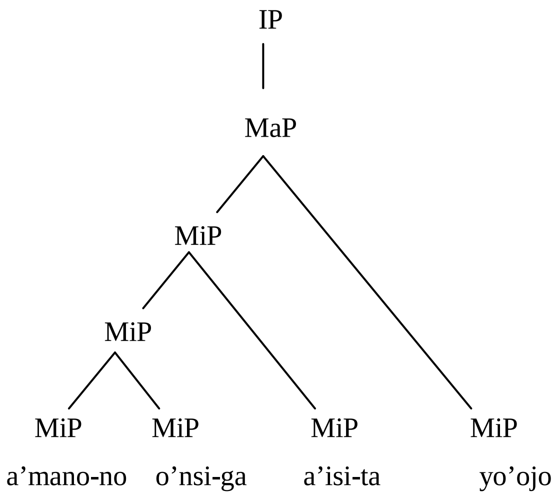
(34b)



Note also here that a Minor Phrase *yo’ojo* is bold-faced, for it to be subject to Antecedent Boost. Again, phonological component must refer to the relative clause structure at the syntax-phonology mapping stage.

(39) SK:

(34b)



As for SK, a Minor Phrase *yo’ojo* is not bold-faced, and so Antecedent Boost does not apply.

Let us turn to uniformly left-branching structures consisting of four accented words which do not involve relative clause construction.

(40) [[[ma’ri-no a’ni-no] ro’ze-no] ryo’o]

Mari-Gen brother-Gen vins rose-Gen amount

‘the amount of Mari’s brother’s vins rose’

(41) [[[a’mano-no o’nsi-no] yo’ojo-no] namae]

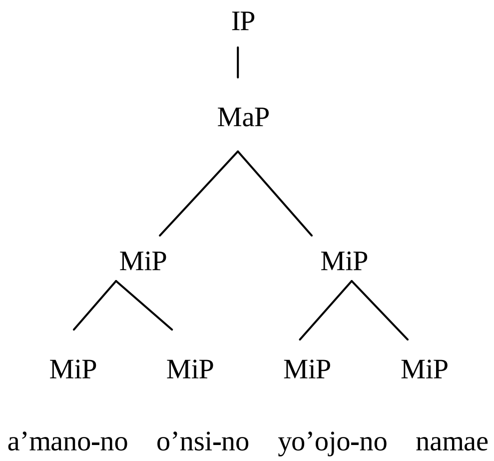
Amano-Gen former teacher-Gen little girl-Gen name

‘the name of Amano’s former teacher’s little girl’

We observed inter-speaker variation in the pitch patterns for these sentences as well. YK showed eurhythmic pitch patterns. As for AM, these two sentences exhibited different pitch patterns as shown in Figures 21 and 22 in Chapter 3. For such an inconsistency, I avoid showing prosodic representation for AM here. SK yielded gradually descending F_0 contours as in uniformly left-branching structure in which the antecedent of the relative clause stands in the fourth position. The prosodic representations I assume for YK and SK are as follows:

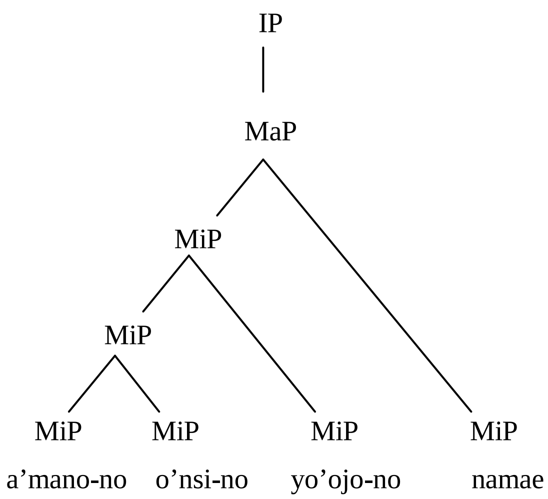
(42) YK:

(41)



(43) SK:

(41)



Now let us turn to the pitch patterns in unaccented word sequences. Thus far, we have seen the prosodic representations of accented word sequences, which largely reflect surface syntactic structures. As I mentioned above, however, prosodic representations of unaccented word sequences do not necessarily reflect surface syntactic structures. With this in mind, first let us see uniformly left-branching structures consisting of four unaccented words.

(44) a. [[[ane-ga [ec_i] yon-da] oi_i-no] ame]

elder sister-Nom [ec] call-Past nephew-Gen candy

'the candies of my nephew whom my elder sister called'

b. [[[ueno ane-ga] [ec_i] yon-da] oi_i]

eldest sister-Nom [ec] call-Past nephew

'my nephew whom my eldest sister called'

As we saw in Chapter 3, speakers had their own default phrasing patterns except for (44b) for SK, which I show again.

(45) YK:

(44a) $_{MiP}$(anega yonda)$_{MiP}$ $_{MiP}$(oino ame)$_{MiP}$

(44b) $_{MiP}$(ueno anega yonda oi)$_{MiP}$

(46) AM:

(44a) $_{MiP}$(anega yonda)$_{MiP}$ $_{MiP}$(oino ame)$_{MiP}$

(44b) $_{MiP}$(ueno anega yonda)$_{MiP}$ $_{MiP}$(oi)$_{MiP}$

(47) SK:

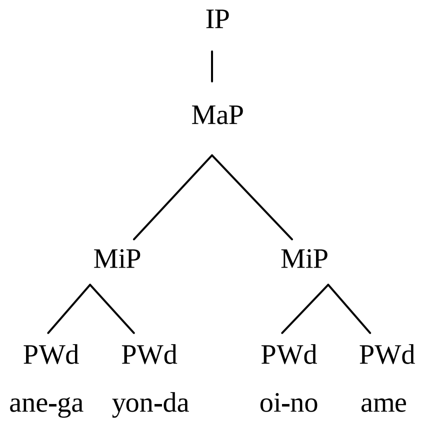
(44a) $_{MiP}$(anega yonda)$_{MiP}$ $_{MiP}$(oino ame)$_{MiP}$

(44b) no default phrasing pattern

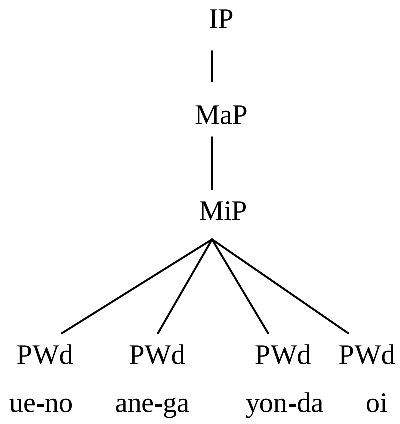
Prosodic representations I assume for these two sentences are shown according to speakers below.

(48) YK:

(44a)

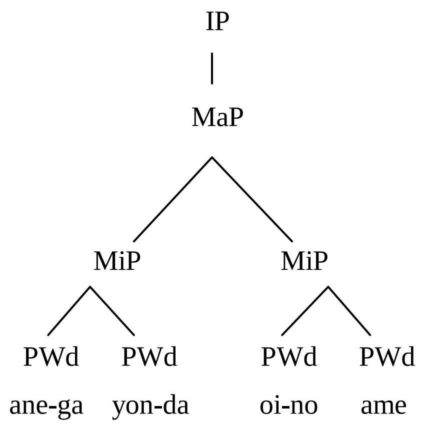


(44b)

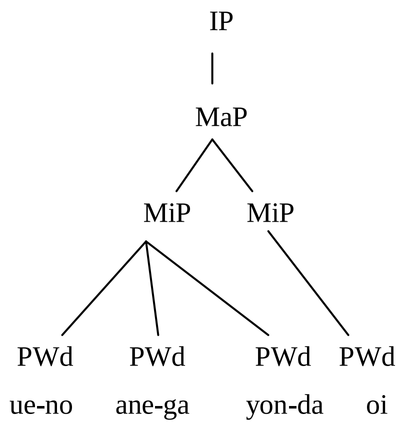


(49) AM:

(44a)

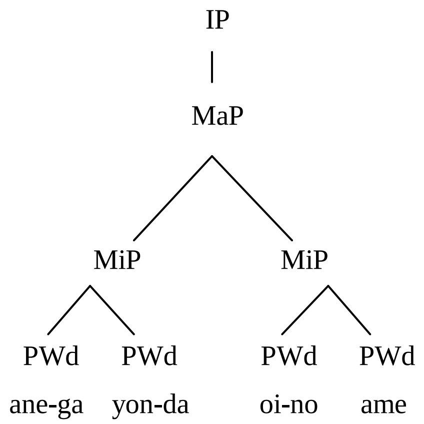


(44b)



(50) SK:

(44a) (44b) no default phrasing pattern



Judging from the prosodic representations for sentence (44b) for YK and AM, it can safely be said that prosodic representation in Japanese can be n-ary.

Finally, let us consider left-branching structures made up of three unaccented words.

(51) a. [[oi-ga [ec_i] mon-da] $momo_i$]

nephew-Nom [ec] rub-Past peach

'the peach that my nephew rubbed'

b. [[oi-no yome-no] momo]

nephew-Gen wife-Gen peach

'my nephew's wife's peach'

We observed that all speakers had their own default phrasing patterns for these two sentences as well, which I show again.

(52) YK:

(51a) ${}_{MiP}$(oiga monda momo)$_{MiP}$

(51b) ${}_{MiP}$(oino yomeno momo)$_{MiP}$

(53) AM:

(51a) ${}_{MiP}$(oiga monda)$_{MiP}$ ${}_{MiP}$(momo)$_{MiP}$

(51b) ${}_{MiP}$(oino yomeno)$_{MiP}$ ${}_{MiP}$(momo)$_{MiP}$

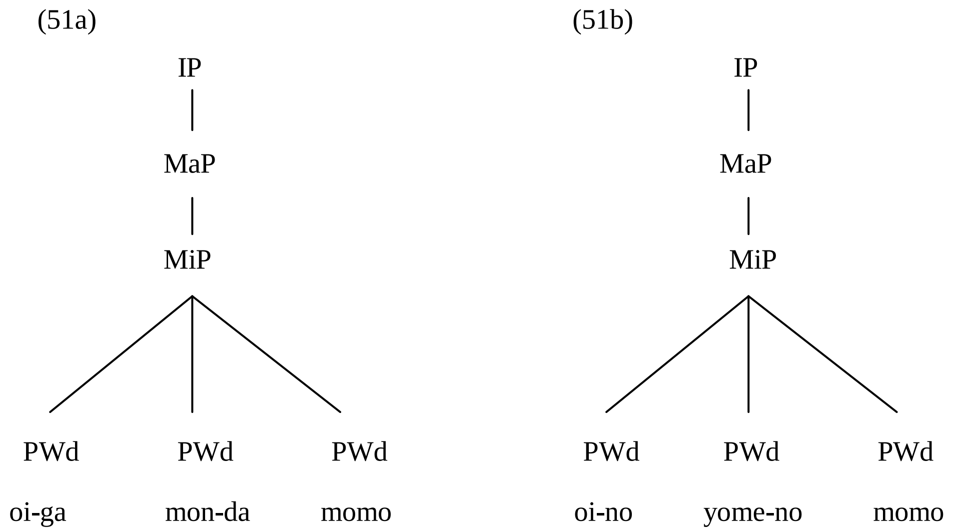
(54) SK:

(51a) ${}_{MiP}$(oiga monda)$_{MiP}$ ${}_{MiP}$(momo)$_{MiP}$

(51b) ${}_{MiP}$(oino yomeno)$_{MiP}$ ${}_{MiP}$(momo)$_{MiP}$

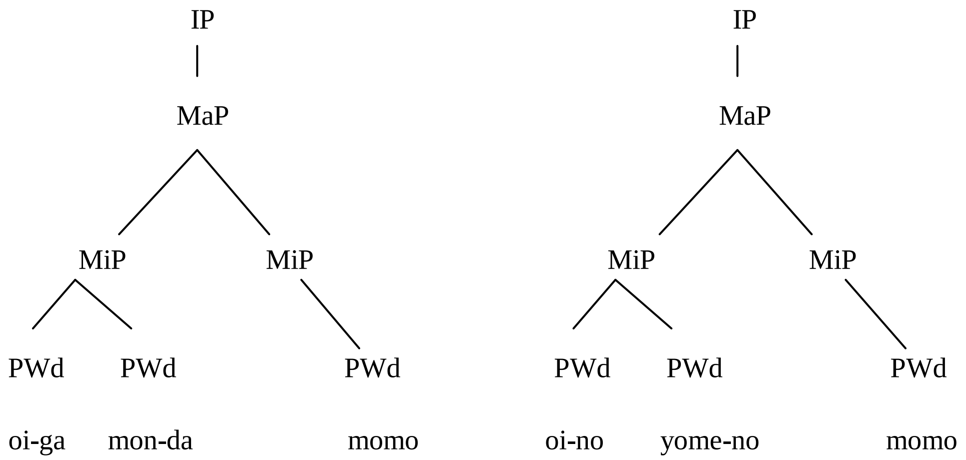
I assume the following prosodic representations for these two sentences according to speakers.

(55) YK:



(56) AM and SK:

(51a) (51b)



Here again, we can see that prosodic representation in Japanese can be n-ary from the representations for YK.

Throughout this section, we have seen prosodic representations for the sentences used in the experiments based on the extracted pitch patterns. In the following section, I will show the interaction of the visibility of empty categories with phonological phrasing in Japanese.

4.4. The Interaction of Visibility Problems with Phonological Phrasing

In Chapters 2 and 3, I argued that syntactic movements and *pro* in relative clauses must be visible to phonological component in Japanese, respectively. In this important section, I will summarize the interaction of the visibility of empty categories with phonological phrasing in Japanese.

As I mentioned above, prosodic representations of syntactic adjunction structures caused by movement operation involve adjunction structures of Major Phrase, following Kabak and Revithiadou's (2007) proposal that recursive morphosyntactic structures should correspond to recursive phonological structures and vice versa based on the fact that recursion is one of the most fundamental characteristics of human communication.[26] Remember that the representations of syntactic adjunction structures reflect the two important facts; (i) the prosodic constituents within the lower Major Phrase are subject to the strong F_0 boosting effect caused by Scrambling Boost, which is much greater than that of Metrical Boost, and (ii) those constituents within the lower Major Phrase are also within the higher Major Phrase, that is, within the domain of downstep caused by the first Minor Phrase.

To sum up, Minor Phrase is the domain of Initial Lowering, Major Phrase the domain of downstep, the higher Minor Phrase the domain of Metrical Boost, and the lower Major Phrase the domain of Scrambling Boost.

Meanwhile, as we have seen in Chapter 3, in relative clauses consisting of four accented Prosodic Words (and *pro* between the first and the second Prosodic Words), where the antecedent stands in the third position, all the speakers pronounced those sentences in such a way that the F_0 boosting effect was observed in the antecedent position, resulting in the eurhythmic High-Low-High-Low pitch pattern. There, following Kubozono (1989), I proposed the bipartite recursive prosodic structure with the third Prosodic Word bold-faced, which means that Antecedent Boost applies to it with reflection of the alternating High-Low-High-Low pitch pattern. Moreover, we saw in Chapter 3, that in relative clauses consisting of four unaccented Prosodic Words (and *pro* between the first and the second Prosodic Words), where the antecedent stands in the third position, all speakers pronounced those sentences in such a way that the Initial Lowering effect was observed in the antecedent position, resulting in the eurhythmic Minor Phrasing pattern.

In the next section, we will see how to derive those prosodic representations from constraint interaction in Optimality Theory (Prince and Smolensky (1993)) in detail.

---

[26] Prosodic recursion itself is well motivated in various languages (Kubozono (1989), Shinya et. al (2004), Selkirk (2009) for Japanese, Ladd (1986) for English, Féry (2010) for German, and Kabak and Revithiadou (2007) for Greek, among others).

4.5. The Optimality-Theoretic Approach to Syntax-Phonology Interface

4.5.1. Phonological Phrasing without Inter-Speaker Variations

In Chapter 1, I mentioned that two main approaches to Phonological Phrasing, that is, end-based approach and relation-based approach, each have advantages and disadvantages. In a manner that compensates for disadvantages, Truckenbrodt (1995, 1999) proposes an Optimality-Theoretic approach to Phonological Phrasing to the effect that Phonological Phrasing that least violates a set of universal constraints in Universal Grammar is regarded as an optimal output representation among the infinite number of candidates. For example, Truckenbrodt (1999) successfully discusses Phonological Phrasing in three languages, Tohono O'odham, Kimatuumbi and Chichewâ in light of constraint interaction as we touched on in Chapter 2. In his approach, Phonological Phrasing is supposed to be subject to the following constraint.

(57) WRAP XP

Each XP is contained in a phonological phrase.

This constraint is intended to replace Hale and Selkirk's (1987) parameter, lexical government, which is one of the advantages of his Optimality-Theoretic approach to syntax-phonology interface.[27] Here we assume that this constraint refers to Major Phrase level. He further proposes the following constraint to avoid excessive phrasing.

(58) *PHONOLOGICAL PHRASE (*P PHRASE for short)

Avoid phonological phrases.

---

[27] As implied in Chapter 2, Truckenbrodt (1999) assumes that the syntax-phonology mapping constraints such as WRAP XP do not refer to functional categories, which we follow here.

This constraint is a member of the family of constraints *STRUC in Prince and Smolensky (1993). Here we assume that this constraint is divided into *MAJOR PHRASE (*MAP) and *MINOR PHRASE (*MIP) in Japanese (for more details about the approach, see Truckenbrodt (1995, 1999)). Constraints regarding Phonological Phrasing we treat here are already independently motivated with some extensions.

Selkirk and Tateishi (1991) claim that the left edge of a syntactic maximal projection (XP) corresponds to the left edge of a Major Phrase in Japanese, based on Selkirk's (1986) original end-based theory. Then we assume the following constraint.

(59) ALIGN XP, L, MAP, L (ALIGN XP, L for short)

Align the left edge of an XP to the left edge of a Major Phrase.

On the other hand, Kubozono's (1989) binary branching recursive mechanism, which directly reflects syntactic structures, works out except for scrambling cases, as long as Prosodic Words that constitute prosodic structure are accented, as I mentioned above. In the Generalized Alignment framework of McCarthy and Prince (1993), it is assumed that one type of grammatical constituent shares a designated edge with some other type of constituent. Vogel (2004) claims that the OT constraints require the surface form (Phonological Form) to reflect the underlying semantic and syntactic representations as maximally as possible. Moreover, Speer et al. (2003) state that speakers often produce prosodic structures that reflect syntactic structures in their work on intonation and sentence processing. Then, also in order to capture the fact that syntactic structure and phonological structure are parallel in that they have the intermediate levels, X bar level and recursive Minor Phrase level (Superordinate Minor Phrase, in Shinya et al.'s (2004) terminology) respectively in

Japanese, I assume the following syntax-phonology interface constraint, following Selkirk and Tateishi (1991) and Shinya et al. (2004).[28]

(60) ALIGN $\overline{X}$, L, SUPERORDINATE MINOR PHRASE, L (ALIGN X', L for short)

Align the left edge of an $\overline{X}$ to the left edge of a Superordinate Minor Phrase.

To be more accurate, this constraint refers to branching X' which does not immediately dominate empty element. Moreover, Selkirk (2000) proposes the following constraint about the size of phonological phrases.

(61) BINARY (MAP) (BIN MAP for short)

A Major Phrase consists of just two Minor Phrases.

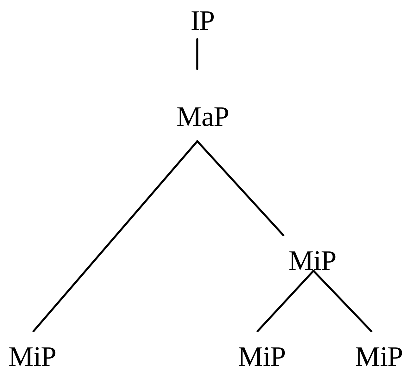
In what follows, we will see how to derive those prosodic representations which were shown in the previous sections from constraint interaction one by one.[29] First, let us see non-scrambled NP case (I will show the prosodic representations together with their corresponding syntactic structures).

---

28 The constraint is independently motivated in OT syntax (Grimshaw (2006)). Following Kubozono (1989), Shinya et al. (2004) suggest that Superordinate Minor Phrase (sMiP hereafter) is a domain of Metrical Boost and state that the degree of Metrical Boost is not enough to make the effect equivalent to the upward pitch resetting found at the left edge of Major Phrase.

29 It is preferable that constraints be ranked in light of factorial typology. In the following discussion, however, such an approach is not taken for limited data. I leave it for future research.

(62) non-scrambled NP



[$_{NP2}$ [$_{AP}$ yowa'musina] [$_{N2'}$ [$_{NP1}$ bare'ebu-no] [$_{N2}$ me'mbaa]]]

Here we can find several points about Phonological Phrasing. First, WRAP XP is not violated since each XP is contained in a Major Phrase. Second, BIN MAP is also not violated since the single Major Phrase immediately dominates just two Minor Phrases. Third, ALIGN XP, L is violated since the left edge of NP$_1$ does not correspond to the left edge of Major Phrase. Fourthly, ALIGN X', L is not violated since the left edge of N$_2$' corresponds to the left edge of sMiP. Lastly, *MAP and *MIP are violated once and four times respectively. We can say nothing about ranking of constraints here.

Let us evaluate the candidates in Tableau 1 ("M" and "m" stand for Major Phrase and Minor Phrase respectively. In what follows, we will evaluate those candidates which do not violate undominated constraints when possible for ease of exposition).[30]

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[30] I apologize to readers that the tableaux below are somewhat difficult to see for the limitation of space.

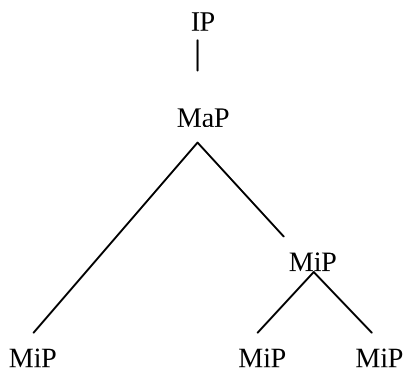
Non-scrambled NP: [$_{NP2}$ [$_{AP}$ yowa'musina] [$_{N2'}$ [$_{NP1}$ bare'ebu-no] [$_{N2}$ me'mbaa]]]

	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	*MAP	*MIP
☞ $((\ )_m ((\ )_m (\ )_m)_m)_M$			NP_1		*	****
$(((\ )_m (\ )_m)_m (\ )_m)_M$			NP_1	N_2'	*	****!
$((\ )_m)_M ((\ )_m (\ )_m)_M$	NP_2	*		N_2'	**	**!*
$((\ )_m (\ )_m (\ )_m)_M$		*	NP_1	N_2'	*	***!

Tableau 1

Let us turn to non-scrambled VP case.

(63) non-scrambled VP



[$_{VP}$ [$_{PP}$ ne'muro-de] [$_{V'}$ [$_{NP}$ wa'in-o] [$_{V}$ no'n-da]]]

The prosodic representation for non-scrambled VP is the same as that for non-scrambled NP. In addition, in light of their XP constructions, these two have the same representation. Therefore, WRAP XP, BIN MAP and ALIGN X', L are not violated as with non-scrambled NP case. Here we cannot say anything new about ranking of constraints. The evaluation of the candidates is as follows:

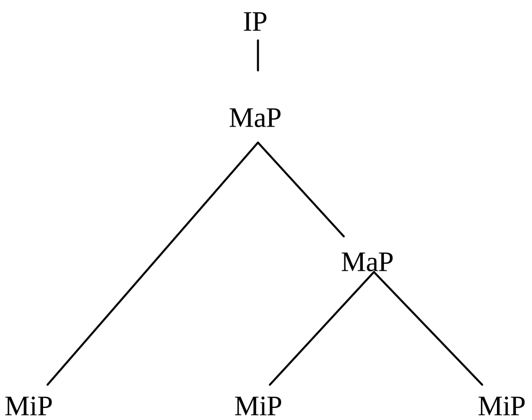
Non-scrambled VP: [$_{VP}$ [$_{PP}$ ne’muro-de] [$_{V'}$ [$_{NP}$ wa’in-o] [$_{V}$ no’n-da]]]

	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X’, L	*MAP	*MIP
☞ $((\ )_m ((\ )_m (\ )_m)_m)_M$			NP		*	****
$(((\ )_m (\ )_m)_m (\ )_m)_M$			NP	V’	*	****!
$((\ )_m)_M ((\ )_m (\ )_m)_M$	VP	*		V’	**	**!*
$((\ )_m (\ )_m (\ )_m)_M$		*	NP	V’	*	***!

Tableau 2

Now we turn to scrambled NP case.

(64) scrambled NP



[$_{NP2}$ [$_{NP1}$ bare’ebu-no$_i$] [$_{NP2}$ [$_{AP}$ yowa’musina] [$_{N2'}$ [*t*$_i$] [$_{N2}$ me’mbaa]]]]

As noted above, the prosodic representation for scrambled NP involves adjunction structure of Major Phrase, which reflects syntactic adjunction structure, following the constraint, MIRROR, proposed by Kabak and Revithiadou (2007).

(65) MIRROR

Recursive morphosyntactic structures should correspond to recursive phonological structures and vice versa.

As is often the case with constraints in Optimality Theory, we divide this constraint into two unidirectional constraints as follows:

(65)' MIRROR (MS→P)

Recursive morphosyntactic structures should correspond to recursive phonological structures.

(65)'' MIRROR (P→MS)

Recursive phonological structures should correspond to recursive morphosyntactic structures.

Hereafter, by MIRROR I mean MIRROR (MS→P) in this thesis.[31]

We observed above that syntactic adjunction structure induced by scrambling involves prosodic adjunction structure, which means that MIRROR is undominated in Japanese. Seen conversely, this constraint is responsible for the visibility of syntactic movement or empty traces to phonological component in Japanese.

As I mentioned in Chapter 2, Truckenbrodt (1999) proposes that phonological processes refer to the lower segment composing category in adjunction structures, which means that WRAP XP, BIN MAP and ALIGN XP, L do not refer to the higher XP and that these three constraints are not violated as for the higher XP. Truckenbrodt (1999) further proposes that constraints relating syntactic and prosodic categories do not apply to empty syntactic elements and their projections, which we follow here. Returning to the argument of constraint violation, ALIGN X', L is not violated since N_2' immediately dominates empty element. We cannot say anything new about ranking of constraints except that MIRROR is undominated. Let us evaluate the candidates based on this hierarchy in

---

[31] We may interpret that Mirror (P→MS) is ranked very low in constraint hierarchy, for, if this constraint were ranked higher, the notion of prosodic recursion would make no sense. Similarly, the constraint which prohibits recursive structures, NONRECURSIVITY, discussed in Truckenbrodt (1999) is assumed to be ranked very low here.

Tableau 3.

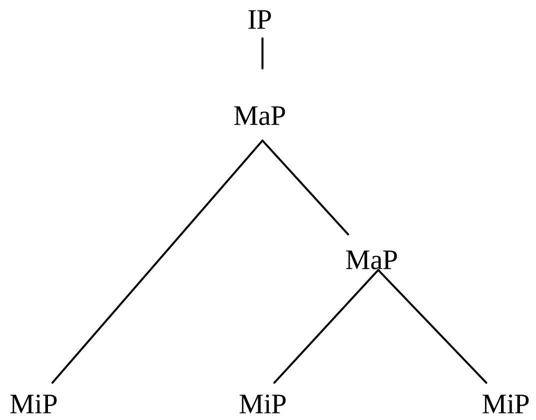
Scrambled NP: [$_{NP2}$ [$_{NP1}$ bare'ebu-no$_i$] [$_{NP2}$ [$_{AP}$ yowa'musina] [$_{N2'}$ [t_i] [$_{N2}$ me'mbaa]]]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	*MAP	*MIP
☞$((\ )_m ((\ )_m (\ )_m)_M)_M$						**	***
$((\ )_m ((\ )_m (\ )_m)_m)_M$	*					*	****!
$((\ )_m)_M ((\ )_m (\ )_m)_M$	*		*			**	**!*
$((\ )_m (\ )_m (\ )_m)_M$	*		*	NP_2 AP		*	*!**

Tableau 3

Let us see scrambled VP case.

(66) scrambled VP



[$_{VP}$ [$_{NP}$ wa'in-o$_i$] [$_{VP}$ [$_{PP}$ ne'muro-de] [$_{V'}$ [t_i] [$_V$ no'n-da]]]]

For this case too, we can see the adjunction structure of Major Phrase for the same reason as for scrambled NP case, resulting in the same prosodic representation as for scrambled NP case. Moreover, these two have the same representation in light of their XP constructions. Therefore ALIGN X', L is not violated also here since V' immediately dominates an empty element. Here we cannot say anything new about ranking of constraints. Hence the evaluation of the candidates is as follows:

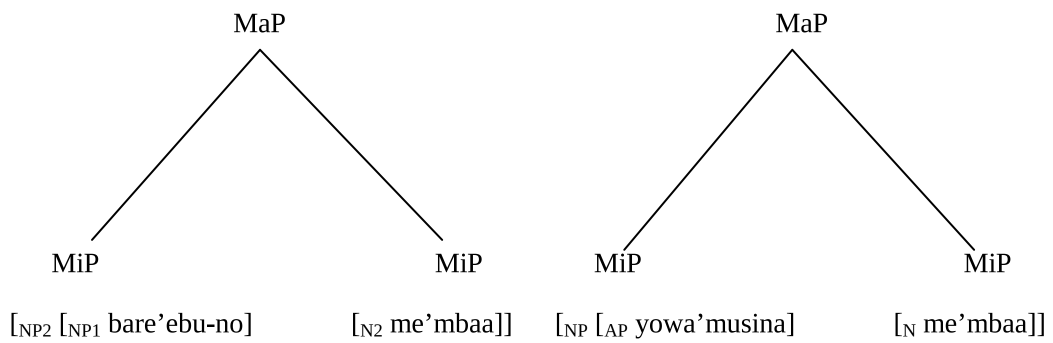
Scrambled VP: [$_{VP}$ [$_{NP}$ wa'in-o$_i$] [$_{VP}$ [$_{PP}$ ne'muro-de] [$_{V'}$ [t_i] [$_V$ no'n-da]]]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	*MAP	*MIP
☞$((\ )_m ((\ )_m (\ )_m)_M)_M$						**	***
$((\ )_m ((\ )_m (\ )_m)_m)_M$	*			VP PP		*	**!**
$((\ )_m)_M ((\ )_m (\ )_m)_M$	*		*			**	**!*
$((\ )_m (\ )_m (\ )_m)_M$	*		*	VP PP		*	*!**

Tableau 4

Next, let us see argument-head sequence and adjunct-head sequence for NPs.

(67) argument-head sequence and adjunct-head sequence for NPs



We can observe that no constraint is violated other than *MAP and *MIP for both structures. Let us evaluate the candidates for these two cases respectively.

Argument-head sequence for NP: [$_{NP2}$ [$_{NP1}$ bare’ebu-no] [$_{N2}$ me’mbaa]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X’, L	*MAP	*MIP
☞ $((\ )_m (\ )_m)_M$						*	**
$((\ )_m)_M ((\ )_m)_M$			**			**!	**

Tableau 5

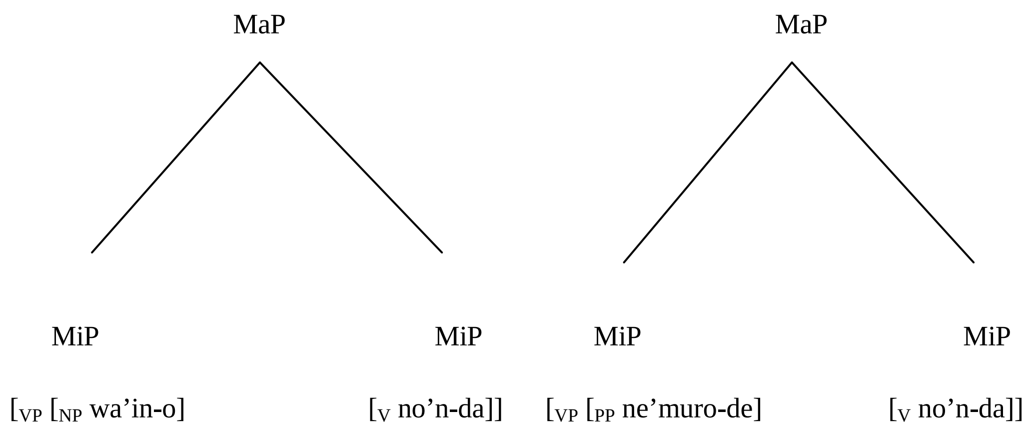
Adjunct-head sequence for NP: [$_{NP}$ [$_{AP}$ yowa’musina] [$_{N}$ me’mbaa]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X’, L	*MAP	*MIP
☞ $((\ )_m (\ )_m)_M$						*	**
$((\ )_m)_M ((\ )_m)_M$			**			**!	**

Tableau 6

We turn to argument-head sequence and adjunct-head sequence for VPs.

(68) argument-head sequence and adjunct-head sequence for VPs



Here again, no constraint is violated other than *MAP and *MIP for both structures. The representation is derived as an optimal output for each case as follows:

Argument-head sequence for VP: $[_{VP}$ $[_{NP}$ wa'in-o] $[_{V}$ no'n-da]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	*MAP	*MIP
☞ (($)_m$ ($)_m$ $)_M$						*	**
(($)_m$ $)_M$ (($)_m$ $)_M$			**			**!	**

Tableau 7

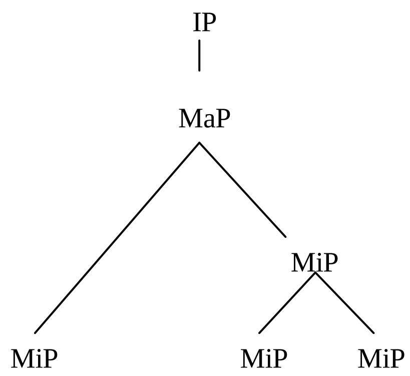
Adjunct-head sequence for VP: $[_{VP}$ $[_{PP}$ ne'muro-de] $[_{V}$ no'n-da]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	*MAP	*MIP
☞ (($)_m$ ($)_m$ $)_M$						*	**
(($)_m$ $)_M$ (($)_m$ $)_M$			**			**!	**

Tableau 8

Next, let us see non-scrambled double object construction.

(69) non-scrambled double object construction



$[_{VP}$ $[_{NP1}$ ya'mana-ni] $[_{V'}$ $[_{NP2}$ no'oto-o] $[_{V}$ ka'esi-ta]]]

Note that the prosodic representation for non-scrambled double object construction is the same as that for non-scrambled VP in (63). In addition, in light of their XP constructions, these two have the same representation. Therefore, we cannot say anything new about ranking of constraints. The evaluation of the candidates is as follows:

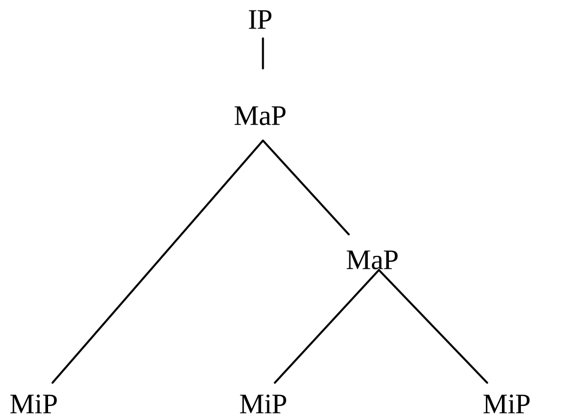
Non-scrambled double object construction: [$_{VP}$ [$_{NP1}$ ya’mana-ni] [$_{V'}$ [$_{NP2}$ no’oto-o] [$_{V}$ ka’esi-ta]]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X’, L	*MAP	*MIP
☞$((\ )_m ((\ )_m (\ )_m)_m)_M$				NP_2		*	****
$(((\ )_m (\ )_m)_m (\ )_m)_M$				NP_2	V’	*	****!
$((\ )_m)_M ((\ )_m (\ )_m)_M$		VP	*		V’	**	**!*
$((\ )_m (\ )_m (\ )_m)_M$			*	NP_2	V’	*	***!

Tableau 9

We turn to scrambled double object construction.

(70) scrambled double object construction



[$_{VP}$ [$_{NP1}$ no’oto-o$_i$] [$_{VP}$ [$_{NP2}$ ya’mana-ni] [$_{V'}$ [t_i] [$_{V}$ ka’esi-ta]]]]

Here again, we find the adjunction structure of Major Phrase for the same reason as for scrambled VP case, resulting in the same prosodic representation as for scrambled VP case. Furthermore, these two have the same representation in light of their XP constructions. Therefore no constraint is violated other than *MAP and *MIP for this case as well. The evaluation of the candidates is as follows:

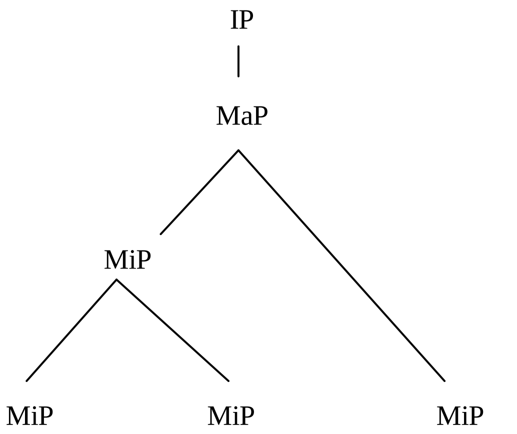
Scrambled double object construction: [$_{VP}$ [$_{NP1}$ no’oto-o$_i$] [$_{VP}$ [$_{NP2}$ ya’mana-ni] [$_{V'}$ [t_i] [$_V$ ka’esi-ta]]]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X’, L	*MAP	*MIP
☞(( )$_m$ (( )$_m$ ( )$_m$)$_M$)$_M$						**	***
(( )$_m$ (( )$_m$ ( )$_m$)$_m$)$_M$	*			VP NP$_2$		*	**!**
(( )$_m$)$_M$ (( )$_m$ ( )$_m$)$_M$	*		*			**	**!*
(( )$_m$ ( )$_m$ ( )$_m$)$_M$	*		*	VP NP$_2$		*	*!**

Tableau 10

Next, let us see left-branching structure consisting of three accented words which involves relative clause construction.

(71) relative clause construction consisting of three accented words



[$_{NP1}$ [$_{CP}$ [$_{NP2}$ na’o-ga] [$_{VP}$ [ec$_i$] [$_V$ yo’n-da]]] [$_{N2}$ no’oto$_i$]]

The constraint hierarchy established so far evaluates the candidates as follows:

Relative clause construction consisting of three accented words:

$[_{NP1}$ $[_{CP}$ $[_{NP2}$ na'o-ga] $[_{VP}$ $[ec_i]$ $[_{V}$ yo'n-da]]] $[_{N1}$ no'oto$_i$]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	*MAP	*MIP
☞$(((\;\;)_m (\;\;)_m)_m (\;\;)_m)_M$				VP		*	****
☞$((\;\;)_m ((\;\;)_m (\;\;)_m)_m)_M$				VP		*	****
$((\;\;)_m)_M ((\;\;)_m (\;\;)_m)_M$		NP_1	*			**	***!
$((\;\;)_m (\;\;)_m)_M ((\;\;)_m)_M$		NP_1 VP	*	VP		**	*!**
☞$((\;\;)_m (\;\;)_m (\;\;)_m)_M$			*	VP		*	***

Tableau 11

We see that the second and the fifth candidates from the top are incorrectly evaluated as optimal outputs. First, we can find that *MIP is lower than BIN MAP in constraint hierarchy to the exclusion of the fifth candidate. However, the second candidate is still evaluated as an optimal output. In this connection, Kim (1997: 218) proposes the following constraint with regard to Korean phonology.

(72) ALIGN (PH, R; I, R)

Align the right edge of a P-phrase (Phonological Phrase) with the right edge of an intonational phrase (Intonational Phrase).

This constraint forces Phonological Phrases to be as rightmost as possible in an Intonational Phrase. Then, I propose the following constraint concerning sMiP.

(73) ALIGN (SMIP, L; MAP, L) (ALIGN SMIP, L for short)

Align the left edge of a superordinate Minor Phrase with the left edge of a Major Phrase.

This constraint forces sMiPs to be as leftmost as possible in a MaP. We can say that this constraint is lower than ALIGN X', L, for, if these two constraints were in the same position in constraint hierarchy, the hierarchy would predict the wrong result as, for example, non-scrambled NP case shows.

Non-scrambled NP: [$_{NP2}$ [$_{AP}$ yowa'musina] [$_{N2'}$ [$_{NP1}$ bare'ebu-no] [$_{N2}$ me'mbaa]]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	ALIGN sMIP, L	*MAP	*MIP
☞$(( )_m (( )_m ( )_m)_m)_M$				NP_1		*	*	****
☞$((( )_m ( )_m)_m ( )_m)_M$				NP_1	N_2'		*	****
$(( )_m)_M (( )_m ( )_m)_M$		NP_2	*		N_2'		*!*	
$(( )_m ( )_m ( )_m)_M$			*	NP_1	N_2'		*!	

Tableau 12

Hence, ALIGN SMIP, L is lower than ALIGN X', L as in Tableau 13.

Non-scrambled NP: [$_{NP2}$ [$_{AP}$ yowa'musina] [$_{N2'}$ [$_{NP1}$ bare'ebu-no] [$_{N2}$ me'mbaa]]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	*MAP	ALIGN sMIP, L	*MIP
☞$(( )_m (( )_m ( )_m)_m)_M$				NP_1		*	*	****
$((( )_m ( )_m)_m ( )_m)_M$				NP_1	N_2'	*!		
$(( )_m)_M (( )_m ( )_m)_M$		NP_2	*		N_2'	*!*		
$(( )_m ( )_m ( )_m)_M$			*	NP_1	N_2'	*!		

Tableau 13

Returning to the representation in (71), let us see the following tableau.

Relative clause construction consisting of three accented words:

$[_{NP2}$ $[_{CP}$ $[_{NP1}$ na’o-ga] $[_{VP}$ $[ec_i]$ $[_V$ yo’n-da]]] $[_{N2}$ no’oto$_i$]]

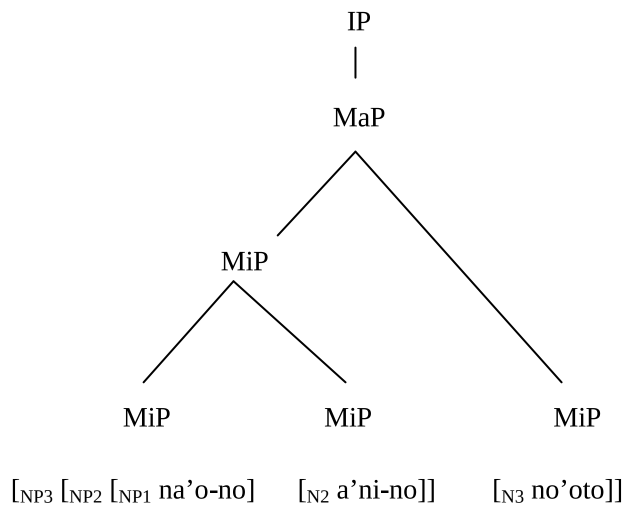
	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X’, L	*MAP	ALIGN sMIP, L	*MIP
☞ $(((\,)_m\,(\,)_m\,)_m\,(\,)_m\,)_M$				VP		*		****
$((\,)_m\,((\,)_m\,(\,)_m\,)_m\,)_M$				VP		*	*	****!
$((\,)_m\,)_M\,((\,)_m\,(\,)_m\,)_M$		NP_2	*			*!*		
$((\,)_m\,(\,)_m\,)_M\,((\,)_m\,)_M$		NP_2 VP	*!	VP		**		
$((\,)_m\,(\,)_m\,(\,)_m\,)_M$			*	VP		*!		

Tableau 14

We can get the correct output according to the constraint hierarchy (we will discuss the status of CP induced by relative clause structure later).

We turn to left-branching structure consisting of three accented words which does not involve relative clause construction.

(74) left-branching structure consisting of three accented words



The constraint hierarchy obtained so far properly generates an optimal output as shown in Tableau 15.

Left-branching structure consisting of three accented words:

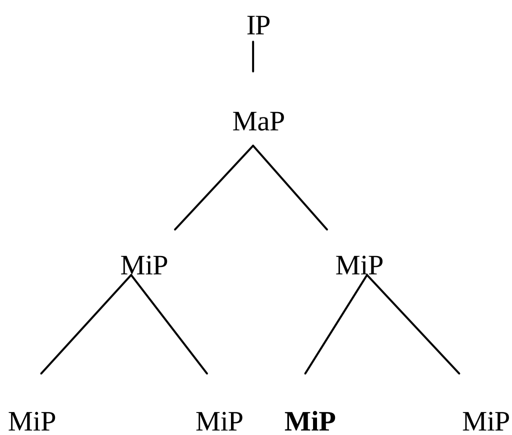
[$_{NP3}$ [$_{NP2}$ [$_{NP1}$ na'o-no] [$_{N2}$ a'ni-no]] [$_{N3}$ no'oto]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	*MAP	ALIGN sMIP, L	*MIP
☞$((( )_m ( )_m)_m ( )_m)_M$						*		****
$(( )_m (( )_m ( )_m)_m)_M$						*	*	****!
$(( )_m)_M (( )_m ( )_m)_M$		NP_3 NP_2!	*			**		
$(( )_m ( )_m)_M (( )_m)_M$		NP_3	*!			**		
$(( )_m ( )_m ( )_m)_M$			*			*!		

Tableau 15

Now, let us see uniformly left-branching relative clause structure consisting of four Prosodic Words which involves the antecedent in the third position.

(75) uniformly left-branching relative clause structure with the antecedent in the third position:



[$_{NP3}$ [$_{NP2}$ [$_{CP}$ [$_{NP1}$ a'mano-ga] [$_{VP}$ [ec_i] [$_V$ a'isi-ta]]] [$_{N2}$ yo'ojo$_i$-no]] [$_{N3}$ namae]]

As touched on above, an empirical question arises as to how we treat a CP boundary inside relative clause construction. In this respect, Truckenbrodt (2005) proposes the following constraint in German prosody.

(76) ALIGN CP, R, IP, R

The right edge of a CP must coincide with the right edge of an intonation phrase (Intonational Phrase).

We have seen that the Principle of Rhythmic Alternation basically applies to uniformly left-branching structure made up of four accented words (or more). Alternatively, uniformly left-branching structure made up of four accented words can be subject to metrical restructuring, resulting in symmetrically branching structure. Taking these insights together, I propose the following constraint here.

(77) ALIGN CP, R (sMIP)

The right edge of a CP must coincide with the right edge of a superordinate Minor Phrase.

This constraint reflects difference in size between Phonological Phrase and Intonational Phrase in general. Moreover, this constraint is also responsible for the visibility of empty elements in Japanese with a condition that its effect emerges in uniformly left-branching structure made up of four words or more.

As noted above, speakers pronounced those sentences which involve uniformly left-branching relative clause structure with the antecedent in the third position in such a way that the antecedent is subject to what we call Antecedent Boost, whose effect is generally greater than that of

Rhythmic Boost. I propose here that ALIGN CP, R (SMIP) triggers Antecedent Boost. This is why I show the Minor Phrase which is subject to Antecedent Boost in bold-faced type. In addition, we found in Chapter 3 that there is a very strong correlation between the eurhythmic effect and the position of the antecedent such that the eurhythmic effect invariably acts on the antecedent which stands in the third position in uniformly left-branching structure. As for the eurhythmic effect, Ghini (1993) proposes the following constraint in syntax-phonology interface.

(78) UNIFORMITY

A string is ideally parsed into same length units.

We can assume that the strong correlation between the eurhythmic effect and the position of the antecedent is a consequence of the conjunction of ALIGN CP, R (SMIP) and UNIFORMITY, in light of Smolensky's (1993) 'Local Conjunction' of constraints as in (79).

(79) Local Conjunction of ALIGN CP, R (SMIP) and UNIFORMITY (A CP, R (SMIP) & UNIF for short)

The right edge of a CP must coincide with the right edge of a sMiP with a string parsed into units of the same length.

I propose here that UNIFORMITY refers to Minor Phrase level and A CP, R (SMIP) & UNIF is also responsible for the visibility of empty elements in Japanese as ALIGN CP, R (SMIP) is. Until some evidence is found, let us assume that the three constraints, ALIGN CP, R (SMIP), UNIFORMITY and A CP, R (SMIP) & UNIF, are undominated as in the following constraint hierarchy.

(80) MIRROR, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X’, L, ALIGN CP, R (SMIP), UNIFORMITY, A CP, R (SMIP) & UNIF, *MAP >> ALIGN SMIP, L, *MIP

This constraint hierarchy properly generates an optimal output as shown in the following tableau.

Uniformly left-branching relative clause structure with the antecedent in the third position:

$[_{NP3}$ $[_{NP2}$ $[_{CP}$ $[_{NP1}$ a’mano-ga] $[_{VP}$ $[ec_i]$ $[_V$ a’isi-ta]]] $[_{N2}$ yo’ojo$_i$-no]] $[_{N3}$ namae]]

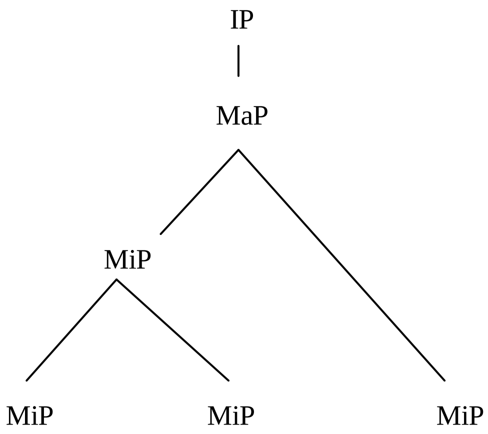
	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X’, L	ALIGN CP, R (SMIP)	UNIFORMITY	A CP, R (SMIP) & UNIF	*MAP	ALIGN SMIP, L	*MIP
☞((( )m ( )m)m (( )m ( )m)m)M				VP					*	*	******
(((( )m ( )m)m ( )m)m ( )m)M				VP		*	*!	*	*		
(( )m ( )m ( )m ( )m)M			*	VP		*!		*	*		

Tableau 16

Note that UNIFORMITY is violated once for the second candidate from the top because the Major Phrase is not symmetrically branching due to the higher sMiP as the top candidate is.

Let us return to (71), repeated as (81).

(81) relative clause construction consisting of three accented words



[$_{NP1}$ [$_{CP}$ [$_{NP2}$ na’o-ga] [$_{VP}$ [ec$_i$] [$_V$ yo’n-da]]] [$_{N2}$ no’oto$_i$]]

The constraint hierarchy in (80) still properly generates an optimal output as shown in Tableau 17.

Relative clause construction consisting of three accented words:

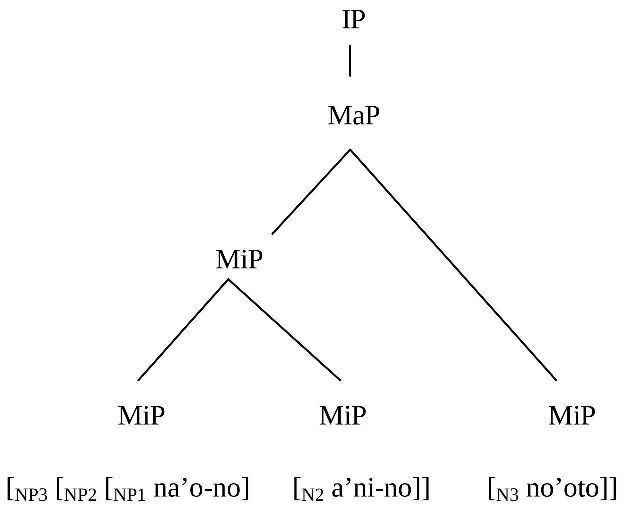
[$_{NP2}$ [$_{CP}$ [$_{NP1}$ na’o-ga] [$_{VP}$ [ec$_i$] [$_V$ yo’n-da]]] [$_{N2}$ no’oto$_i$]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X’, L	ALIGN CP, R (SMIP)	UNIFORMITY	A CP, R (SMIP) & UNIF	*MAP	ALIGN SMIP, L	*MIP
☞((( )$_m$ ( )$_m$)$_m$ ( )$_m$)$_M$				VP					*		****
(( )$_m$ (( )$_m$ ( )$_m$)$_m$)$_M$				VP		*		*!	*		
(( )$_m$)$_M$ (( )$_m$ ( )$_m$)$_M$		NP$_2$	*			*!	*	*	**		
(( )$_m$ ( )$_m$)$_M$ (( )$_m$)$_M$		NP$_2$ VP	*!	VP			*	*	**		
(( )$_m$ ( )$_m$ ( )$_m$)$_M$			*	VP				*!	*		

Tableau 17

For comparison, let us see left-branching structure consisting of three accented words without relative clause construction (74) repeated as (82).

(82) left-branching structure consisting of three accented words



Also here, the constraint hierarchy in (80) still properly generates an optimal output as shown in the following tableau.

Left-branching structure consisting of three accented words:

$[_{NP3}\ [_{NP2}\ [_{NP1}$ na'o-no] $[_{N2}$ a'ni-no]] $[_{N3}$ no'oto]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	ALIGN CP, R (SMIP)	UNIFORMITY	A CP, R (SMIP) & UNIF	*MAP	ALIGN SMIP, L	*MIP
☞$((( )_m ( )_m)_m ( )_m)_M$									*		****
$(( )_m (( )_m ( )_m)_m)_M$									*	*	*** *!
$(( )_m)_M (( )_m ( )_m)_M$		NP_2 NP_3!	*				*		**		
$(( )_m ( )_m)_M (( )_m)_M$		NP_3	*!				*		**		
$(( )_m ( )_m ( )_m)_M$			*						*!		

Tableau 18

Thus far, we have discussed Phonological Phrasing without inter-speaker variation. In the next subsection, we will deal with Phonological Phrasing with inter-speaker variations.

4.5.2. Phonological Phrasing with Inter-Speaker Variations

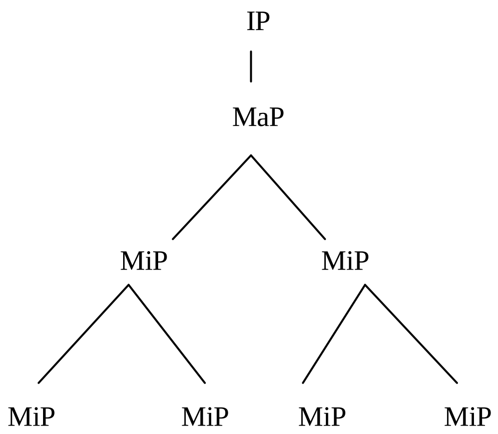
4.5.2.1. Accented Sequences

In the previous sections, we have seen inter-speaker variations in Phonological Phrasing for some sentences. In what follows, we will continuously discuss how to derive inter-speaker variations in Phonological Phrasing, which cannot be dealt with by at least end-based approach, based on constraint hierarchy obtained so far from speaker to speaker.

First, let us see uniformly left-branching relative clause structure made up of four accented words which involves the antecedent in the fourth position.

(83) uniformly left-branching relative clause structure with the antecedent in the fourth position

YK:



[$_{NP3}$ [$_{CP}$ [$_{NP2}$ [$_{NP1}$ a'mano-no] [$_{N2}$ o'nsi-ga]] [$_{VP}$ [ec$_i$] [$_{V}$ a'isi-ta]]] [$_{N3}$ yo'ojo$_i$]]

YK basically showed the eurhythmic pattern for this construction. The constraint hierarchy in (80) cannot generate an optimal output as shown in Tableau 19 (we will explain why the last Minor Phrase in the second candidate from the top is bold-faced a short time later).

Uniformly left-branching relative clause structure with the antecedent in the fourth position for YK:

[$_{NP3}$ [$_{CP}$ [$_{NP2}$ [$_{NP1}$ a’mano-no] [$_{N2}$ o’nsi-ga]] [$_{VP}$ [ec$_i$] [$_V$ a’isi-ta]]] [$_{N3}$ yo’ojo$_i$]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X’, L	ALIGN CP, R (SMIP)	UNIFORMITY	A CP, R (SMIP) & UNIF	*MAP	ALIGN SMIP, L	*MIP
$((( )_m ( )_m)_m (( )_m ( )_m)_m)_M$				VP		*		*	*	*	******!
☞$(((( )_m ( )_m)_m ( )_m)_m ( )_m)_M$				VP			*	*	*		******
$(( )_m ( )_m ( )_m ( )_m)_M$			*	VP		*		*	*!		

Tableau 19

We can say that for YK ALIGN CP, R (SMIP) is lower than UNIFORMITY in constraint hierarchy as shown in (84).

(84) constraint hierarchy for YK

MIRROR, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X’, L, UNIFORMITY, A CP, R (SMIP) & UNIF, *MAP >> ALIGN CP, R (SMIP), ALIGN SMIP, L, *MIP

Based on the constraint hierarchy in (84), an optimal output is properly generated as shown in the following tableau.

Uniformly left-branching relative clause structure with the antecedent in the fourth position for YK:

[$_{NP3}$ [$_{CP}$ [$_{NP2}$ [$_{NP1}$ a'mano-no] [$_{N2}$ o'nsi-ga]] [$_{VP}$ [ec$_i$] [$_V$ a'isi-ta]]] [$_{N3}$ yo'ojo$_i$]]

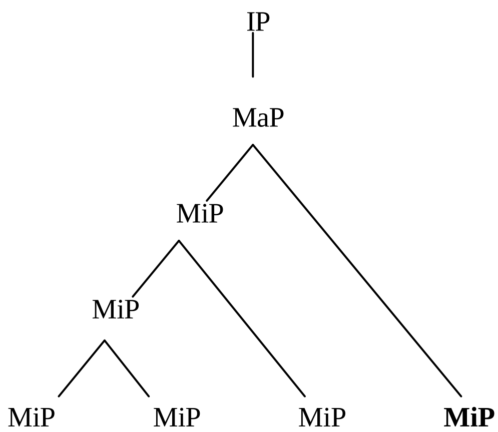
	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	UNIFORMITY	A CP, R (SMIP) & UNIF	*MAP	ALIGN CP, R (SMIP)	ALIGN SMIP, L	*MIP
☞$((( )_m ( )_m)_m (( )_m ( )_m)_m)_M$				VP			*	*	*	*	******
$(((( )_m ( )_m)_m ( )_m)_m ( )_{\mathbf{m}})_M$				VP		*	*	*!			
$(( )_m ( )_m ( )_m ( )_m)_M$			*	VP			*	*!			

Tableau 20

Next, we turn to the case for AM for this construction. Remember that AM consistently showed the effect of Antecedent Boost for this construction.

(85) uniformly left-branching relative clause structure with the antecedent in the fourth position

AM:



[$_{NP3}$ [$_{CP}$ [$_{NP2}$ [$_{NP1}$ a'mano-no] [$_{N2}$ o'nsi-ga]] [$_{VP}$ [ec$_i$] [$_V$ a'isi-ta]]] [$_{N3}$ yo'ojo$_i$]]

Note that a Minor Phrase *yo'ojo* is bold-faced, for it to be subject to Antecedent Boost. The constraint hierarchy in (80) repeated as in (86), continuously generates an optimal output as shown in Tableau 21.

(86) constraint hierarchy for AM

MIRROR, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X', L, ALIGN CP, R (SMIP), UNIFORMITY, A CP, R (SMIP) & UNIF, *MAP >> ALIGN SMIP, L, *MIP

Uniformly left-branching relative clause structure with the antecedent in the fourth position for AM:

[$_{NP3}$ [$_{CP}$ [$_{NP2}$ [$_{NP1}$ a'mano-no] [$_{N2}$ o'nsi-ga]] [$_{VP}$ [ec$_i$] [$_V$ a'isi-ta]]] [$_{N3}$ yo'ojo$_i$]]

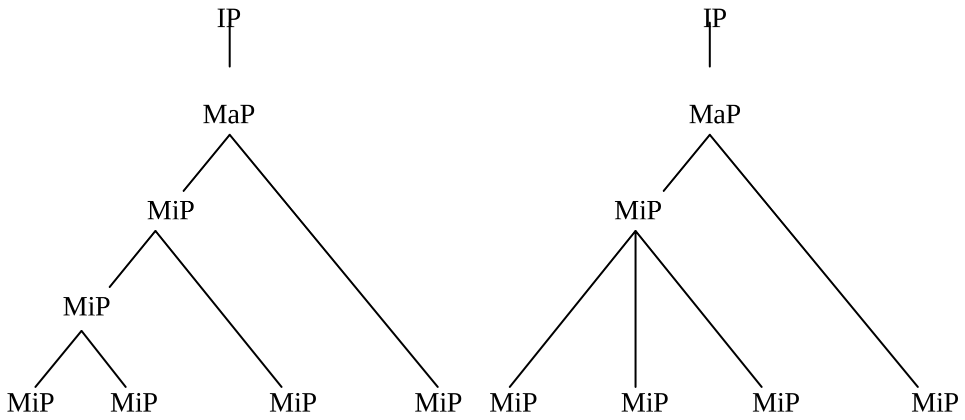
	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	ALIGN CP, R (SMIP)	UNIFORMITY	A CP, R (SMIP) & UNIF	*MAP	ALIGN SMIP, L	*MIP
((( )$_m$ ( )$_m$)$_m$ (( )$_m$ ( )$_m$)$_m$)$_M$				VP		*		*	*	*	******!
☞(((( )$_m$ ( )$_m$)$_m$ ( )$_m$)$_m$ ( )$_{\mathbf{m}}$)$_M$				VP			*	*	*		******
(( )$_m$ ( )$_m$ ( )$_m$ ( )$_m$)$_M$			*	VP		*		*	*!		

Tableau 21

Note that in the winning candidate the last Minor Phrase is bold-faced. I assume here that ALIGN CP, R (SMIP) which triggers Antecedent Boost is undominated.

Here an empirical problem arises as to how exactly we should represent the internal structure of the higher sMiP in the winning candidate. Two possible representations come to mind as shown in (87).

(87) a. b.



Of the two representations, (87a) captures the fact that the degree of downstepping differs between in left-branching structure and in right-branching structure. In this connection, Shinya (2005, personal communication) argues that a Minor Phrase is ideally made up of two Prosodic Words as in the following form.

(88) A Minor Phrase must be binary at the Prosodic Word level.

As Shinya (2005) claims, binarity constraint like this is well motivated in Japanese phonology. For example, Ito (1990) argues that a word in Japanese must minimally contain two moras in the form of a word minimality constraint. Poser (1990) also claims the role of foot binarity at the mora level in Japanese phonology. Following them, I propose the constraint in (89) here.

(89) BINARY sMIP (BIN sMIP for short)

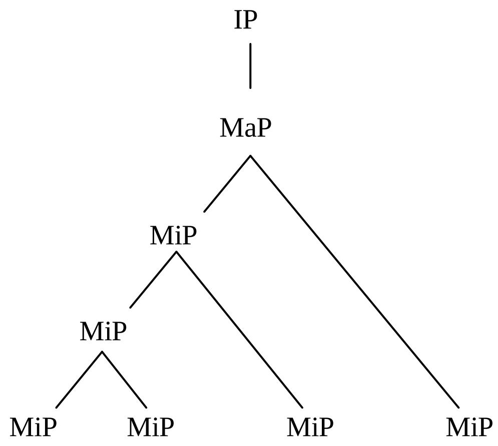
A superordinate Minor Phrase must be binary at the Minor Phrase level.

I assume that this constraint is undominated and omit it from the discussion from now on.

Let us see the case for SK for this construction. SK basically yielded a gradually descending pitch pattern for this construction.

(90) uniformly left-branching relative clause structure with the antecedent in the fourth position

SK:



[$_{NP3}$ [$_{CP}$ [$_{NP2}$ [$_{NP1}$ a'mano-no] [$_{N2}$ o'nsi-ga]] [$_{VP}$ [ec$_i$] [$_V$ a'isi-ta]]] [$_{N3}$ yo'ojo$_i$]]

Note that the last Minor Phrase is not bold-faced, which means that ALIGN CP, R (SMIP) is not undominated. Moreover, UNIFORMITY is not undominated either, for if this constraint was undominated, the constraint hierarchy would predict the symmetrically branching structure as with the case for YK. Hence the constraint hierarchy for SK is as follows:

(91) constraint hierarchy for SK

MIRROR, BIN SMIP, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X', L, A CP, R (SMIP) & UNIF, *MAP >> UNIFORMITY, ALIGN CP, R (SMIP), ALIGN SMIP, L, *MIP

This hierarchy properly generates an optimal output as shown in the following tableau.

Uniformly left-branching relative clause structure with the antecedent in the fourth position for SK:

[$_{NP3}$ [$_{CP}$ [$_{NP2}$ [$_{NP1}$ a’mano-no] [$_{N2}$ o’nsi-ga]] [$_{VP}$ [ec$_i$] [$_V$ a’isi-ta]]] [$_{N3}$ yo’ojo$_i$]]

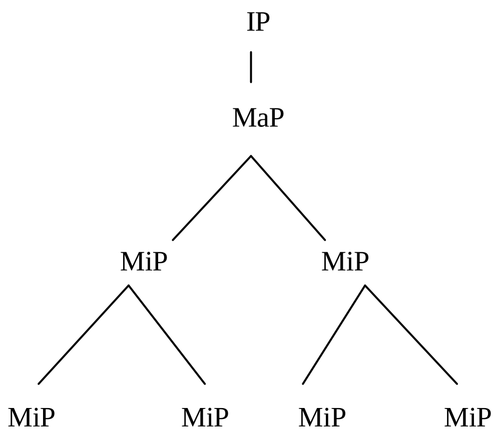
	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X’, L	A CP, R (sMIP) & UNIF	*MAP	UNIFORMITY	ALIGN CP, R (sMIP)	ALIGN sMIP, L	*MIP
$((( )_m ( )_m)_m (( )_m ( )_m)_m)_M$				VP		*	*		*	*	******!
☞$(((( )_m ( )_m)_m ( )_m)_m ( )_m)_M$				VP		*	*	*			******
$(( )_m ( )_m ( )_m ( )_m)_M$			*	VP		*	*!				

Tableau 22

We turn to uniformly left-branching structure without relative clause construction. First, let us see the case for YK. YK showed the eurhythmic pattern for this construction as well.

(92) uniformly left-branching structure without relative clause construction

YK:



[$_{NP4}$ [$_{NP3}$ [$_{NP2}$ [$_{NP1}$ a’mano-no] [$_{N2}$ o’nsi-no]] [$_{N3}$ yo’ojo-no]] [$_{N4}$ namae]]

The constraint hierarchy (93) for YK properly generates an optimal output as shown in Tableau 23.

(93) constraint hierarchy for YK

MIRROR, BIN sMIP, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X’, L, UNIFORMITY, A CP, R (sMIP) & UNIF, *MAP >> ALIGN CP, R (sMIP), ALIGN sMIP, L, *MIP

Uniformly left-branching structure without relative clause construction for YK:

[$_{NP4}$ [$_{NP3}$ [$_{NP2}$ [$_{NP1}$ a’mano-no] [$_{N2}$ o’nsi-no]] [$_{N3}$ yo’ojo-no]] [$_{N4}$ namae]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X’, L	UNIFORMITY	A CP, R (sMIP) & UNIF	*MAP	ALIGN CP, R (sMIP)	ALIGN sMIP, L	*MIP
☞((( )$_m$ ( )$_m$)$_m$ (( )$_m$ ( )$_m$)$_m$)$_M$								*		*	******
(((( )$_m$ ( )$_m$)$_m$ ( )$_m$)$_m$ ( )$_m$)$_M$						*		*!			
(( )$_m$ ( )$_m$ ( )$_m$ ( )$_m$)$_M$			*					*!			

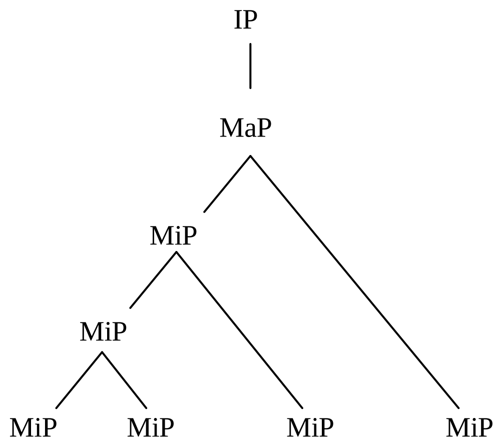
Tableau 23

As mentioned in the previous section, as for AM, I avoided showing prosodic representation for this construction for inconsistency.

We turn to the case for SK for this construction. SK yielded a gradually descending pitch pattern also for this construction.

(94) uniformly left-branching structure without relative clause construction

SK:



[$_{NP4}$ [$_{NP3}$ [$_{NP2}$ [$_{NP1}$ a’mano-no] [$_{N2}$ o’nsi-no]] [$_{N3}$ yo’ojo-no]] [$_{N4}$ namae]]

The constraint hierarchy (91) for SK cannot properly generate an optimal output as shown in Tableau 24.

Uniformly left-branching structure without relative clause construction for SK:

[$_{NP4}$ [$_{NP3}$ [$_{NP2}$ [$_{NP1}$ a’mano-no] [$_{N2}$ o’nsi-no]] [$_{N3}$ yo’ojo-no]] [$_{N4}$ namae]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X’, L	A CP, R (SMIP) & UNIF	*MAP	UNIFORMITY	ALIGN CP, R (SMIP)	ALIGN SMIP, L	*MIP
☞((( )$_m$ ( )$_m$)$_m$ (( )$_m$ ( )$_m$)$_m$)$_M$							*			*	******!
☞(((( )$_m$ ( )$_m$)$_m$ ( )$_m$)$_m$ ( )$_m$)$_M$							*	*			******
(( )$_m$ ( )$_m$ ( )$_m$ ( )$_m$)$_M$			*				*!				

Tableau 24

We can say that UNIFORMITY is lower than ALIGN SMIP, L in constraint hierarchy for SK as shown in (95).

(95) constraint hierarchy for SK

MIRROR, BIN SMIP, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X', L, A CP, R (SMIP) & UNIF, *MAP >> ALIGN CP, R (SMIP), ALIGN SMIP, L, *MIP >> UNIFORMITY

Based on this constraint hierarchy, an optimal output is properly generated as shown in Tableau 25.

Uniformly left-branching structure without relative clause construction for SK:

[$_{NP4}$ [$_{NP3}$ [$_{NP2}$ [$_{NP1}$ a'mano-no] [$_{N2}$ o'nsi-no]] [$_{N3}$ yo'ojo-no]] [$_{N4}$ namae]]

	MIRROR	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN X', L	A CP, R (SMIP) & UNIF	*MAP	ALIGN CP, R (SMIP)	ALIGN SMIP, L	*MIP	UNIFORMITY
$(((\ )_m\ (\ )_m\ )_m\ ((\ )_m\ (\ )_m\ )_m\ )_M$							*		*	******!	
☞$((((\ )_m\ (\ )_m\ )_m\ (\ )_m\ )_m\ (\ )_m\ )_M$							*			******	*
$((\ )_m\ (\ )_m\ (\ )_m\ (\ )_m\ )_M$			*				*!				

Tableau 25

4.5.2.2. Unaccented Sequences

From here we will discuss the cases for unaccented sequences, that is, Minor Phrasing. First, Selkirk and Tateishi (1988) propose the following three constraints (or conditions) on Minor

Phrasing.

(96) ACCENT CONDITION ON MINOR PHRASING

A Minor Phrase may contain at most one accented Prosodic Word.

(97) TERNARY BRANCHING CONDITION ON MINOR PHRASING (TERNARY for short)

A Minor Phrase may consist of at most three Prosodic Words.

(98) PERIPHERALITY CONSTRAINT ON MINOR PHRASING (PERIPHERALITY for short)

An unaccented Prosodic Word at the periphery of Major Phrase must be dominated by the same Minor Phrase as an adjacent unaccented Prosodic Word.

Since we discuss the case for unaccented sequences, ACCENT is inevitably observed here. Hence we consider it to be undominated and ignore it from now on. Likewise, for limitation of space in tableaux, MIRROR and ALIGN X', L are considered to be undominated and will be omitted from the discussion.

Selkirk et al. (2004) claim that word length has an effect on the number and distribution of Major and Minor Phrases. Specifically, they propose a constraint to the effect that 3-mora (or less) unaccented Minor Phrase is not allowed, which means that a 3-mora (or less) unaccented Prosodic Word is unlikely to stand on its own as a Minor Phrase.

(99) *(3μ)MIP

3-mora (or less) unaccented Minor Phrases are not allowed.

In addition, as a member of the family of constraints *STRUC, we need the following constraint.

(100) *PROSODIC WORD (*PWD for short)

Avoid Prosodic Words.

Since the number of the violations of this constraint is the same in what follows, we assume that it is undominated and ignore it from now on.[32]

Let us see uniformly left-branching structure with the antecedent in the third position. For this construction, all the speakers have the same default phrasing pattern, namely, the eurhythmic pattern. For the accented counterpart, we have assumed A CP, R (SMIP) & UNIF and ALIGN CP, R (SMIP). However, since the unaccented sequences in principle do not have the sMiP level, we need to postulate the following constraints.

(101) ALIGN CP, R (MIP)

The right edge of a CP must coincide with the right edge of a Minor Phrase.

(102) Local Conjunction of ALIGN CP, R (MIP) and UNIFORMITY (A CP, R (MIP) & UNIF for short)

The right edge of a CP must coincide with the right edge of a Minor Phrase with a string parsed into units of the same length.

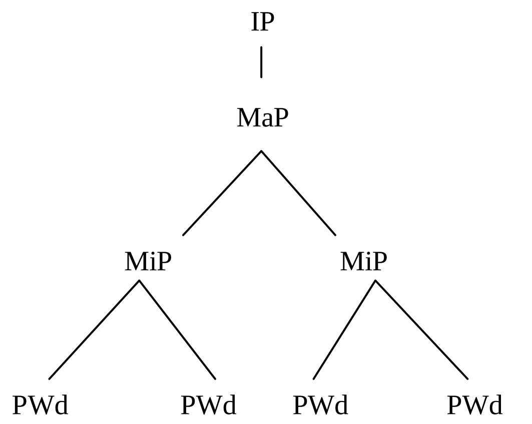
Note that the constraint (102) is also responsible for the visibility of empty elements to phonological component in Japanese. Assuming that these two constraints are undominated, let us proceed.

[32] We can assume that MAX((Prosodic)Word) and DEP((Prosodic)Word) are undominated to prohibit deletion and insertion of Words, respectively.

The prosodic representation for uniformly left-branching structure with the antecedent in the third position for all three speakers is as follows:

(103) uniformly left-branching structure with the antecedent in the third position

YK, AM, SK:



[$_{NP3}$ [$_{NP2}$ [$_{CP}$ [$_{NP1}$ ane-ga] [$_{VP}$ [ec$_i$] [$_V$ yon-da]]] [$_{N2}$ oi$_i$-no]] [$_{N3}$ ame]]

Now constraint hierarchy (93) for YK is changed into (104) with an assumption that TERNARY, PERIPHERALITY and *(3μ)MIP are also undominated at this stage.

(104) constraint hierarchy for YK

MIRROR, BIN SMIP, ACCENT, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X’, L, UNIFORMITY, A CP, R (SMIP) & UNIF, A CP, R (MIP) & UNIF, *MAP, TERNARY, PERIPHERALITY, *(3μ)MIP, *PWD, ALIGN CP, R (MIP) >> ALIGN CP, R (SMIP), ALIGN SMIP, L, *MIP

Based on this constraint hierarchy, an optimal output is properly generated as shown in the following tableau (“P” stands for Prosodic Word).

Uniformly left-branching structure with the antecedent in the third position for YK:

$[_{NP3}$ $[_{NP2}$ $[_{CP}$ $[_{NP1}$ ane-ga] $[_{VP}$ [ec$_i$] $[_V$ yon-da]]] $[_{N2}$ oi$_i$-no]] $[_{N3}$ ame]]

	WRAP XP	BIN MAP	ALIGN XP, L	UNIFORMITY	A CP, R (sMIP) & UNIF	A CP, R (MIP) & UNIF	*MAP	TERNARY	PERIPHERALITY	*(3μ) MIP	ALIGN CP, R (MIP)	ALIGN CP, R (sMIP)	ALIGN sMIP, L	*MIP
☞$((( )_P ( )_P)_m (( )_P ( )_P)_m)_M$			*		*		*					*		**
$(((( )_P)_m (( )_P)_m)_m ((( )_P)_m (( )_P)_m)_m)_M$			*				*		**!	****				
$(((( )_P ( )_P)_m ( )_P)_m ( )_P)_m)_M$		*	*	*	*!	*	*	*						
$((( )_P)_m (( )_P)_m (( )_P)_m (( )_P)_m)_M$		*	*		*		*!		**	****				
$((( )_P ( )_P ( )_P ( )_P)_m)_M$		*	*		*	*!	*	*			*			

Tableau 26

We turn to the case for AM. Now, the constraint hierarchy for AM is as follows:

(105) constraint hierarchy for AM

MIRROR, BIN sMIP, ACCENT, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X', L, ALIGN CP, R (sMIP), ALIGN CP, R (MIP), UNIFORMITY, A CP, R (sMIP) & UNIF, A CP, R (MIP) & UNIF, *MAP, TERNARY, PERIPHERALITY, *(3μ)MIP, *PWD >> ALIGN sMIP, L, *MIP

Based on this constraint hierarchy, an optimal output is properly generated as shown in Tableau 27.

Uniformly left-branching structure with the antecedent in the third position for AM:

[$_{NP3}$ [$_{NP2}$ [$_{CP}$ [$_{NP1}$ ane-ga] [$_{VP}$ [ec$_i$] [$_V$ yon-da]]] [$_{N2}$ oi$_i$-no]] [$_{N3}$ ame]]

	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN CP, R (SMIP)	ALIGN CP, R (MIP)	UNIFORMITY	A CP, R (SMIP) & UNIF	A CP, R (MIP) & UNIF	*MAP	TERNARY	PERIPHERALITY	*(3μ) MIP	ALIGN SMIP, L	*MIP
☞$((( )_P ( )_P)_m (( )_P ( )_P)_m)_M$			*	*			*		*					**
$(((( )_P)_m (( )_P)_m)_m ((( )_P)_m (( )_P)_m)_m)_M$			*						*		**	*!***	*	******
$(((( )_P ( )_P)_m ( )_P)_m ( )_P)_m)_M$		*	*	*	*	*!	*	*	*	*				
$((( )_P)_m (( )_P)_m (( )_P)_m (( )_P)_m)_M$		*	*	*			*		*!		**	****		
$((( )_P ( )_P ( )_P ( )_P)_m)_M$		*	*	*	*		*!	*	*	*				

Tableau 27

Next, let us see the case for SK. Until now, the constraint hierarchy for SK is as follows:

(106) constraint hierarchy for SK

MIRROR, BIN SMIP, ACCENT, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X’, L, A CP, R (SMIP) & UNIF, A CP, R (MIP) & UNIF, *MAP, TERNARY, PERIPHERALITY, *(3μ)MIP, *PWD, ALIGN CP, R (MIP) >> ALIGN CP, R (SMIP), ALIGN SMIP, L, *MIP >> UNIFORMITY

We can see that an optimal output is properly generated based on this constraint hierarchy as shown in Tableau 28.

Uniformly left-branching structure with the antecedent in the third position for SK:

[$_{NP3}$ [$_{NP2}$ [$_{CP}$ [$_{NP1}$ ane-ga] [$_{VP}$ [ec$_i$] [$_V$ yon-da]]] [$_{N2}$ oi$_i$-no]] [$_{N3}$ ame]]

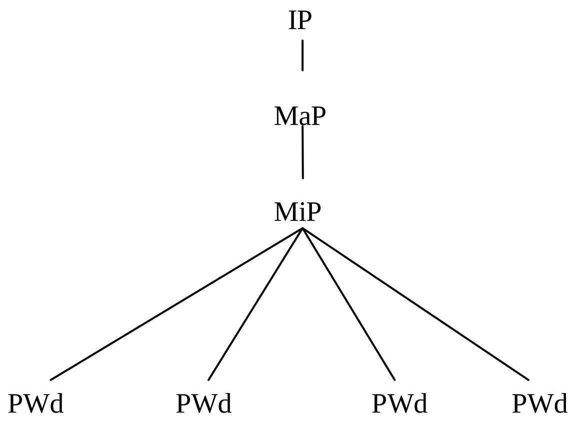
	WRAP XP	BIN MAP	ALIGN XP, L	A CP, R (SMIP)& UNIF	A CP, R (MIP) & UNIF	*MAP	TERNARY	PERIPHERALITY	*(3μ) MIP	ALIGN CP, R (MIP)	ALIGN CP, R (SMIP)	ALIGN SMIP, L	*MIP	UNIFORMITY
☞$((( )_P ( )_P)_m (( )_P ( )_P)_m)_M$			*	*		*					*		**	
$(((( )_P)_m (( )_P)_m)_m ((( )_P)_m (( )_P)_m)_m)_M$			*			*		**!	****					
$(((( )_P ( )_P)_m ( )_P)_m ( )_P)_m)_M$		*	*	*	*!	*	*							
$((( )_P)_m (( )_P)_m (( )_P)_m (( )_P)_m)_M$		*	*	*		*!		**	****					
$((( )_P ( )_P ( )_P ( )_P)_m)_M$		*	*	*	*!	*	*			*				

Tableau 28

Now we turn to uniformly left-branching structure with the antecedent in the fourth position. YK's default phrasing is the one in which no Initial Lowering is observed except for sentence-initial position as shown in (107).

(107) uniformly left-branching structure with the antecedent in the fourth position

YK:



[$_{NP3}$ [$_{CP}$ [$_{NP2}$ [$_{NP1}$ ue-no] [$_{N2}$ ane-ga]] [$_{VP}$ [ec$_i$] [$_V$ yon-da]]] [$_{N3}$ oi$_i$]]

Note that the constraint hierarchy in (104) for YK wrongly predicts an optimal output as shown in the following tableau.

Uniformly left-branching structure with the antecedent in the fourth position for YK:

[$_{NP3}$ [$_{CP}$ [$_{NP2}$ [$_{NP1}$ ue-no] [$_{N2}$ ane-ga]] [$_{VP}$ [ec$_i$] [$_V$ yon-da]]] [$_{N3}$ oi$_i$]]

	WRAP XP	BIN MAP	ALIGN XP, L	UNIFORMITY	A CP, R (sMIP) & UNIF	A CP, R (MIP) & UNIF	*MAP	TERNARY	PERIPHERALITY	*(3μ) MIP	ALIGN CP, R (MIP)	ALIGN CP, R (sMIP)	ALIGN sMIP, L	*MIP
☞$(((\,)_P\,(\,)_P\,)_m\,((\,)_P\,(\,)_P\,)_m\,)_M$			*		*	*	*				*	*		**
$((((\,)_P\,)_m\,((\,)_P\,)_m\,)_m\,(((\,)_P\,)_m\,((\,)_P\,)_m\,)_m\,)_M$			*		*		*		**	*!***				
$((((\,)_P\,(\,)_P\,)_m\,(\,)_P\,)_m\,(\,)_P\,)_m\,)_M$		*	*	*	*	*	*!	*			*			
$(((\,)_P\,(\,)_P\,(\,)_P\,)_m\,((\,)_P\,)_m\,)_M$		*	*	*	*	*	*!		*	*				
$(((\,)_P\,)_m\,((\,)_P\,)_m\,((\,)_P\,)_m\,((\,)_P\,)_m\,)_M$		*	*		*		*		**!	****				
$(((\,)_P\,(\,)_P\,(\,)_P\,(\,)_P\,)_m\,)_M$		*	*		*	*	*	*!			*			

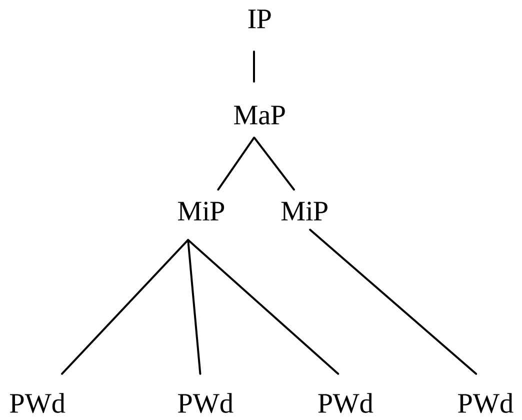
Tableau 29

It seems that the candidate at the bottom, the actual representation, does not win, no matter how the constraints given so far are ranked. As mentioned above, Selkirk et al. (2004) claim that word length has an effect on the number and distribution of Major and Minor Phrases. As they argue, it can be assumed that a sort of ‘lookahead’ effect might operate in such a way that the already-made Minor Phrase incorporates the 2-mora Prosodic Word incapable of standing alone as a Minor Phrase. In fact, she pronounced the sentence with a Minor Phrase boundary inserted before the antecedent twice out of eleven utterances. Taking into account the fact that YK strictly observes UNIFORMITY, it may be that she manages to observe UNIFORMITY in the middle of pronouncing the third Prosodic Word, resulting in the monophrasal pattern. We do not discuss it any further here.

Let us see the case for AM for this construction. She basically inserted a Minor Phrase boundary before the antecedent as shown in (108).

(108) uniformly left-branching structure with the antecedent in the fourth position

AM:



$[_{NP3}$ $[_{CP}$ $[_{NP2}$ $[_{NP1}$ ue-no] $[_{N2}$ ane-ga]] $[_{VP}$ $[ec_i]$ $[_{V}$ yon-da]]] $[_{N3}$ $oi_i]]$

The constraint hierarchy in (105) for AM wrongly predicts an optimal output as shown in Tableau 30.

Uniformly left-branching structure with the antecedent in the fourth position for AM:

[$_{\text{NP3}}$ [$_{\text{CP}}$ [$_{\text{NP2}}$ [$_{\text{NP1}}$ ue-no] [$_{\text{N2}}$ ane-ga]] [$_{\text{VP}}$ [ec$_{\text{i}}$] [$_{\text{V}}$ yon-da]]] [$_{\text{N3}}$ oi$_{\text{i}}$]]

	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN CP, R (SMIP)	ALIGN CP, R (MIP)	UNIFORMITY	A CP, R (SMIP) & UNIF	A CP, R (MIP) & UNIF	*MAP	TERNARY	PERIPHERALITY	*(3μ) MIP	ALIGN SMIP, L	*MIP
☞((( )$_{P}$ ( )$_{P}$)$_{m}$ (( )$_{P}$ ( )$_{P}$)$_{m}$)$_{M}$			*	*	*		*	*	*					**
(((( )$_{P}$)$_{m}$ (( )$_{P}$)$_{m}$)$_{m}$ ((( )$_{P}$)$_{m}$ (( )$_{P}$)$_{m}$)$_{m}$)$_{M}$			*	*			*		*		**	*!***		
(((( )$_{P}$ ( )$_{P}$)$_{m}$ ( )$_{P}$)$_{m}$ ( )$_{P}$)$_{m}$)$_{M}$		*	*		*	*	*	*	*!	*				
((( )$_{P}$ ( )$_{P}$ ( )$_{P}$)$_{m}$ (( )$_{P}$)$_{m}$)$_{M}$			*	*		*	*	*	*		*!	*		
((( )$_{P}$)$_{m}$ (( )$_{P}$)$_{m}$ (( )$_{P}$)$_{m}$ (( )$_{P}$)$_{m}$)$_{M}$		*	*	*			*		*		**!	****		
((( )$_{P}$ ( )$_{P}$ ( )$_{P}$ ( )$_{P}$)$_{m}$)$_{M}$		*	*	*	*		*	*	*!	*				

Tableau 30

For the fourth candidate from the top to win, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN CP, R (MIP) and *MAP are to be undominated on top of MIRROR, BIN SMIP, ACCENT, ALIGN X’, L and *PWD, which is still compatible with the results so far for AM. The constraint hierarchy in (105) is changed into (109).

(109) constraint hierarchy for AM

MIRROR, BIN sMIP, ACCENT, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X', L, ALIGN CP, R (MIP), *MAP, *PWD >> ALIGN CP, R (sMIP), UNIFORMITY, A CP, R (sMIP) & UNIF, A CP, R (MIP) & UNIF, TERNARY, PERIPHERALITY, *(3μ)MIP >> ALIGN sMIP, L, *MIP

We can see that an optimal output is properly generated based on this constraint hierarchy as shown in Tableau 31.

Uniformly left-branching structure with the antecedent in the fourth position for AM:

[$_{NP3}$ [$_{CP}$ [$_{NP2}$ [$_{NP1}$ ue-no] [$_{N2}$ ane-ga]] [$_{VP}$ [ec$_i$] [$_V$ yon-da]]] [$_{N3}$ oi$_i$]]

	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN CP, R (MIP)	*MAP	ALIGN CP, R (SMIP)	*(3μ) MIP
$((( )_P ( )_P)_m (( )_P ( )_P)_m)_M$			*	*	*!		
$(((( )_P)_m (( )_P)_m)_m ((( )_P)_m (( )_P)_m)_m)_M$			*		*	*	****
$(((( )_P ( )_P)_m ( )_P)_m ( )_P)_m)_M$		*	*	*!	*		
☞$((( )_P ( )_P ( )_P)_m (( )_P)_m)_M$			*		*	*	*
$((( )_P)_m (( )_P)_m (( )_P)_m (( )_P)_m)_M$		*	*		*!		
$((( )_P ( )_P ( )_P ( )_P)_m)_M$		*	*	*!	*		

	UNIFORMITY	A CP, R (SMIP) & UNIF	A CP, R (MIP) & UNIF	TERNARY	PERIPHERALITY	ALIGN SMIP, L	*MIP
$((( )_P ( )_P)_m (( )_P ( )_P)_m)_M$							
$(((( )_P)_m (( )_P)_m)_m ((( )_P)_m (( )_P)_m)_m)_M$		*			*!*	*	******
$(((( )_P ( )_P)_m ( )_P)_m ( )_P)_m)_M$							
☞$((( )_P ( )_P ( )_P)_m (( )_P)_m)_M$	*	*	*		*		**
$((( )_P)_m (( )_P)_m (( )_P)_m (( )_P)_m)_M$							
$((( )_P ( )_P ( )_P ( )_P)_m)_M$							

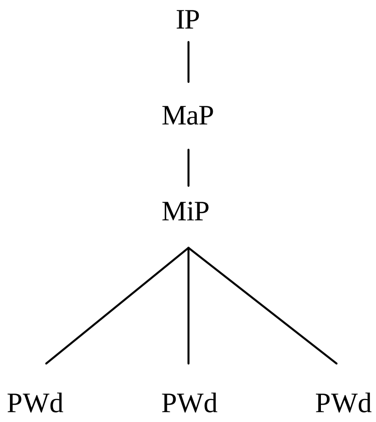
Tableau 31

As mentioned above, SK showed no less than six phrasing patterns and does not seem to have default phrasing for this construction. Hence we do not discuss it any further here.

Now let us see left-branching structure made up of three Prosodic Words with relative clause construction. YK consistently showed the monophrasal pattern for this construction as in (110).

(110) left-branching structure made up of three Prosodic Words with relative clause construction

YK:



[$_{NP2}$ [$_{CP}$ [$_{NP1}$ oi-ga] [$_{VP}$ [ec$_i$] [$_{V}$ mon-da]]] [$_{N2}$ momo$_i$]]

The constraint hierarchy in (104) for YK wrongly predicts an optimal output as shown in the following tableau.

Left-branching structure made up of three Prosodic Words with relative clause construction for YK:

$[_{NP2}\ [_{CP}\ [_{NP1}$ oi-ga] $[_{VP}$ [ec$_i$] $[_V$ mon-da]] $[_{N2}$ momo$_i$]]]

	WRAP XP	BIN MAP	ALIGN XP, L	UNIFORMITY	A CP, R (sMIP) & UNIF	A CP, R (MIP) & UNIF	*MAP	TERNARY	PERIPHERALITY	*(3μ) MIP	ALIGN CP, R (MIP)	ALIGN CP, R (sMIP)	ALIGN sMIP, L	*MIP
$((()_P\ ()_P\ ()_P)_m)_M$		*	*		*	*	*!				*	*		*
$(((((\ )_P)_m\ ((\ )_P)_m)_m\ ((\ )_P)_m)_M$			*			*	*		**!	***				
☞ $((((\ )_P\ (\ )_P)_m\ (\ )_P)_m)_M$		*	*		*		*							
$(((\ )_P\ (\ )_P)_m\ ((\ )_P)_m)_M$			*	*	*	*	*!		*	*				
$(((\ )_P)_m\ ((\ )_P)_m\ ((\ )_P)_m)_M$		*	*		*		*		*!*	***				

Tableau 32

For the top candidate, the actual representation, to win, ALIGN CP, R (MIP) & UNIF, ALIGN CP, R (sMIP), ALIGN CP, R (MIP) and ALIGN sMIP, L are to be the lowest in the constraint hierarchy as in (111), which is still compatible with the results so far for YK.

(111) constraint hierarchy for YK

MIRROR, BIN sMIP, ACCENT, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X', L, UNIFORMITY, A CP, R (sMIP) & UNIF, *MAP, TERNARY, PERIPHERALITY, *(3μ)MIP, *PWD >> *MIP >> A CP, R (MIP) & UNIF, ALIGN CP, R (sMIP), ALIGN CP, R (MIP), ALIGN sMIP, L

Based on this constraint hierarchy, an optimal output is properly generated as shown in the following tableau.

Left-branching structure made up of three Prosodic Words with relative clause construction for YK:

[$_{NP2}$ [$_{CP}$ [$_{NP1}$ oi-ga] [$_{VP}$ [ec$_i$] [$_V$ mon-da]] [$_{N2}$ momo$_i$]]]

	WRAP XP	BIN MAP	ALIGN XP, L	UNIFORMITY	A CP, R (sMIP) & UNIF	*MAP	TERNARY
☞ $(((\,)_P(\,)_P(\,)_P)_m)_M$		*	*		*	*	
$(((((\,)_P)_m((\,)_P)_m)_m((\,)_P)_m)_M$			*			*	
$((((\,)_P(\,)_P)_m(\,)_P)_m)_M$		*	*		*	*	
$(((\,)_P(\,)_P)_m((\,)_P)_m)_M$			*	*	*	*	
$(((\,)_P)_m((\,)_P)_m((\,)_P)_m)_M$		*	*		*	*	

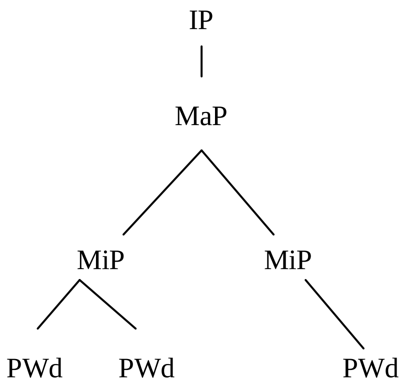
	PERIPHERALITY	*(3μ) MIP	*MIP	ALIGN CP, R (sMIP)	ALIGN CP, R (MIP)	ALIGN sMIP, L	A CP, R (MIP) & UNIF
☞ $(((\,)_P(\,)_P(\,)_P)_m)_M$			*	*	*		*
$(((((\,)_P)_m((\,)_P)_m)_m((\,)_P)_m)_M$	**	*!**					
$((((\,)_P(\,)_P)_m(\,)_P)_m)_M$			**!				
$(((\,)_P(\,)_P)_m((\,)_P)_m)_M$	*!	*					
$(((\,)_P)_m((\,)_P)_m((\,)_P)_m)_M$	*!*	***					

Tableau 33

We turn to the case for AM. AM basically inserted a Minor Phrase boundary before the antecedent as the representation in (112) shows.

(112) left-branching structure made up of three Prosodic Words with relative clause construction

AM:



[$_{NP2}$ [$_{CP}$ [$_{NP1}$ oi-ga] [$_{VP}$ [ec$_{i}$] [$_{V}$ mon-da]]] [$_{N2}$ momo$_{i}$]]

The constraint hierarchy in (109) for AM wrongly predicts an optimal output as shown in the following tableau.

Left-branching structure made up of three Prosodic Words with relative clause construction for AM:

$[_{NP2}$ $[_{CP}$ $[_{NP1}$ oi-ga] $[_{VP}$ $[ec_i]$ $[_{V}$ mon-da]]] $[_{N2}$ $momo_i]]$

	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN CP, R (MIP)	*MAP	ALIGN CP, R (SMIP)	*(3μ) MIP	UNIFORMITY	A CP, R (sMIP) & UNIF	A CP, R (MIP) & UNIF	TERNARY	PERIPHERALITY	ALIGN sMIP, L	*MIP
$((( )_P ( )_P ( )_P)_m)_M$		*	*	*!	*									
☞ $((((( )_P)_m (( )_P)_m)_m (( )_P)_m)_M$			*		*		***					**	*	******
$(((( )_P ( )_P)_m ( )_P)_m)_M$		*	*		*!									
$((( )_P ( )_P)_m (( )_P)_m)_M$			*		*	*	*	*	*	*		*!		
$((( )_P)_m (( )_P)_m (( )_P)_m)_M$		*	*		*!									

Tableau 34

For the fourth candidate from the top to win, PERIPHERALITY stands alone in the second highest position in constraint hierarchy for AM, which is still compatible with the results so far for her. The hierarchy (109) is changed into (113).

(113) constraint hierarchy for AM

MIRROR, BIN SMIP, ACCENT, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X', L, ALIGN CP, R (MIP), *MAP, *PWD >> PERIPHERALITY >> ALIGN CP, R (SMIP), UNIFORMITY, A CP, R (SMIP) & UNIF, A CP, R (MIP) & UNIF, TERNARY, *(3μ)MIP >> ALIGN SMIP, L, *MIP

We can see that an optimal output is properly generated based on this constraint hierarchy as shown in the following tableau.

Left-branching structure made up of three Prosodic Words with relative clause construction for AM: $[_{NP2}\ [_{CP}\ [_{NP1}$ oi-ga] $[_{VP}$ [ec$_i$] $[_{V}$ mon-da]]] $[_{N2}$ momo$_i$]]

	WRAP XP	BIN MAP	ALIGN XP, L	ALIGN CP, R (MIP)	*MAP	PERIPHERALITY	ALIGN CP, R (SMIP)
$((( )_P ( )_P ( )_P)_m)_M$		*	*	*!	*		
$((((( )_P)_m (( )_P)_m)_m (( )_P)_m)_M$			*		*	**!	
$(((( )_P ( )_P)_m ( )_P)_m)_M$		*	*		*!		
☞ $((( )_P ( )_P)_m (( )_P)_m)_M$			*		*	*	*
$((( )_P)_m (( )_P)_m (( )_P)_m)_M$		*	*		*!		

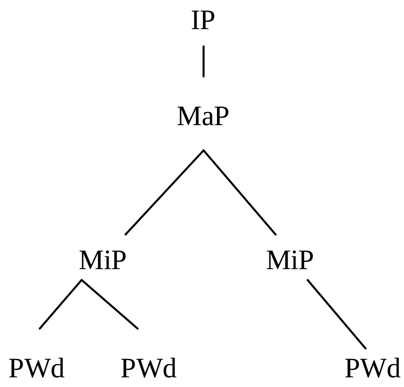
	*(3μ) MIP	UNIFORMITY	A CP, R (SMIP) & UNIF	A CP, R (MIP) & UNIF	TERNARY	ALIGN SMIP, L	*MIP
$((( )_P ( )_P ( )_P)_m)_M$							
$((((( )_P)_m (( )_P)_m)_m (( )_P)_m)_M$							
$(((( )_P ( )_P)_m ( )_P)_m)_M$							
☞ $((( )_P ( )_P)_m (( )_P)_m)_M$	*	*	*	*			**
$((( )_P)_m (( )_P)_m (( )_P)_m)_M$							

Tableau 35

Let us see the case for SK. He basically inserted a Minor Phrase boundary before the antecedent as with AM, as shown in (114).

(114) left-branching structure made up of three Prosodic Words with relative clause construction

SK:



[$_{NP2}$ [$_{CP}$ [$_{NP1}$ oi-ga] [$_{VP}$ [ec$_i$] [$_V$ mon-da]]] [$_{N2}$ momo$_i$]]

The constraint hierarchy in (106) for SK wrongly predicts an optimal output as shown in Tableau 36.

Left-branching structure made up of three Prosodic Words with relative clause construction for SK:

[$_{NP2}$ [$_{CP}$ [$_{NP1}$ oi-ga] [$_{VP}$ [ec$_i$] [$_V$ mon-da]]] [$_{N2}$ momo$_i$]]

	Wrap XP	Bin MaP	Align XP, L	A CP, R (sMiP) & Unif	A CP, R (MiP) & Unif	*MaP	Ternary	Peripherality	*(3μ) MiP	Align CP, R (MiP)	Align CP, R (sMiP)	Align sMiP, L	*MiP	Uniformity
☞ $((( )_P ( )_P ( )_P)_m)_M$		*	*	*	*	*				*!	*		*	
$((((( )_P)_m (( )_P)_m)_m (( )_P)_m)_M$			*			*		**	**!*					
$(((( )_P ( )_P)_m ( )_P)_m)_M$		*	*	*	*	*					*		**!	
$((( )_P ( )_P)_m (( )_P)_m)_M$			*	*	*	*		*	*!					
$((( )_P)_m (( )_P)_m (( )_P)_m)_M$		*	*	*	*	*		*!*	***					

Tableau 36

For the fourth candidate from the top to win, Wrap XP, Bin MaP, Align XP, L, *MaP and Align CP, R (MiP) are to be undominated on top of Mirror, Bin sMiP, Accent, Align X’, L and *PwD, which is still compatible with the results so far for SK. The constraint hierarchy (106) is changed into (115).

(115) constraint hierarchy for SK

Mirror, Bin sMiP, Accent, Wrap XP, Bin MaP, Align XP, L, Align X’, L, *MaP, Align CP, R (MiP), *PwD >> A CP, R (sMiP) & Unif, A CP, R (MiP) & Unif, Ternary, Peripherality, *(3μ)MiP >> Align CP, R (sMiP), Align sMiP, L, *MiP >> Uniformity

Based on this constraint hierarchy, an optimal output is properly generated as shown in the following tableau.

Left-branching structure made up of three Prosodic Words with relative clause construction for SK:

[$_{NP2}$ [$_{CP}$ [$_{NP1}$ oi-ga] [$_{VP}$ [ec$_i$] [$_V$ mon-da]]] [$_{N2}$ momo$_i$]]

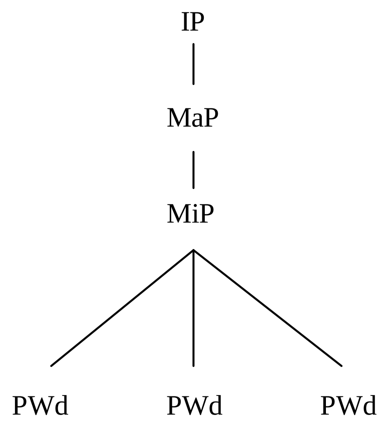
	Wrap XP	Bin MaP	Align XP, L	*MaP	Align CP, R (MiP)	A CP, R (MiP) & Unif	A CP, R (sMiP) & Unif	Ternary	Peripherality	*(3μ) MiP	Align CP, R (sMiP)	Align sMiP, L	*MiP	Uniformity
$((( )_P ( )_P ( )_P)_m)_M$		*	*	*!	*									
$((((( )_P)_m (( )_P)_m)_m (( )_P)_m)_M$			*	*					**	***!				
$(((( )_P ( )_P)_m ( )_P)_m)_M$		*	*	*!										
☞ $((( )_P ( )_P)_m (( )_P)_m)_M$			*	*		*	*		*	*	*		**	*
$((( )_P)_m (( )_P)_m (( )_P)_m)_M$		*	*	*!										

Tableau 37

Lastly, let us see left-branching structure made up of three Prosodic Words without relative clause construction. YK consistently showed the monophrasal pattern for this construction too as in (116).

(116) left-branching structure made up of three Prosodic Words without relative clause construction

YK:



[$_{NP3}$ [$_{NP2}$ [$_{NP1}$ oi-no] [$_{N2}$ yome-no]] [$_{N3}$ momo]]

The constraint hierarchy in (111) for YK properly generates an optimal output as shown in the following tableau.

Left-branching structure made up of three Prosodic Words without relative clause construction for YK:

$[_{NP3}$ $[_{NP2}$ $[_{NP1}$ oi-no] $[_{N2}$ yome-no]] $[_{N3}$ momo]]

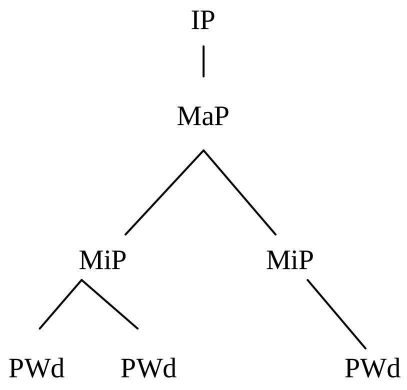
	WRAP XP	BIN MAP	ALIGN XP, L	UNIFORMITY	A CP, R (SMIP) & UNIF	*MAP	TERNARY	PERIPHERALITY	*(3μ) MIP	*MIP	ALIGN CP, R (SMIP)	ALIGN CP, R (MIP)	ALIGN SMIP, L	A CP, R (MIP) & UNIF
☞ $(((\ )_P\ (\ )_P\ (\ )_P\ )_m\ )_M$		*				*				*				
$(((((\ )_P\ )_m\ ((\ )_P\ )_m\ )_m\ ((\ )_P\ )_m\ )_M$						*		**!	***					
$((((\ )_P\ (\ )_P\ )_m\ (\ )_P\ )_m\ )_M$		*				*				**!				
$(((\ )_P\ (\ )_P\ )_m\ ((\ )_P\ )_m\ )_M$				*		*		*!	*					
$(((\ )_P\ )_m\ ((\ )_P\ )_m\ ((\ )_P\ )_m\ )_M$		*				*		*!*	***					

Tableau 38

We turn to the case for AM. AM basically inserted a Minor Phrase boundary before the third Prosodic Word also here as the representation in (117) shows.

(117) left-branching structure made up of three Prosodic Words without relative clause construction

AM:



[$_{NP3}$ [$_{NP2}$ [$_{NP1}$ oi-no] [$_{N2}$ yome-no]] [$_{N3}$ momo]]

Based on the constraint hierarchy in (113) for AM, an optimal output is properly generated as shown in the following tableau.

Left-branching structure made up of three Prosodic Words without relative clause construction for AM:

$[_{NP3}$ $[_{NP2}$ $[_{NP1}$ oi-no] $[_{N2}$ yome-no]] $[_{N3}$ momo]]

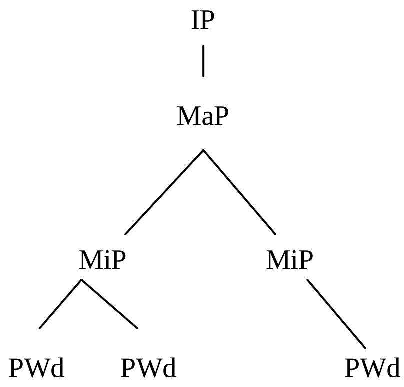
	Wrap XP	Bin MaP	Align XP, L	Align CP, R (MiP)	*MaP	Peripherality	Align CP, R (sMiP)	*(3μ) MiP	Uniformity	A CP, R (sMiP) & Unif	A CP, R (MiP) & Unif	Ternary	Align sMiP, L	*MiP
$((( )_P ( )_P ( )_P)_m)_M$		*			*!									
$((((( )_P)_m (( )_P)_m)_m (( )_P)_m)_M$					*	**!								
$(((( )_P ( )_P)_m ( )_P)_m)_M$		*			*!									
☞ $((( )_P ( )_P)_m (( )_P)_m)_M$					*	*		*	*					**
$((( )_P)_m (( )_P)_m (( )_P)_m)_M$		*			*!									

Tableau 39

We turn to the case for SK. He basically inserted a Minor Phrase boundary before the third Prosodic Word as with AM, as shown in (118).

(118) left-branching structure made up of three Prosodic Words without relative clause construction

SK:



[$_{NP3}$ [$_{NP2}$ [$_{NP1}$ oi-no] [$_{N2}$ yome-no]] [$_{N3}$ momo]]

We can see that an optimal output is properly generated based on the constraint hierarchy in (115) for SK as shown in the following tableau.

Left-branching structure made up of three Prosodic Words without relative clause construction for SK:

[$_{NP3}$ [$_{NP2}$ [$_{NP1}$ oi-no] [$_{N2}$ yome-no]] [$_{N3}$ momo]]

	WRAP XP	BIN MAP	ALIGN XP, L	*MAP	ALIGN CP, R (MIP)	A CP, R (MIP) & UNIF	A CP, R (SMIP)& UNIF	TERNARY	PERIPHERALITY	*(3μ) MIP	ALIGN CP, R (SMIP)	ALIGN SMIP, L	*MIP	UNIFORMITY
$((( )_P ( )_P ( )_P)_m)_M$		*		*!										
$((((( )_P)_m (( )_P)_m)_m (( )_P)_m)_M$				*					**	*!**				
$(((( )_P ( )_P)_m ( )_P)_m)_M$		*		*!										
☞ $((( )_P ( )_P)_m (( )_P)_m)_M$				*					*	*			**	*
$((( )_P)_m (( )_P)_m (( )_P)_m)_M$		*		*!										

Tableau 40

The final constraint hierarchy for each speaker is as follows:[33]

(119) constraint hierarchy for YK (final version)

MIRROR, BIN SMIP, ACCENT, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X', L, UNIFORMITY, A CP, R (SMIP) & UNIF, *MAP, TERNARY, PERIPHERALITY, *(3μ)MIP, *PWD >> *MIP >> A CP, R (MIP) & UNIF, ALIGN CP, R (SMIP), ALIGN CP, R (MIP), ALIGN SMIP, L

[33] Interestingly, these constraint hierarchies properly generate optimal outputs even if the subjects are not omitted from the discussion. That is to say, it follows that a subject normally stands on its own as a Major Phrase in a declarative sentence.

(120) constraint hierarchy for AM (final version)

MIRROR, BIN sMIP, ACCENT, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X’, L, ALIGN CP, R (MIP), *MAP, *PWD >> PERIPHERALITY >> ALIGN CP, R (SMIP), UNIFORMITY, A CP, R (SMIP) & UNIF, A CP, R (MIP) & UNIF, TERNARY, *(3μ)MIP >> ALIGN SMIP, L, *MIP

(121) constraint hierarchy for SK (final version)

MIRROR, BIN sMIP, ACCENT, WRAP XP, BIN MAP, ALIGN XP, L, ALIGN X’, L, *MAP, ALIGN CP, R (MIP), *PWD >> A CP, R (SMIP) & UNIF, A CP, R (MIP) & UNIF, TERNARY, PERIPHERALITY, *(3μ)MIP >> ALIGN CP, R (SMIP), ALIGN SMIP, L, *MIP >> UNIFORMITY

In Chapter 1, I mentioned that two main derivational approaches to Phonological Phrasing, that is, end-based approach and relation-based approach, each have disadvantages. Here we can compensate for those disadvantages through constraint interaction. Moreover, we have seen that OT approach can deal with inter-speaker variations. It is, of course, desirable that constraints be ranked in light of factorial typology. For limited data, however, such an approach could not be taken here. It may be that the combination of accented words and unaccented words makes it possible to take such an approach to Phonological Phrasing. I leave this issue for future research.

Note here that MIRROR is responsible for the visibility of syntactic movement or empty traces to phonological component in Japanese as mentioned above. A plausible explanation is that MIRROR is not undominated, which causes the equivalent of Scrambling Boost not to apply in other languages. Also remember that ALIGN CP, R (SMIP) triggers Antecedent Boost and that ALIGN CP, R (SMIP) & UNIFORMITY, and ALIGN CP, R (MIP) & UNIFORMITY are also responsible for the visibility of empty elements in (superordinate) Minor Phrasing to phonological component in Japanese. It may be that ALIGN CP, R (SMIP), ALIGN CP, R (SMIP) & UNIFORMITY and ALIGN CP, R (MIP) &

UNIFORMITY are so low ranked that the effects of the equivalent of Antecedent Boost and the equivalents of uniform superordinate Minor Phrasing and uniform Minor Phrasing do not occur, respectively, in other languages.

Through the discussion so far, we have been able to derive the actual prosodic representations from the interaction of constraints, which leads to producing the surface pitch contours. In the last chapter, we will discuss how we should deal with the problem with visibility of empty elements in detail as a concluding remark.

Chapter 5: The Theoretical Implications and Concluding Remarks

Until now, we have seen that scrambling, a kind of movement operation, must be visible to phonological component in Japanese under the movement analysis of scrambling. In addition, we observed that internal structure of relative clause construction also must be visible to phonology on a given condition. In this chapter, we will first discuss whether or not non-movement analysis of scrambling, namely, base-generation approach, can be taken in order to evade the problem with visibility of movement operation or empty elements to phonological component. The reason is that since the advent of Generative Grammar, it has been basically regarded as a matter of course that phonological component cannot refer to core syntactic operation, movement, for autonomy of components in that model except for specific phenomena such as *wanna*-contraction. Among those are Selkirk (1984), Nespor and Scorretti (1984), Nespor and Vogel (1986), Hayes (1990), Nespor (1990) and Truckenbrodt (1999).

In the first section, we will discuss the two representative base-generation approaches to scrambling, Tonoike (1997) and Neeleman and Reinhart (1998) and point out problems with their analyses.

5.1. Base-Generation Approaches to Scrambling

5.1.1. Tonoike (1997)

Tonoike (1997) argues that there are three problems with movement approach to scrambling, in favor of base-generation approach. The first is “why languages like Japanese, Korean, and Hindi exhibit Scrambling while other languages like English do not”, which he calls ‘typology problem’. As for typology problem, Neeleman and Reinhart (1998) give a straightforward explanation that there is a strong correlation between word order and availability of scrambling such that SOV languages generally allow scrambling, whereas SVO languages do not. Tonoike (1997) assumes that the 'scrambled' constituent is base-generated as an adjunct in an IP (or a VP) adjoined position and it binds a zero pronoun '*pro*' in the 'original' position in conjunction with availability of *pro* in languages in such a way that those languages which allow *pro* in *all* argument positions like Japanese, Korean and Hindi have an option of base-generated adjunct, whereas those which do not generally allow *pro* such as English do not have such an option, which is crucial for his theory. Then, how about, for example, German and Dutch? Although these languages allow *pro* in more restricted contexts than in Japanese, they do have scrambling. It seems that Tonoike's (1997) *pro* approach has obvious drawbacks already at this point.

The second point which Tonoike (1997) makes is "what motivates the movement of a scrambled phrase", which he calls 'motivation problem'. He argues that in Chomsky's (1992) Minimalist framework, all movements are morphologically driven such that an element can move only to have its morphological shape checked by a hosting element. The examples are as follows (Tonoike (1997: 125)):

(1) a. [John-ga *Mary-o* nagut-ta]

John-Nom Mary-Acc hit-past

'John hit Mary.'

b. [*Mary-o*$_i$ [John-ga t_i nagut-ta]]

Mary-Acc John-Nom hit-Past

According to Tonoike (1997), it does not seem that the accusative NP *Mary(-o)* has any morphologically identifiable shape that has to be checked by a higher element.

Later, however, Chomsky (2000) slightly modifies the idea and proposes that what causes movement is uniform throughout the grammar, that is, EPP (Extended Projection Principle)-driven. In line with Chomsky (2000), Miyagawa (2005) claims that T in Japanese is associated with the EPP. The structures in (1) are changed into (2) according to Miyagawa's (2005) analysis.

(2) a. $[_{TP}$ John-ga$_i$ $[_{vP}$ t_i *Mary-o* nagut-ta]]

b. $[_{TP}$ *Mary-o*$_i$ $[_{vP}$ John-ga t_i nagut-ta]]

He argues that EPP requirement is satisfied by moving the subject as in (2a), or the object as in (2b) and concludes that this type of movement is motivated by the EPP, so that the movement is not optional. I also point out that in the scrambled sentence (2b), the subject NP *John(-ga)* is subject to what I call 'Scrambling Boost', which causes (2b) to be somewhat less easily interpreted in a neutral context than (2a) is, or the subject *John-ga* to be focused in (2b).

The third point which Tonoike (1997) makes is that if scrambling causes the effect that can be undone at LF ('radical reconstruction' in Saito's (1989) terminology), the principle of economy of derivation rules out all derivations where scrambling is undone at LF, which he calls 'economy problem'. Saito's (1989) original argument is that scrambling is not only purely optional, but it must obligatorily reconstruct at LF, which regards scrambling as a semantically vacuous operation. As an example of radical reconstruction, Saito (1989) gives the following pair of sentences.

(3) a. John-ga $[_{WH\text{-}ISLAND}$ Taroo-ga nani-o kat-ta ka] siritagatteiru.

John-Nom Taro-Nom what-Acc buy-Past Q want-to-know

'John wants to know what Taro bought.'

b. ? Nani-o$_i$ John-ga [$_{WH\text{-}ISLAND}$ Taroo-ga t_i kat-ta ka] siritagatteiru.

what-Acc John-Nom Taro-Nom t_i buy-Past Q want-to-know

In the scrambled sentence (3b), the wh-phrase *nani* ‘what’ is scrambled to the head of the matrix clause. Note that this sentence is still a declarative sentence, not a direct question. Hence the wh-phrase has to be interpreted inside the subordinate clause in spite of its surface position outside the subordinate clause as in (3a). Therefore, the wh-phrase in (3b) undergoes radical reconstruction according to Saito (1989). Contrary to his claim, Miyagawa (2006) argues that the meaning of the sentences in (3) is not totally the same in line with Pesetsky’s (1987) notion of ‘D(iscourse)-linking’ to the effect that in certain wh-constructions the D-linked ‘which N’ elements tend to behave differently from bare wh-items in such a way that they presuppose a prominent set of objects or people in the discourse context from which the hearer is asked to select. Miyagawa (2006) points out that the wh-phrase *nani* in (3b) is D-linked but that in (3a) is not, which makes the two sentences different in meaning, and concludes that radical reconstruction does not occur in (3b) with a general suggestion that optional movement such as scrambling must be motivated in terms of effect on the output. This argument rejects ‘economy problem’.

Throughout the discussion so far, it is clear that Tonoike’s (1997) base-generation approach to scrambling is inadequate. Then we will turn to the other approach by Neeleman and Reinhart (1998).

5.1.2. Neeleman and Reinhart (1998)

Unlike Tonoike (1997), who assumes base-generation approach to scrambling with the device of *pro*, Neeleman and Reinhart (1998) claim that across languages that have scrambling, both the normal word order and the scrambled word order are base-generated by the basic flexibility of the computational system, that is, flexible merge operation. They argue that word order variation across languages is mainly based on case checking, which can take place either in prosodic or in syntactic domains, and that in SVO languages, which do not allow scrambled word order, less costly prosodic checking can and must take place if the object follows the verb, whereas in SOV languages, which allow scrambled word order, prosodic checking is impossible, and the system must resort to the more costly syntactic checking, with the assumption that taking into consideration that the derivation tries to reach the articulatory system as soon as possible, prosodic checking is preferred to syntactic checking. In their theory, prosodic checking means that a verb may enter into a checking relation with a constituent, if and only if the verb precedes the constituent and they are contained in the same Phonological Phrase, which is derived by reference to the right end of XP in line with Selkirk's (1986) original end-based theory. On the other hand, syntactic checking means that a verb may enter into a checking relation with a constituent, if and only if the verb follows the constituent and they mutually m-command each other.[34] For example, in English case checking always takes place in prosodic domains as in (4) (their (29)), where curly brackets indicate Phonological Phrase boundaries.

(4) a. [[A friend of [Mary's]] [gave [a book][to [Sue]]]]

b. {A friend of Mary's} {gave a book} {to Sue}

In (4b), the object is in the same Phonological Phrase as the verb. Since the verb can check its features in this domain, the object's features are also checked (although they say nothing about the cases for the subject and the complement of the preposition). Then, as an example of an SOV language, consider the Dutch case they argue (their (33)).

[34] Note that they do not assume mutual c-command relation but mutual m-command relation in order to broaden syntactic checking domains.

(5) a. [Dat [Jan] [[het boek] las]]

b. {Dat Jan} {het boek} {las}

'that John the book read (that John read the book)'

Their argument is that since the verb is contained solely in a Phonological Phrase, their features cannot be checked in the prosodic domain, and hence the system must resort to the more costly syntactic domain. Here I point out that they arbitrarily assume that in Dutch, Phonological Phrase is derived by reference to the *right* edge of XP. As far as I know, there has been no report that the right edge of XP corresponds to the right edge of Phonological Phrase in Dutch. According to Tokizaki (1999), there seems to be a correlation between the syntactic head parameter and the phonological edge parameter in such a way that head-initial languages such as Chimwi:ni have right edge as the parameter value, while head-final languages such as Japanese have left as the value. Tokizaki (1999) gives the following lists of languages.

(6) Right edges of lexically headed XPs (head-initial languages):

Chimwi:ni (Kisseberth and Abasheikh (1974), Selkirk (1986))

Kimatuumbi (Odden (1987))

Xiamen (Chen (1987))

(7) Left edges of lexically headed XPs (head-final languages):

Ewe (Clements (1978))

Japanese (Selkirk and Tateishi (1991))

Korean (Cho (1990))

Northern Kyungsang Korean (Kenstowicz and Sohn (1996))

Shanghai Chinese (Selkirk and Shen (1990))

Therefore, if Dutch, an SOV language, has left edge as the parameter value, the Phonological Phrasing in (5b) is changed into (8).

(8) {Dat} {Jan} {het boek las}

In (8), the object is in the same Phonological Phrase as the verb, and hence prosodic checking turns out to be possible at least for the sentence. This is the first problem with their analysis.

The second problem arises when the verb is focused in English sentence (4). According to Selkirk (2000), the right edge of a focused constituent must correspond to the right edge of a Phonological Phrase in the form of an undominated constraint. If the verb is focused in (4), the Phonological Phrasing is changed into (9).

(9) {A friend of Mary's} {**gave**} {a book} {to Sue}

In (9), the verb and the object are separated by a Phonological Phrase boundary, which means that their features cannot be checked in the prosodic domain. A particular operation seems to be necessary in such a case.

The third problem is that they restrict the argument about base-generation of scrambling to Germanic SOV languages, particularly to Dutch, despite their first claim that across languages that have scrambling, both the normal word order and the scrambled word order are base-generated. They argue, for example, that the base-generation analysis explains why scrambling is strictly clause-bound as indicated in (10) (their (17)).

(10) * dat Kees [dat artikel]$_i$ dacht [t_i dat hij t_i gelezen had]

'that Kees that article thought that he read had (that Kees thought that he had read that article)'

However, the corresponding Japanese sentence is fully grammatical as in (11).

(11) Kees-ga [sono-kiji-o]$_i$ [kare-ga t_i yonda kotogaaru] to omotta koto

Kees-Nom that article-Acc$_i$ he-Nom t_i read had that thought that

'*that Kees thought that he had read that article*'

In addition, they argue that, based on the base-generation analysis, when two DPs (or NPs) are scrambled, their respective order is always preserved in Dutch, whether the verb combines with an adverb first or not as in (12) (their (19)).

(12) a. Dat ik gisteren Marie de foto toonde

'that I yesterday Mary the picture showed (that I showed Mary the picture yesterday)'

b. Dat ik Marie de foto gisteren toonde

c. * Dat ik de foto Marie gisteren toonde

The corresponding Japanese sentence is, however, fully grammatical also here as in (13c).

(13) a. watasi-ga kinoo Mary-ni sono-syasin-o mise-ta koto

I-Nom yesterday Mary-Dat the picture-Acc show-Past that

b. watasi-ga Mary-ni sono-syasin-o kinoo mise-ta koto

c. watasi-ga sono-syasin-o Mary-ni kinoo mise-ta koto

'that I showed Mary the picture yesterday'

The fourth problem with their base-generation analysis, which seems crucial, is that they assume that double object constructions in English can only be licensed in prosodic domain if VP shell is formed. Their argument is that for both the Theme argument (i.e. direct object) and the Goal argument (i.e. indirect object) to be checked in prosodic domain, the verb merges with the Theme argument first, and then it moves to the left of the Goal argument as in (14) (their (43)).

(14) a. $[_{VP}\ DP_G\ [V\ DP_T]]$

b. $[_{VP}\ V\ [_{VP}\ DP_G\ [t_V\ DP_T]]]$

c. $\{V\ DP_G\}\ \{t_V\ DP_T\ \}$

According to their analysis, the verb is in the same prosodic domain as the Goal argument, and its trace is in the same prosodic domain as the Theme argument, which makes it possible that the Theme argument can check its case against the verb's trace and the Goal argument can check its case against the verb itself. As they admit, the claim that the Theme argument can check its case against the verb's trace presupposes that traces are visible at PF. They attribute the claim to a specific kind of phenomenon, *wanna*-contraction, which may be sensitive to the presence of intervening traces as in

(15).

(15) a. Who do you want t_i to kiss her?

b. *Who do you wanna kiss her?

As for *wanna*-contraction, Goodall (1991, 2006) proposes an analysis that need not refer to intervening traces. Here the crucial point is that if traces are visible at PF in one specific construction, namely, double object construction, all traces left behind by movement operation must be visible at PF, which seems to weaken their base-generation analysis of scrambling, since the analysis does not ascribe scrambling to movement, which does leave traces.[35]

Throughout the discussion so far, it is likely that Neeleman and Reinhart's (1998) base-generation analysis of scrambling lacks consistency, and hence we cannot adopt their analysis here. Before proceeding, let us discuss what language acquisition data tell us about scrambling in the next section.

5.2. What Language Acquisition Data Tell Us about Scrambling

5.2.1. Sugisaki and Isobe (2001)

In this section, I report the results of two experimental studies on acquisition of scrambling in Japanese, by Sugisaki and Isobe (2001) and Murasugi and Kawamura (2005).

According to Tada (1993), scrambling in Japanese is made up of three distinct subclasses: L(ong)-scrambling, M(iddle)-scrambling and S(hort)-scrambling. L-scrambling moves an element to sentence-initial position across a clause boundary. M-scrambling is clause-internal scrambling to

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[35] Ackema and Neeleman (2004) argue, in line with Neeleman and Reinhart (1998), that there can be traces at PF in order for features to be checked on the basis of Selkirk's (1986) original end-based theory. As for the possibility itself of traces at PF, their argument may be compatible with the present study. However, they presuppose the existence of traces at PF in some languages for prosodic checking based on the incomplete prosodic phrasing mentioned above.

sentence-initial position. S-scrambling is VP-internal scrambling such as permutation of the IO-DO order. Following Tada's (1993) definition of scrambling, it turns out that we have dealt with the case of S-scrambling in this study. I leave it for future research to explore the interaction between L- or M-scrambling and their prosody.

Sugisaki and Isobe (2001) carried out an experiment in which they examined to what degree Japanese children can comprehend those sentences with and without scrambling (M- or S-scrambling). According to Otsu's (1994) comprehension experiment, Japanese children as young as three have no difficulty in interpreting M-scrambled sentences. And so we will mainly focus on S-scrambling here. The experimental design in Sugisaki and Isobe (2001) is as follows:

The subjects were 20 monolingual Japanese-speaking children (mean age 4;6). The task was truth-value verification. The child was told some stories, and at the end of each story, a character appeared on the computer screen and described verbally what he thought had happened in the story. The task for the child was to judge whether his description was correct or wrong, by pointing at one of the cards the character had in his hands: O (correct) or X (wrong).

The main test sentences in their experiment are as follows (Sugisaki and Isobe (2001: 547)):

(16) *SUB-IO-DO-V*:

Satoshi-ga akachan-ni Pokémon-o misetayo.

Satoshi-Nom baby-Dat Pokémon-Acc showed

'Satoshi showed his Pokémon to the baby.'

(17) *SUB-DO-IO-V (S-scrambling)*:

Satoshi-ga Pikachu-o okaasan-ni misetayo.

Satoshi-Nom Pikachu-Acc mother-Dat showed

'Satoshi showed Pikachu to his mother.'

(18) *SUB-IO-DO-V*:

Ookido Hakase-ga Kasumi-ni atarashii Pokémon-o misetayo.

Dr. Ookido-Nom Kasumi-Dat new Pokémon-Acc showed

'Dr. Ookido showed a new Pokémon to Kasumi.'

(19) *IO-SUB-DO-V (M-scrambling)*:

Kasumi-ni Satoshi-ga Pichu-o misetayo.

Kasumi-Dat Satoshi-Nom Pichu-Acc showed

'Satoshi showed Pichu to Kasumi.'

The results of the experiment are summarized in (20) (Sugisaki and Isobe (2001: 548)).

(20)

	# correct answers	% correct
SUB-IO-DO-V (16):	17/20	.85
SUB-DO-IO-V (17):	12/20	.60
SUB-IO-DO-V (18):	19/20	.95
IO-SUB-DO-V (19):	18/20	.90

Sugisaki and Isobe (2001) interpret the results in such a way that the children had little difficulty in comprehending the non-scrambled order in (16) and (18) and that they also had little difficulty in comprehending the M-scrambling order in (19), which is compatible with Otsu's (1994) observation. As for the S-scrambling order in (17), however, they regard the performance of it as around the chance level, compared with the other two types. They conclude that Japanese-speaking children have more difficulty in comprehending the S-scrambling order than the non-scrambled order, which supports the movement analysis of scrambling against the base-generation analysis, with the hypothesis that Japanese-speaking children have more difficulty in comprehending constructions that involve word order permutation via A-movement than those that do not.

5.2.2. Murasugi and Kawamura (2005)

Murasugi and Kawamura (2005) carried out two experiments in which regular active, passive and scrambled sentences, each with and without the anaphor *zibun* '(one-)self' were given to 22 monolingual Japanese-speaking children ranging in age from 2 to 6. *Zibun* in Japanese not only requires a c-commanding antecedent but also is subject-oriented. For the following discussion, we focus on the regular active (i.e. non-scrambled) and the scrambled sentences. The experimental technique was act-out such that the child was asked to demonstrate the meaning of the test sentence by manipulating toy animals. Examples of the test sentences in the first experiment which do not involve the anaphor are given below (their (12a, c)).

(21) a. non-scrambled sentence without anaphor

Ahiru-ga usi-o oikake-ta.

duck-Nom cow-Acc chase-Past

'The duck chased the cow.'

b. scrambled sentence without anaphor

Usi-o_i ahiru-ga ec_i oikake-ta.

cow-Acc duck-Nom ec_i chase-Past

'The cow, the duck chased.'

The result is as follows: Those who interpret active sentences correctly get a high percentage of correct answers also in scrambling even at age 2, which means that the acquisition of scrambling can be as early as the acquisition of the basic sentences. At first sight, this result seems to be incompatible with the result in Sugisaki and Isobe (2001) and support the base-generation analysis of scrambling. As Murasugi and Kawamura (2005) imply, however, the result of their second experiment shows that that is not the case. Examples of the test sentences in the second experiment which do involve the anaphor are shown below (their (15)).

(22) a. non-scrambled sentence with the anaphor

Ahiru$_i$-ga usi-o [zibun$_i$-no niwa-de] oikake-ta.

duck$_i$-Nom cow-Acc self$_i$-Gen garden-Loc chase-Past

'The duck chased the cow at the garden of himself.'

b. scrambled sentence with the anaphor

Usi-o_i [zibun$_j$-no niwa-de]$_k$ ahiru$_j$-ga ec_i ec_k oikake-ta.

cow$_i$-Acc [self$_j$-Gen garden-Loc]$_k$ duck$_j$-Nom ec_i ec_k chase-Past

'The cow, at the garden of himself, the duck chased.'

Note that the anaphor *zibun* must have a c-commanding antecedent at LF. In (22a), the subject *ahiru-ga* c-commands *zibun* and then can be the antecedent of the anaphor. In (22b), the same interpretation is allowed despite the fact that the required c-command relation is destroyed by scrambling. Therefore, reconstruction of the PP *zibun-no niwa-de* 'at self's garden' is required at LF in order to meet the c-command requirement.

The result of the second experiment relevant for the discussion here is as follows: Those who interpret the predicate-argument relation of scrambled sentences correctly are also successful in the interpretation of scrambled sentences with *zibun*. Murasugi and Kawamura (2005) conclude that the children assigning correct interpretation to simple scrambled sentences have knowledge of the reconstruction property of scrambling, which suggests not only that children can properly interpret simple scrambled sentences, but also that they actually know the properties of scrambling as a movement operation from a very early age, with the result that children know A'-scrambling earlier than generally assumed.

In this section, we have seen the evidences from language acquisition which favor the movement analysis of scrambling against the base-generation analysis. In the next section, we will discuss a somewhat unusual analysis of scrambling, that is, PF movement analysis by Sauerland and Elbourne (2002).

5.3. The PF Movement Approach to Scrambling

In section 1, I introduced Saito's (1989) 'radical reconstruction' to the effect that semantically vacuous operation is undone at LF. I also presented Miyagawa's (2006) argument against the view that scrambling is a semantically vacuous operation. In this section, I will introduce Sauerland and Elbourne's (2002) claim that radical reconstruction ('total reconstruction' in their terminology) is due not to undoing operation at LF, but to purely phonological movement.

Sauerland and Elbourne (2002) present Hoji's (1985) observation that a double object construction in Japanese exhibits scopal rigidity in the dative-accusative word order, while the inverse accusative-dative order is scopally ambiguous as in (23) (Sauerland and Elbourne (2002: 308)).

(23) a. John-ga dareka-ni daremo-o syookaisi-ta.

John-Nom someone-Dat everyone-Acc introduce-Past

'John introduced everyone to someone.'

unambiguous: someone > everyone, *everyone > someone

b. John-ga daremo-o dareka-ni syookaisi-ta.

John-Nom everyone-Acc someone-Dat introduce-Past

ambiguous: someone > everyone, everyone > someone

They argue that the ambiguity of (23b) is explained if we make an analysis that derives the sentence by means of scrambling that can radically reconstruct at LF as in (24) (following Sauerland and Elbourne (2002), we use English translations of the Japanese words hereafter).

(24) John_{NOM} $\text{everyone}_{\text{ACC}}$ $\text{someone}_{\text{DAT}}$ t_{ACC} introduced

Then they present Yatsushiro's (1996) observation that the relative scope of two objects is rigid even when both the dative phrase and the accusative phrase occur to the left of the subject as in (25a). Note that (25a) contrasts with (25b) and (25c), where both of the objects also appear to the left of the subject, but in the inverse order (Sauerland and Elbourne (2002: 308)).

(25) a. Dareka-ni daremo-o John-ga syookaisi-ta.

someone-Dat everyone-Acc John-Nom introduce-Past

unambiguous: someone > everyone, *everyone > someone

b. Daremo-o dareka-ni John-ga syookaisi-ta.

everyone-Acc someone-Dat John-Nom introduce-Past

ambiguous: someone > everyone, everyone > someone

c. Dareka-o daremo-ni John-ga syookaisi-ta.

someone-Acc everyone-Dat John-Nom introduce-Past

ambiguous: someone > everyone, everyone > someone

In order to account for the lack of ambiguity in (25a), they assume the two step derivation in which movement of ‘someone’ precedes movement of ‘everyone’ in overt syntax as in (26).

(26) someone$_{DAT}$ everyone$_{ACC}$ John$_{NOM}$ t_{DAT} t_{ACC} introduced

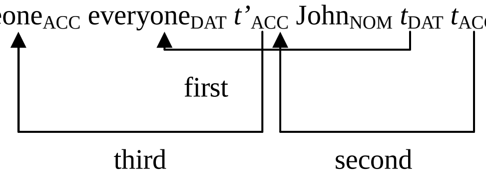
first

second

At first sight, the derivation in (26) seems to violate the cycle, since movement to a higher position precedes movement to a lower position. However they claim that it is allowed since both movements target specifiers of the same head in line with Richard (1997) and Mulders’ (1997) view of cycle.

As for the ambiguous sentences (25b) and (25c), they propose the three step derivation in which the first two steps are the same as those in (26), and the third step of movement, which in (27), the derivation of (25c), is from the position of t'_{ACC} to the surface position of 'someone', can take place either in overt syntax or at PF. If the third step of movement takes place in overt syntax, 'someone' takes scope over 'everyone'. On the other hand, if it takes place at PF, 'everyone' takes scope over 'someone'. In this way, they explain both possible scopal orders in (25b) and (25c).

(27) someone$_{ACC}$ everyone$_{DAT}$ t'_{ACC} John$_{NOM}$ t_{DAT} t_{ACC} introduced



Note that if the third step of movement in question takes place at PF, it turns out that it leaves a trace at PF.

As they mention, however, they restrict PF movement to the case of radical reconstruction, excluding the case of normal scrambling.[36] Furthermore, Miyagawa (2006) claims that scopal ambiguity does not necessarily occur even when relative order of two quantifiers changes as in (28) (Miyagawa (2006: 618)).

(28) Daremo-ni$_i$ dareka-ga [Mary-ga t_i atta to] omotteiru.

everyone-Dat$_i$ someone-Nom [Mary-Nom t_i met COMP] thinks

'Everyone, someone thinks that Mary met.'

someone > everyone, *everyone > someone

He argues that the optional movement of the universal quantifier is licensed not on the basis of scope,

[36] PF movement itself is well-motivated in other languages as well; an interaction between raising and *wh*-movement in English, facts from agreement group terms in British English (Sauerland and Elbourne (2002)), extraposition from subject and object in English (Göbbel (2007)), an interaction of clitic left-dislocation, *wh*-interrogatives and topicalization in Lebanese Arabic (Aoun and Benmamoun (1998)), relativization in Chinese (Cheng (2006)), and so forth. The reader is referred to these studies for details.

but on the basis of focus. He seems to suppose that the universal quantifier is focused in this sentence, which makes it possible that this optional movement is motivated in terms of effect on the output.

Returning to (25), all the three sentences are the cases of what Tada (1993) calls M-scrambling. As Ishihara (2000) also implies, in such a case the subject *John-ga* is subject to F_0 boosting, a sort of our ‘Scrambling Boost’, resulting in being focused, and hence even scrambling in (25a), which does not have scopal ambiguity, is not a semantically vacuous operation.

Here if we extended Sauerland and Elbourne’s (2002) view of radical reconstruction as PF movement to normal scrambling cases such as those which do not involve quantifiers, the system would no longer understand when scrambling occurs and when it does not.

Throughout the discussion so far, it seems very difficult to regard scrambling in general as PF movement. If we can adopt neither base-generation analysis nor PF movement analysis, how can we explain the difference in pitch pattern between non-scrambled order and scrambled order? In Chapter 2, I presented Truckenbrodt’s (1999) suggestion that phonological processes refer to the lower segment composing category in adjunction structures in relation to Phonological Phrasing in Tohono O’odham. What if the higher segment caused by scrambling in adjunction structure is invisible to phonological component? As, for example, the question-answer pair in (29) indicates, however, we cannot cope with contrastive focus.

(29) Q   Na’oya-wa   na’ni-o   ne’muro-de   no’n-da-no?

Naoya-Top   what-Acc Nemuro-Loc drink-Past-Q

‘What did Naoya drink in Nemuro?’

A Na'oya-wa **wa'in-o** ne'muro-de no'n-da-ndayo.

Naoya-Top wine-Acc(**focus**) Nemuro-Loc drink-Past

'Naoya drank **wine** in Nemuro.'

In the answer sentence, if the higher segment in adjunction structure is invisible to phonological component, we can no longer put focus on it. In other words, there exist some cases in which scrambled words or phrases get prominence. If we wish to avoid the problem with visibility of syntactic movement to phonological component, we must assume that syntactic movement is invisible to phonology except for the cases of contrastive focus or some.[37] It seems to be just a description of the matter, not an explanation. In addition, remember that Phonological Phrasing in Tohono O'odham is simply due to presence or absence of the distinct $L_0H_1L_1$ tonal pattern discussed in Chapter 2, where we saw that the object is right-adjoined to VP and assigned to a separate tone group. In that case, the tonal phenomenon in the relevant Phonological Phrase caused by the adjunction operation is the same as that in any other Phonological Phrase. In contrast, the tonal phenomenon caused by the adjunction operation in Japanese is different in nature; the operation *itself* produces the extra F_0 boosting effect that is not observed in normal configurations.

To summarize, it may safely be said that syntactic movement must be visible to phonological component in Japanese, whatever analyses observed thus far we may make (except for

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37 Moreover, in scrambled sentences without subjects, we cannot draw pitch contours in higher segments in adjunction structures as the underline in the following sentence shows.

(i) [$_{VP}$ [$_{NP}$ wa'in-o$_i$] [$_{VP}$ [$_{PP}$ ne'muro-de] [$_{V'}$ [t_i] [$_V$ no'n-da]]]]

'(someone) drank wine in Nemuro.'

In addition, it follows that we cannot generalize that lower XPs (VPs or NPs) in adjunction structures are subject to Scrambling Boost, for the embedded subject before the trace seems to be subject to Scrambling Boost in the following embedded sentence.

(ii) [$_{CP1}$ [$_{NP3}$ no'oto-o$_i$] [$_{CP1}$ [$_{NP1}$ o'ono-wa] [$_{VP1}$ [$_{CP2}$ [$_{NP2}$ ya'mana-ga] [$_{VP2}$ [t_i] [$_{V2}$ yo'n-da]]] [$_{V1}$ to-it-ta]]]]

'Ono said that Yamana read the notebook.'

Optimality-Theoretic approach mentioned in Chapter 4, where we observed that constraint interaction can account for the visibility of syntactic movement to phonological component in Japanese). Seen conversely, it can also be said that traces caused by movement operation are left until PF. Given that PF movement for radical reconstruction may exist, which can leave traces at PF, the latter view may be more natural, in line with Neeleman and Reinhart's (1998) suggestion above that traces are visible at PF in this respect. This is crucial for the whole architecture of grammar. In any case, the existence of visibility of syntactic movement, or that of traces, to phonological component in Japanese is inevitable in standard syntactic theory, which may manifest the psychological reality of movement.[38]

In the next section, we will discuss another problem with empty elements, relative clause structures.

5.4. The Problem with the Visibility of the Internal Structures of Relative Clauses

In Chapter 3, we observed that in uniformly left-branching structure consisting of four accented words that involves relative clause with the antecedent in the third position, the degree of F_0 boosting in the third position is generally greater than that in corresponding structure without relative clause construction or that which involves relative clause with the antecedent in the fourth position. Note also that left-branching structures made up of three accented words are not generally subject to the Principle of Rhythmic Alternation irrespective of their internal structures. Here we assume *pro* approach to relative clause structure against empty operator approach, for, as we saw in Chapter 3, the latter has a crucial problem that the position from which empty operator would move (to SpecCP) has already been occupied by the overt NP (or PP), repeated in (30).

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[38] Later, we will see that within Chomsky's (2001) Minimalist framework including the notion of 'phase', Fukui and Kasai (2004) propose that scrambled word order can be derived from the process of linearization at PF but that several problems remain in their proposal, too.

(30) [$_{NP}$ [$_{IP}$ [$_{NP}$ watasi-ga] [$_{VP}$ [$_{NP}$ sono'-hito$_i$-ni] [$_{NP}$ okane-o] watasi-wasu're-ta]] [$_{NP}$ okyaku$_i$]]

I-Nom the-person-Dat money-Acc give-forget-Past customer

'the customer, to whom I forgot to give money'

The internal structures of relative clauses we assume here are as follows (for comparison, I show the corresponding structure without relative clause construction):

(31) a. with the antecedent in the third position

[$_{NP3}$ [$_{NP2}$ [$_{CP}$ [$_{NP1}$ ma'ri-ga] [$_{VP}$ *pro*$_i$ [$_{V}$ no'n-da]]] [$_{N2}$ ro'ze$_i$-no]] [$_{N3}$ ryo'o]]

Mari-Nom *pro*$_i$ drink-Past vins rose$_i$-Gen amount

'the amount of the vins rose that Mari drank'

b. with the antecedent in the fourth position

[$_{NP3}$ [$_{CP}$ [$_{NP2}$ [$_{NP1}$ ma'ri-no] [$_{N2}$ a'ni-ga]] [$_{VP}$ *pro*$_i$ [$_{V}$ no'n-da]]] [$_{N3}$ ro'ze$_i$]]

Mari-Gen brother-Nom *pro*$_i$ drink-Past vins rose$_i$

'the vins rose that Mari's brother drank'

c. without relative clause construction

[$_{NP4}$ [$_{NP3}$ [$_{NP2}$ [$_{NP1}$ m'ari-no] [$_{N2}$ a'ni-no]] [$_{N3}$ ro'ze-no]] [$_{N4}$ ryo'o]]

Mari-Gen brother-Gen vins rose-Gen amount

'the amount of Mari's brother's vins rose'

As for (31a), in which the antecedent is consistently subject to what I call 'Antecedent Boost', some potential explanations come to mind. The first is that the noun immediately after the CP boundary is subject to the effect. This explanation predicts that the noun immediately after the CP boundary in apposition construction in (32) is also subject to the effect.

(32) apposition construction

$[_{IP}$ $[_{NP2}$ $[_{CP}$ $[_{NP1}$ ma'ri-ga] $[_{VP1}$ no'n-da]] $[_{N2}$ koto'-ga]] $[_{VP2}$ ba're-ta]]

Mari-Nom drink-Past fact-Nom come to light-Past

'The fact that Mari drank came to light.'

Since it was so difficult to make such a sentence with satisfaction of the phonetic, phonological and semantic requirements, such an approach was not taken. My impressionistic observation is that the expected F_0 boosting in the third position in (32) is not as great as that in (31a). Interestingly, the speakers consistently pronounced the type of the sentences (31a) in such a way that (31a) was perceived as if "Mari had drank the amount of vins rose" due to the extra F_0 boosting, which, as mentioned in Chapter 3, might cause intonational neutralization with symmetrically branching structure as Kubozono (1989, 1993) reports. The same is true of the case for Minor Phrasing. As we saw in Chapter 3, all the speakers preferably put a Minor Phrase boundary before the antecedent in uniformly left-branching structure consisting of four unaccented words which involves relative clause with the antecedent in the third position as in (33), which causes hearers to perceive the sentence as if "My elder sister called the candies of my nephew".

(33) $_{MiP}$(anega *pro*$_i$ yonda)$_{MiP}$ $_{MiP}$(oi$_i$no ame)$_{MiP}$

elder sister-Nom *pro*$_i$ call-Past nephew$_i$-Gen candy

'the candies of my nephew whom my elder sister called'

Noteworthy in this respect is that the effect of the perception seems to reflect Kamide and Mitchell's (1997) claim that in Japanese, speakers in general prefer high attachment in comprehending relative clause sentences with a complex noun phrase as in (34).

(34) Da'reka-ga baru'koniiniiru joyuu-no mesitu'kai-o u't-ta.

someone-Nom be on the balcony-Pres actress-Gen servant-Acc shoot-Past

'Someone shot the servant of the actress who was on the balcony.'

This sentence is ambiguous regarding the attachment of the relative clause. According to Kamide and Mitchell (1997), Japanese speakers generally prefer the reading that the person who is on the balcony is the servant of the actress, not the actress as in (35) (curly brackets indicate some prosodic boundaries).

(35) a. preferred

{baru'koniiniiru} {joyuuno mesitu'kai}

b. non-preferred

{baru'koniiniiru joyuuno} {mesitu'kai}

Taken together, I reject the assumption that the noun immediately after the CP boundary is subject to the F_0 boosting effect.

The second explanation is that antecedent is consistently subject to Antecedent Boost anywhere in the structure. As mentioned above, however, the effect operates in uniformly left-branching structures consisting of four accented words (or more), not of three accented words.

Moreover, in (31b) with the antecedent in the fourth position, the effect may and may not operate from speaker to speaker as we saw in Chapter 3. This explanation is not valid.

The third explanation is that the F_0 level of predicate is suppressed as compared to argument. As I pointed out in Chapter 3, comparing (31a) type with (31b) type, the differences in pitch peaks between the first and the second words in four pairs of sentences were significantly different in one pair for YK, in two pairs for AM and in two pairs for SK. Comparing (31a) type with (31c) type, the differences in pitch peaks between the first and the second words in two pairs of sentences were significantly different only for SK in both two pairs. Moreover, in left-branching structures consisting of three accented words with and without relative clause construction as in (36), the differences in pitch peaks between the first and the second words in the two sentences were significantly different only for SK.

(36) a. with relative clause structure

[$_{NP2}$ [$_{CP}$ [$_{NP1}$ na'o-ga] [$_{VP}$ [ec$_i$] [$_V$ yo'n-da]]] [$_{N2}$ no'oto$_i$]]

Nao-Nom ec$_i$ read-Past notebook$_i$

'the notebook which Nao read'

b. without relative clause structure

[$_{NP3}$ [$_{NP2}$ [$_{NP1}$ na'o-no] [$_{N2}$ a'ni-no]] [$_{N3}$ no'oto]]

Nao-Gen brother-Gen notebook

'Nao' s brother's notebook'

Clearly we can find inter-speaker variation in the F_0 level of predicate. SK shows tendency to suppress the F_0 level of predicate, whereas YK and AM show tendency not to suppress the F_0 level of predicate. In this analysis, all we can say is that some speakers tend to suppress the F_0 level of predicate, other speakers do not tend to suppress the F_0 level of predicate. This analysis seems to be just a description of the matter, not an explanation of the phenomenon.

The fourth explanation is that *pro* in uniformly left-branching relative clause structure consisting of four words or more can and must be visible to phonological component in Japanese as we saw in the last section in Chapter 4. This assumption can explain the difference in pitch pattern between (31a) and (31b) as long as speakers unconsciously understand that there exists *pro* within the relative clause. The same argument is true of the unaccented case. It seems that *pro* in uniformly left-branching relative clause structure consisting of four unaccented words (or more) can and must be visible to phonological component in Minor Phrasing in Japanese. This explanation may be incompatible with Uechi's (1998) claim that *pro* is invisible to phonological component in Japanese. Consider the following Yes-No question (Uechi (1998: 267)).

(37) Q yu'uji-wa bi'iru-ni wa'in-o ma'ze-ta-no?

Yuji-Top beer-into wine-Acc mix-Past-Q

'Did Yuji mix wine into beer?'

A (Un.) yu'uji-wa *pro* *pro* ma'ze-ta-yo.

Yeah Yuji-Top *pro* *pro* mix-Past

'Yeah. Yuji mixed (wine into beer).'

Uechi (1998) implies that *pro* is supposed to be absent at the syntax-phonology mapping, which leads to the normal configuration of downstep in the answer sentence. It may be that since *pro* approach to relative clause construction is not totally problem-free as Mihara (1994) points out, *pro* in relative clause has different properties from normal *pro* in Japanese, which leads to the assumption that *pro* in relative clause (consisting of four words or more) is visible to phonological component, whereas *pro* in other configurations is invisible in Japanese.[39] Alternatively, as with traces left behind by scrambling, *pro* in relative clause may be assumed to be left until PF.

5.5. Within the Minimalist Program

In this section, I will emphasize that the problem with visibility of syntactic movement operation or that of traces at PF is compatible with Chomsky's (2001) current Minimalist Program.[40] Before proceeding, let us see Fukui and Kasai's (2004) proposal that scrambled word order can be derived from the process of linearization at PF within the Minimalist framework, and see several problems with it.

5.5.1. Fukui and Kasai (2004)

Chomsky (2001) proposes that syntactic operations such as movement operate within a limited domain 'phase', and that an operation 'Spell-Out' delivers the structure already formed to the phonological component in a cyclic fashion. He assumes that CP and *v*P are phases and that VP and TP (or IP) are Spell-Out domains.

Following Chomsky (2001), Fukui and Kasai (2004) propose that in Japanese, scrambled word order can be derived from the process of linearization of cyclically spelled out syntactic objects at PF, with the assumption that the class of phases includes noun phrases and postpositional

[39] It seems that the same is true even if we assume empty operator approach. We will eventually have to know from where the empty operator moves in relative clause taking the approach.

[40] For relevant discussion on syntax-phonology interface in Japanese within the framework of the Minimalist Program, see Ishihara (2007). He discusses the sentences with and without middle-scrambling, and assumes V-to-T raising in Japanese, which is irrelevant here.

phrases.[41] They assume that the precedence relation in temporal order is determined as follows (Fukui and Kasai (2004: 114));

(38) If α undergoes Spell-Out prior to β, α precedes β in temporal order.

According to (38), the normal word order and the scrambled word order in VP, for example, are derived as follows (spelled out syntactic objects are indicated by bold-type);

(39) a. normal word order

[$_{\mathbf{VP}}$ [$_{PP}$ ne'muro-de] [$_{V'}$ [$_{NP}$ wa'in-o] [$_{V}$ no'n-da]]]

Nemuro-Loc wine-Acc drink-Past

'(Someone) drank wine in Nemuro.'

↓ linearization

ne'muro-de wa'in-o no'n-da

b. scrambled word order

[$_{\mathbf{VP}}$ [$_{PP}$ ne'muro-de] [$_{V'}$ [$_{\mathbf{NP}}$ wa'in-o] [$_{V}$ no'n-da]]]

↑ second ↑ first

↓ linearization

wa'in-o ne'muro-de no'n-da

In (39a), the whole VP is spelled out and the normal word order is derived. In contrast, in (39b), NP undergoes Spell-Out prior to VP and so NP precedes the rest of the VP, which leads to the scrambled

[41] They insist that the absence of formal agreement in the language enables Spell-Out to apply only to an argument of the verb.

word order. Scrambling in NP and in double object construction, we observed, can be treated in the same manner.

Their approach, however, has several drawbacks. First, as mentioned above, they assume that noun phrases and postpositional phrases are Spell-Out domains. As for NP, Akmajian (1975) presents the evidence that the node NP is a cyclic node. But how about postpositional phrases? What motivates postpositional phrases as phases? We have never heard that postpositional phrases are syntactic domains on a par with clauses where rules or operations apply.

Second, as they admit, it cannot prevent the subject from scrambling long-distance. Saito (1985: 192) argues that the subject does not scramble long-distance as in (40).

(40) a. Mary-ga John-ni [kono giron-ga okasii to] itta.
Mary-Nom John-Dat this argument-Nom strange that told
'Mary told John that this argument is strange.'

b. *[kono giron$_i$-ga] Mary-ga John-ni [t_i okasii to] itta.
this argument-Nom Mary-Nom John-Dat strange that told
'This argument, Mary told John that is strange.'

In (40b), the embedded subject is scrambled to the matrix sentence-initial position and the sentence is ill-formed. Fukui and Kasai's (2004) model predicts, however, that (40b) is well-formed on a par with (40a) since it is assumed that the scrambled constituent actually does not undergo any syntactic movement but rather stays in the base-generated position. Clearly, a special device is needed in order for the subject not to scramble long-distance within their approach.

Third, they assume that a long-distance dislocated element cannot license its bound pronoun in line with Ueyama's (2002: 44) observation.

(41) ?* 10 izyoo-no kigyoo-ni$_i$ [so-ko-no$_1$ bengosi]-ga [John-ga e$_i$ ayamatta to]

10 more-than-Gen company-Dat that-place-Gen attorney-Nom John-Nom apologized that

omotteiru.

think

'Their attorneys think that John apologized to ten or more companies.'

Ueyama (2002) argues that in (41), the dislocated object fails to license the bound pronoun *so-ko* 'that-place'. However, the sentence is difficult to interpret, since *so-ko* in Japanese normally refers to a singular noun, not to a plural noun such as *10 izyoo-no kigyoo* 'ten or more companies'. Consider the following example.

(42) a. *Sinbun-ga [so-ko-no$_i$ raibarugaisya-ga Toyota-ni$_i$ sangyoosupai-o

newspaper-Nom that-place-Gen rival company-Nom Toyota-Dat industrial spy-Acc

okutta to] hoodoosita.

sent that reported

'The newspaper reported that its$_i$ rival company had sent an industrial spy to Toyota$_i$.'

b. Toyota-ni$_i$ sinbun-ga [so-ko-no$_i$ raibarugaisya-ga ec$_i$ sangyoosupai-o

okutta to] hoodoosita.

'To Toyota$_i$, the newspaper reported that its$_i$ rival company had sent an industrial spy.'

In (42a), the embedded indirect object *Toyota-ni* 'to-Toyota' fails to license the bound pronoun *so-ko*.

In contrast, in (42b), the dislocated object is able to license the bound pronoun *so-ko*. Haig (1976) suggests in this respect that a pause is obligatory between the long-distance scrambled element and the rest of the sentence as in (42b). It follows, then, that a long-distance scrambled element can license its bound pronoun given appropriate prosody. Fukui and Kasai's (2004) model cannot explain the contrast in (42) since it does not assume any overt movement in scrambling.

To sum up, it seems that Fukui and Kasai's (2004) model is so powerful that it would generate ill-formed sentences involving scrambling.

5.5.2. Deriving the Boosting and the Initial Lowering Effects

Now let us see how to derive the F_0 boosting effects we observed throughout this paper, that is, Scrambling Boost and Antecedent Boost, within the Minimalist framework. Following Chomsky (2001), we assume that CP and *v*P are phases here. Note that we dealt with the *short*-scrambling case in our experiment in Chapter 2. The three representatives with short scrambling are shown below.

(43) a. scrambled NP:

$[_{VP}$ … $[_{NP2}$ $[_{NP1}$ bare'ebu-no$_i$] $[_{NP2}$ $[_{AP}$ yowa'musina] $[_{N2'}$ [t_i] $[_{N2}$ me'mbaa]]]] …]

↓

/ bare'ebu-no yowa'musina *t* me'mbaa /

b. scrambled VP:

$[_{VP}$ $[_{NP}$ wa'in-o$_i$] $[_{VP}$ $[_{PP}$ ne'muro-de] $[_{V'}$ [t_i] $[_{V}$ no'n-da]]]]

↓

/ wa'in-o ne'muro-de *t* no'n-da /

c. scrambled double object construction:

[$_{VP}$ [$_{NP1}$ no’oto-o$_i$] [$_{VP}$ [$_{NP2}$ ya’mana-ni] [$_{V'}$ [t_i] [$_V$ ka’esi-ta]]]]

↓

/ no’oto-o ya’mana-ni *t* ka’esi-ta /

As you can see, the moved elements and their traces are within the same Spell-Out domain, VP, in all the three cases. Chomsky (2000) proposes that any phrase that moves to the *edge* of a phase is then accessible for movement in a later phase. Slightly extending his idea, Sauerland and Elbourne (2002) propose that actually the edge of a phase can be distinct for LF or PF and that a phrase in only LF or PF edge of a phase is accessible only for LF or PF movement, respectively, in a later phase. Following them, I propose that the constituent following the one to the edge of a phase (or immediately preceding the trace) is subject to Scrambling Boost at PF in the course of derivation.[42]

I hypothesize that basically the same is true of accented relative clause construction. In Chapter 3, we observed that in uniformly left-branching relative clause structure with the antecedent in the third position, the antecedent is consistently subject to Antecedent Boost.[43] In that case, the derivation by phase is as follows:

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[42] Shinya (personal communication) points out that the adjective in the following sentence seems to be subject to Scrambling Boost.

[$_{VP}$ [$_{NP1}$ wa’in-o$_i$] [$_{PP}$ [$_{AP}$ na’una] [$_{NP2}$ ne’muro-de]] [t_i] [$_V$ no’n-da]]

‘(Someone) drank wine in modern Nemuro.’

It follows, then, that the constituent in question is not NP_2 but PP dominating AP.

[43] In Chapter 3, we also found that in uniformly left-branching relative clause structure with the antecedent in the fourth position, the antecedent may be subject to Antecedent Boost depending on speakers. I leave the variation in the derivation by phase for future research.

(44) uniformly left-branching relative clause structure with the accented antecedent in the third position:

$[_{NP3}$ $[_{NP2}$ $[_{CP}$ $[_{IP}$ $[_{NP1}$ a’mano-ga] $[_{VP}$ *pro*$_i$ $[_{V}$ a’isi-ta]]]] $[_{N2}$ yo’ojo$_i$-no]] $[_{N3}$ namae]]

a. *pro* a’isi-ta   νP phase

b. a’mano-ga *pro* a’isi-ta   CP phase

c. a’mano-ga *pro* a’isi-ta yo’ojo-no namae

(45) template at syntax-phonology interface

__________ *pro* __________ __________ __________

↑

Antecedent Boost

In the derivation (44), the IP ‘amano-ga *pro* aisi-ta’ is spelled out at the CP phase and the spelled-out elements including *pro* are kept in PF until the rest of the sentence is spelled-out at the next phase. I propose that at the end of the derivation, the antecedent is subject to Antecedent Boost as shown in the template (45).

The same is true of unaccented relative clause construction. The derivation by phase is as follows:

(46) uniformly left-branching relative clause structure with the unaccented antecedent in the third position:

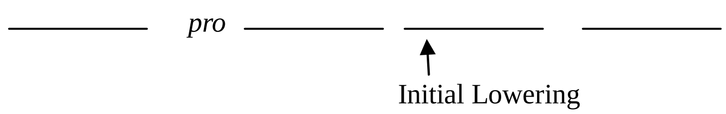
[$_{NP3}$ [$_{NP2}$ [$_{CP}$ [$_{IP}$ [$_{NP1}$ ane-ga] [$_{VP}$ *pro*$_i$ [$_V$ yon-da]]]] [$_{N2}$ oi$_i$-no]] [$_{N3}$ ame]]

a. *pro* yon-da — *v*P phase

b. ane-ga *pro* yon-da — CP phase

c. ane-ga *pro* yon-da oi-no ame

(47) template at syntax-phonology interface



In the derivation (46), the IP ‘ane-ga *pro*$_i$ yon-da’ is spelled out at the CP phase and the spelled-out elements including *pro* are kept in PF until the rest of the sentence is spelled-out at the next phase. It follows that at the end of the derivation, the antecedent is subject to Initial Lowering as shown in the template (47).

As seen in Chapter 4, visibility of syntactic movement (together with Scrambling Boost) and that of *pro* (together with Antecedent Boost, or Initial Lowering) can be accounted for in OT framework. A possibility is that OT syntax (Grimshaw (1997)) may explain those phenomena in collaboration with OT phonology.[44]

44 See Gabriel (2010) for syntax-phonology interface in Argentinean Spanish in Minimalist OT framework.

5.6. Concluding Remarks

In this chapter, we discussed that the existence of visibility of syntactic movement or empty elements to phonological component in Japanese is inevitable in standard syntactic theory. An interesting question that emerges from the theoretical implication is whether there exist other languages in which movement operation may be visible to phonology in the similar way as in Japanese. If so, there seems to be room to reconsider the whole architecture of grammar. If that is not the case, the question remains whether we may consider it to be a language particular operation to keep some traces after (narrow) syntax. I leave it for future research.

For practical purposes, this study may contribute to the refinement of synthesized speech such as ToBI approach by Venditti (2005). Needless to say, it is important to do research from a theoretical and an empirical point of view.

Finally, this study may evoke the need for interdisciplinary research in science. Now it is necessary that linguistics interact with other academic disciplines, especially with cognitive science and neuroscience, which will yield more benefits than staying alone. I would like to continue research with broader perspective.

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Raw Data

	ao'yama-wa	yowa'musi-na	bare'ebu-no	me'mbaa-da
1	307	275	268	234
2	296	295	250	221
3	328	297	295	237
4	310	304	259	235
5	314	292	276	230
6	315	291	283	229
7	319	295	276	242
8	318	294	284	246
9	327	283	264	236
10	313	272	260	227
11	307	295	260	240
average	314.0	290.3	270.5	234.3
SD	8.77	9.24	12.87	6.85

Table 1: Peak F_0 values of the four phrases in sentence (1a) in Chapter 2 for speaker YK.

	ao'yama-wa	bare'ebu-no	yowa'musi-na	me'mbaa-da
1	318	271	274	221
2	308	276	300	202
3	308	280	284	210
4	317	277	286	223
5	321	292	293	224
6	330	302	298	246
7	312	262	268	243
8	312	286	282	251
9	314	277	286	227
10	308	277	289	218
11	311	273	285	207
average	314.5	279.4	285.9	224.7
SD	6.41	10.25	8.98	15.35

Table 2: Peak F_0 values of the four phrases in sentence (1b) in Chapter 2 for speaker YK.

	o'ohara-wa	o'oheina	ma'nshon-no	o'onaa-da
1	290	294	238	224
2	310	297	230	217
3	316	304	249	240
4	301	290	238	221
5	306	305	278	259
6	302	306	244	227
7	305	284	262	228
8	320	294	257	227
9	310	281	264	255
10	314	285	272	239
11	310	299	282	235
average	307.6	294.5	255.8	233.8
SD	7.84	8.33	16.61	12.86

Table 3: Peak F_0 values of the four phrases in sentence (2a) in Chapter 2 for speaker YK.

	o'ohara-wa	ma'nshon-no	o'oheina	o'onaa-da
1	277	276	264	222
2	316	285	264	219
3	312	279	271	218
4	316	283	282	226
5	296	282	280	232
6	317	283	293	230
7	315	284	289	229
8	287	247	254	213
9	313	288	280	204
10	326	290	304	218
11	310	269	272	206
average	307.7	278.7	277.5	219.7
SD	14.05	11.43	13.81	8.91

Table 4: Peak F_0 values of the four phrases in sentence (2b) in Chapter 2 for speaker YK.

	na'oya-ga	ne'muro-de	wa'in-o	no'n-da
1	297	290	240	211
2	301	283	269	212
3	327	315	299	207
4	318	304	230	197
5	314	305	231	187
6	316	254	272	203
7	306	244	286	202
8	313	291	275	207
9	311	296	271	198
10	318	294	287	210
11	311	276	275	203
average	312.0	286.5	266.8	203.4
SD	7.99	20.50	22.06	7.02

Table 5: Peak F_0 values of the four phrases in sentence (3a) in Chapter 2 for speaker YK.

	na'oya-ga	wa'in-o	ne'muro-de	no'n-da
1	304	270	282	196
2	314	268	285	199
3	325	252	288	232
4	319	282	311	229
5	316	248	295	200
6	326	255	301	206
7	296	271	304	210
8	318	269	277	217
9	310	288	283	212
10	314	292	298	204
11	302	262	285	211
average	313.1	268.8	291.7	210.5
SD	8.97	13.61	10.23	11.14

Table 6: Peak F_0 values of the four phrases in sentence (3b) in Chapter 2 for speaker YK.

	a’mano-ga	mo’rimori	go’han-o	ta’be-ta
1	318	255	241	208
2	302	288	216	200
3	329	295	259	223
4	310	293	215	192
5	317	298	221	196
6	329	306	266	222
7	337	303	263	221
8	324	307	257	215
9	308	290	273	214
10	318	309	231	201
11	322	297	287	218
average	319.5	294.6	248.1	210.0
SD	9.78	14.19	23.50	10.63

Table 7: Peak F_0 values of the four phrases in sentence (4a) in Chapter 2 for speaker YK.

	a’mano-ga	go’han-o	mo’rimori	ta’be-ta
1	303	267	277	205
2	310	260	286	188
3	342	269	302	204
4	323	255	298	207
5	314	267	291	201
6	328	285	287	216
7	326	255	292	210
8	309	249	294	224
9	321	259	302	204
10	316	280	296	200
11	316	272	293	210
average	318.9	265.3	292.5	206.3
SD	10.26	10.51	7.01	8.79

Table 8: Peak F_0 values of the four phrases in sentence (4b) in Chapter 2 for speaker YK.

	ao'yama-wa	bare'ebu-no	me'mbaa-da
1	321	271	241
2	309	276	245
3	301	279	223
4	297	267	236
5	303	302	239
6	224	306	224
7	326	309	231
8	310	289	232
9	327	291	243
10	314	280	235
11	320	304	252
average	304.7	288.5	236.5
SD	27.26	14.28	8.38

Table 9: Peak F_0 values of the three phrases in sentence (5a) in Chapter 2 for speaker YK.

	ao'yama-wa	yowa'musi-na	me'mbaa-da
1	307	283	216
2	295	301	231
3	309	285	236
4	304	296	228
5	307	296	231
6	307	322	231
7	312	288	241
8	307	284	209
9	312	293	205
10	326	307	235
11	317	274	214
average	309.4	293.5	225.2
SD	7.43	12.60	11.49

Table 10: Peak F_0 values of the three phrases in sentence (5b) in Chapter 2 for speaker YK.

	o’ohara-wa	ma’nshon-no	o’onaa-da
1	301	264	242
2	319	286	233
3	322	282	242
4	296	292	245
5	328	301	248
6	300	294	272
7	309	290	259
8	318	278	256
9	307	291	216
10	314	296	260
11	295	287	219
average	309.9	287.4	244.7
SD	10.62	9.58	16.40

Table 11: Peak F_0 values of the three phrases in sentence (6a) in Chapter 2 for speaker YK.

	o’ohara-wa	o’oheina	o’onaa-da
1	301	289	227
2	300	272	218
3	316	287	221
4	315	288	220
5	313	301	230
6	324	288	234
7	314	291	224
8	308	278	228
9	314	294	208
10	306	274	210
11	304	290	219
average	310.5	286.5	221.7
SD	6.96	8.25	7.64

Table 12: Peak F_0 values of the three phrases in sentence (6b) in Chapter 2 for speaker YK.

	na'oya-ga	wa'in-o	no'n-da
1	303	257	214
2	296	285	214
3	310	272	230
4	315	289	221
5	305	278	209
6	329	272	220
7	322	292	220
8	310	276	216
9	314	266	204
10	327	286	203
11	307	291	205
average	312.5	278.5	214.2
SD	9.74	10.69	8.02

Table 13: Peak F_0 values of the three phrases in sentence (7a) in Chapter 2 for speaker YK.

	na'oya-ga	ne'muro-de	no'n-da
	302	282	207
	278	290	198
	315	268	214
	313	318	205
	311	319	200
	318	292	206
	317	303	215
	297	280	210
	339	290	208
	327	298	203
	312	298	199
average	311.7	294.4	205.9
SD	15.09	14.66	5.43

Table 14: Peak F_0 values of the three phrases in sentence (7b) in Chapter 2 for speaker YK.

	a'mano-ga	go'han-o	ta'be-ta
1	299	266	205
2	309	278	226
3	341	257	201
4	327	257	210
5	309	297	235
6	329	275	206
7	329	302	213
8	335	297	219
9	313	310	209
10	325	312	225
11	319	297	212
average	321.4	286.2	214.6
SD	12.12	19.39	9.94

Table 15: Peak F_0 values of the three phrases in sentence (8a)

in Chapter 2 for speaker YK.

	a'mano-ga	mo'rimori	ta'be-ta
1	303	280	214
2	300	283	210
3	313	296	202
4	315	305	197
5	321	292	221
6	333	305	208
7	317	286	207
8	324	291	215
9	344	301	215
10	320	290	207
11	315	308	225
average	318.6	294.3	211.0
SD	11.83	9.05	7.72

Table 16: Peak F_0 values of the three phrases in sentence (8b)

in Chapter 2 for speaker YK.

	ao'yama-wa	bare'ebu-no	me'mbaa-da
1	307	286	267
2	290	268	267
3	288	266	274
4	289	273	259
5	304	272	269
6	296	263	257
7	313	282	270
8	295	269	266
9	301	281	278
10	300	272	262
11	336	287	271
average	301.7	274.5	267.3
SD	13.16	7.86	5.94

Table 17: Peak F_0 values of the three phrases in sentence (5a) in Chapter 2 for speaker AM.

	ao'yama-wa	yowa'musi-na	me'mbaa-da
1	284	268	260
2	293	267	265
3	276	271	260
4	277	263	254
5	284	261	262
6	286	269	257
7	283	269	262
8	287	269	266
9	288	277	253
10	286	265	250
11	278	273	256
average	283.8	268.4	258.6
SD	4.90	4.27	4.85

Table 18: Peak F_0 values of the three phrases in sentence (5b) in Chapter 2 for speaker AM.

	o'ohara-wa	ma'nshon-no	o'onaa-da
1	283	272	260
2	292	286	272
3	318	291	259
4	307	279	257
5	292	261	266
6	323	289	274
7	324	278	273
8	299	268	262
9	309	272	257
10	280	260	253
11	310	288	271
average	303.4	276.7	264.0
SD	14.62	10.54	7.15

Table 19: Peak F_0 values of the three phrases in sentence (6a) in Chapter 2 for speaker AM.

	o'ohara-wa	o'oheina	o'onaa-da
1	304	281	251
2	286	269	261
3	304	264	252
4	293	275	257
5	279	275	269
6	310	265	253
7	299	269	249
8	292	289	259
9	300	268	252
10	331	284	260
11	298	272	260
average	299.6	273.7	256.6
SD	12.96	7.66	5.61

Table 20: Peak F_0 values of the three phrases in sentence (6b) in Chapter 2 for speaker AM.

	na’oya-ga	wa’in-o	no’n-da
1	273	277	272
2	276	262	262
3	292	257	252
4	288	263	256
5	296	274	264
6	292	263	264
7	301	260	256
8	299	263	270
9	300	261	255
10	294	259	255
11	285	260	251
average	290.5	263.5	259.7
SD	8.91	5.94	6.78

Table 21: Peak F_0 values of the three phrases in sentence (7a) in Chapter 2 for speaker AM.

	na’oya-ga	ne’muro-de	no’n-da
1	276	267	258
2	292	260	258
3	287	259	253
4	285	258	255
5	297	269	259
6	301	270	263
7	291	259	250
8	287	263	262
9	300	276	252
10	282	260	248
11	291	268	269
average	289.9	264.5	257.0
SD	7.25	5.61	5.92

Table 22: Peak F_0 values of the three phrases in sentence (7b) in Chapter 2 for speaker AM.

	a’mano-ga	go’han-o	ta’be-ta
1	298	277	273
2	284	273	274
3	297	277	276
4	287	260	256
5	286	267	272
6	307	283	277
7	297	274	268
8	302	259	261
9	287	281	255
10	298	275	266
11	311	287	267
average	295.8	273.9	267.7
SD	8.52	8.47	7.31

Table 23: Peak F_0 values of the three phrases in sentence (8a)

in Chapter 2 for speaker AM.

	a’mano-ga	mo’rimori	ta’be-ta
1	270	261	266
2	284	264	261
3	275	261	275
4	294	260	255
5	304	269	264
6	294	270	271
7	302	262	271
8	290	266	270
9	300	269	266
10	311	258	251
11	288	273	269
average	292.0	264.8	265.4
SD	11.81	4.65	6.92

Table 24: Peak F_0 values of the three phrases in sentence (8b)

in Chapter 2 for speaker AM.

	ao’yama-wa	bare’ebu-no	me’mbaa-da
1	198	175	125
2	199	173	143
3	194	173	120
4	182	175	132
5	199	169	125
6	196	171	126
7	191	168	126
8	182	167	127
9	186	163	127
10	180	171	138
11	181	163	142
average	189.8	169.8	130.1
SD	7.41	4.06	7.27

Table 25: Peak F_0 values of the three phrases in sentence (5a) in

Chapter 2 for speaker SK.

	ao’yama-wa	yowa’musi-na	me’mbaa-da
1	181	183	115
2	188	172	117
3	179	175	121
4	187	160	129
5	185	167	131
6	181	165	125
7	181	163	125
8	179	171	135
9	182	162	136
10	167	157	137
11	176	162	140
average	180.5	167.0	128.3
SD	5.47	7.26	8.00

Table 26: Peak F_0 values of the three phrases in sentence (5b) in

Chapter 2 for speaker SK.

	o'ohara-wa	ma'nshon-no	o'onaa-da
1	176	169	157
2	175	156	141
3	181	155	143
4	193	162	134
5	199	148	146
6	186	158	142
7	181	160	142
8	193	157	141
9	184	166	142
10	170	156	137
11	167	157	139
average	182.3	158.5	142.2
SD	9.56	5.40	5.57

Table 27: Peak F_0 values of the three phrases in sentence (6a) in Chapter 2 for speaker SK.

	o'ohara-wa	o'oheina	o'onaa-da
1	182	180	170
2	185	176	141
3	207	170	147
4	170	167	131
5	177	167	162
6	205	167	140
7	187	166	142
8	166	157	154
9	171	162	142
10	168	169	143
11	162	159	135
average	180.0	167.3	146.1
SD	14.42	6.41	11.06

Table 28: Peak F_0 values of the three phrases in sentence (6b) in Chapter 2 for speaker SK.

	na'oya-ga	wa'in-o	no'n-da
1	185	162	125
2	182	157	118
3	175	161	122
4	181	146	130
5	183	150	123
6	186	149	115
7	177	152	145
8	178	155	127
9	184	155	139
10	173	148	123
11	170	150	145
average	179.5	153.2	128.4
SD	5.00	5.02	9.85

Table 29: Peak F_0 values of the three phrases in sentence (7a) in Chapter 2 for speaker SK.

	na'oya-ga	ne'muro-de	no'n-da
1	174	170	138
2	182	153	139
3	172	156	136
4	178	162	130
5	182	164	127
6	177	160	138
7	178	143	143
8	173	162	146
9	185	165	146
10	166	153	139
11	177	155	150
average	176.7	158.5	139.3
SD	5.10	7.08	6.54

Table 30: Peak F_0 values of the three phrases in sentence (7b) in Chapter 2 for speaker SK.

	a’mano-ga	go’han-o	ta’be-ta
1	180	150	130
2	176	154	148
3	180	147	132
4	180	159	137
5	168	150	137
6	172	140	149
7	184	154	151
8	171	157	140
9	175	149	144
10	165	144	143
11	172	146	132
average	174.8	150.0	140.3
SD	5.56	5.43	6.98

Table 31: Peak F_0 values of the three phrases in sentence (8a)

in Chapter 2 for speaker SK.

	a’mano-ga	mo’rimori	ta’be-ta
1	170	157	149
2	195	160	132
3	185	171	134
4	179	164	140
5	182	157	133
6	176	162	143
7	170	161	154
8	181	159	143
9	177	153	144
10	192	154	137
11	161	162	145
average	178.9	160.0	141.3
SD	9.40	4.77	6.58

Table 32: Peak F_0 values of the three phrases in sentence (8b)

in Chapter 2 for speaker SK.

	o'ono-ga	ya'mana-ni	no'oto-o	ka'esi-ta
1	327	268	260	245
2	318	272	236	236
3	307	269	252	270
4	325	279	256	259
5	305	271	256	240
6	322	271	250	254
7	325	293	263	250
8	323	278	271	255
9	317	278	265	229
10	322	283	264	257
11	313	269	227	227
average	318.5	275.5	254.5	247.5
SD	7.06	7.27	12.45	12.76

Table 33: Peak F_0 values of the four phrases in sentence (9a) in Chapter 2 for speaker YK.

	o'ono-ga	no'oto-o	ya'mana-ni	ka'esi-ta
1	301	269	257	241
2	328	299	271	277
3	308	255	245	233
4	340	268	257	237
5	304	252	257	251
6	322	262	271	243
7	321	277	265	233
8	328	284	272	254
9	318	267	264	258
10	337	302	266	246
11	314	271	264	230
average	320.1	273.3	262.6	245.7
SD	12.15	15.43	7.71	13.15

Table 34: Peak F_0 values of the four phrases in sentence (9b) in Chapter 2 for speaker YK.

	se’mmu-ga	mo’rino-o	ra’nchi-ni	mane’i-ta
1	318	261	243	229
2	318	251	259	231
3	327	264	253	255
4	309	256	245	249
5	333	293	245	249
6	323	265	247	230
7	320	266	259	252
8	314	292	253	237
9	328	282	263	261
10	328	301	285	256
11	332	287	276	239
average	322.7	274.4	257.1	244.4
SD	7.28	16.27	12.81	11.00

Table 35: Peak F_0 values of the four phrases in sentence (10a) in Chapter 2 for speaker YK.

	se’mmu-ga	ra’nchi-ni	mo’rino-o	mane’i-ta
1	327	267	245	236
2	335	269	261	233
3	329	257	244	244
4	312	265	266	235
5	311	270	253	248
6	334	285	233	252
7	330	276	264	245
8	325	266	261	243
9	333	288	268	249
10	333	297	288	246
11	321	273	272	258
average	326.4	273.9	259.5	244.5
SD	8.06	11.18	14.47	7.20

Table 36: Peak F_0 values of the four phrases in sentence (10b) in Chapter 2 for speaker YK.

	o'ono-ga	ya'mana-ni	no'oto-o	ka'esi-ta
1	292	256	250	237
2	271	249	238	242
3	302	258	243	239
4	310	243	238	249
5	288	243	238	245
6	274	236	242	245
7	292	249	245	245
8	295	255	241	248
9	281	243	243	243
10	295	246	242	243
11	291	247	241	245
average	290.1	247.7	241.9	243.7
SD	10.89	6.31	3.37	3.36

Table 37: Peak F_0 values of the four phrases in sentence (9a) in Chapter 2 for speaker AM.

	o'ono-ga	no'oto-o	ya'mana-ni	ka'esi-ta
1	292	245	263	229
2	283	248	249	235
3	276	246	251	238
4	272	247	253	242
5	309	253	264	246
6	279	241	247	252
7	287	244	248	239
8	301	241	252	237
9	281	244	246	238
10	325	252	260	255
11	293	244	244	237
average	290.7	245.9	252.5	240.7
SD	15.06	3.73	6.60	7.24

Table 38: Peak F_0 values of the four phrases in sentence (9b) in Chapter 2 for speaker AM.

	se'mmu-ga	mo'rino-o	ra'nchi-ni	mane'i-ta
1	285	250	244	227
2	278	250	244	236
3	296	250	237	231
4	328	253	247	237
5	283	257	241	243
6	286	249	233	238
7	280	238	243	242
8	284	243	237	232
9	312	252	242	239
10	290	250	240	231
11	292	249	249	235
average	292.2	249.2	241.5	235.5
SD	14.41	4.76	4.44	4.72

Table 39: Peak F_0 values of the four phrases in sentence (10a) in Chapter 2 for speaker AM.

	se'mmu-ga	ra'nchi-ni	mo'rino-o	mane'i-ta
1	293	247	256	241
2	283	241	242	223
3	283	249	249	234
4	283	244	242	235
5	268	235	239	233
6	302	251	253	236
7	287	252	260	247
8	291	238	241	234
9	259	239	242	235
10	290	246	238	236
11	288	249	251	245
average	284.3	244.6	246.6	236.3
SD	11.27	5.42	7.14	6.14

Table 40: Peak F_0 values of the four phrases in sentence (10b) in Chapter 2 for speaker AM.

	o'ono-ga	ya'mana-ni	no'oto-o	ka'esi-ta
1	186	150	146	153
2	183	159	145	150
3	176	158	130	111
4	194	161	141	118
5	177	161	138	115
6	188	158	146	121
7	177	155	117	112
8	195	161	130	119
9	181	154	150	126
10	189	159	132	113
11	175	157	140	125
average	183.7	157.5	137.7	123.9
SD	6.86	3.26	9.24	13.84

Table 41: Peak F_0 values of the four phrases in sentence (9a) in Chapter 2 for speaker SK.

	o'ono-ga	no'oto-o	ya'mana-ni	ka'esi-ta
1	180	149	154	140
2	186	155	157	152
3	197	174	168	148
4	185	159	164	151
5	189	158	162	140
6	181	159	161	116
7	181	149	149	122
8	182	163	152	124
9	182	151	155	138
10	182	130	160	119
11	181	166	153	144
average	184.2	155.7	157.7	135.8
SD	4.80	10.85	5.50	12.63

Table 42: Peak F_0 values of the four phrases in sentence (9b) in Chapter 2 for speaker SK.

	se'mmu-ga	mo'rino-o	ra'nchi-ni	mane'i-ta
1	194	165	159	148
2	190	154	141	126
3	204	159	144	152
4	191	155	157	127
5	182	160	149	136
6	187	153	133	127
7	189	150	133	125
8	176	148	139	129
9	187	151	146	129
10	187	144	140	121
11	191	158	162	115
average	188.9	154.3	145.7	130.5
SD	6.67	5.72	9.56	10.48

Table 43: Peak F_0 values of the four phrases in sentence (10a) in Chapter 2 for speaker SK.

	se'mmu-ga	ra'nchi-ni	mo'rino-o	mane'i-ta
1	189	148	181	138
2	199	155	153	135
3	186	157	166	144
4	197	158	152	131
5	193	159	156	133
6	192	138	145	120
7	173	146	143	126
8	189	147	173	114
9	186	149	147	123
10	194	145	148	121
11	188	157	153	134
average	189.6	150.8	156.1	129.0
SD	6.64	6.46	11.61	8.54

Table 44: Peak F_0 values of the four phrases in sentence (10b) in Chapter 2 for speaker SK.

	na' o-ga	yo' n-da	no' oto
1	293	240	240
2	293	233	205
3	320	218	233
4	298	212	223
5	303	205	211
6	315	214	224
7	312	212	231
8	324	221	239
9	315	208	225
10	316	230	228
11	323	212	229
average	310.2	218.6	226.2
SD	10.98	10.66	10.14

Table 45: Peak F_0 values of the three phrases in sentence

(8a) in Chapter 3 for speaker YK.

	na' o-no	a' ni-no	no' oto
1	288	225	218
2	310	235	224
3	318	227	230
4	328	219	229
5	308	225	221
6	311	230	217
7	320	218	231
8	310	219	229
9	316	222	218
10	316	235	241
11	316	218	229
average	312.8	224.8	226.1
SD	9.52	6.09	6.95

Table 46: Peak F_0 values of the three phrases in sentence

(8a) in Chapter 3 for speaker YK.

	na’o-ga	yo’n-da	no’oto
1	268	240	244
2	283	244	258
3	262	241	240
4	270	239	246
5	272	249	258
6	258	238	250
7	273	234	248
8	279	235	245
9	266	231	240
10	269	237	248
11	266	232	238
average	269.6	238.2	246.8
SD	6.79	5.06	6.36

Table 47: Peak F_0 values of the three phrases in sentence (8a) in Chapter 3 for speaker AM.

	na’o-no	a’ni-no	no’oto
1	271	233	246
2	297	238	238
3	274	240	249
4	279	249	251
5	255	234	240
6	289	237	244
7	289	244	250
8	266	237	237
9	260	230	241
10	273	243	241
11	270	241	240
average	274.8	238.7	243.4
SD	12.22	5.19	4.72

Table 48: Peak F_0 values of the three phrases in sentence (8a) in Chapter 3 for speaker AM.

	na’o-ga	yo’n-da	no’oto
1	178	120	142
2	187	132	159
3	186	168	122
4	190	151	131
5	167	128	114
6	179	133	143
7	180	131	128
8	188	145	122
9	169	127	128
10	174	126	116
11	185	131	143
average	180.3	135.6	131.6
SD	7.41	13.16	13.08

Table 49: Peak F_0 values of the three phrases in sentence (8a) in Chapter 3 for speaker SK.

	na’o-no	a’ni-no	no’oto
1	190	187	132
2	183	155	116
3	179	171	111
4	174	169	118
5	179	168	118
6	184	141	118
7	197	163	124
8	177	162	119
9	176	151	116
10	176	156	110
11	182	145	115
average	181.5	160.7	117.9
SD	6.54	12.47	5.74

Table 50: Peak F_0 values of the three phrases in sentence (8a) in Chapter 3 for speaker SK.

	ma’ri-ga	no’n-da	ro’ze-no	ryo’o
1	314	227	260	207
2	287	229	269	212
3	347	256	274	236
4	310	229	275	211
5	313	226	237	208
6	316	231	258	200
7	310	218	259	216
8	324	224	243	202
9	322	226	270	228
10	305	232	267	212
11	329	229	282	237
average	316.1	229.7	263.1	215.4
SD	14.39	9.07	12.98	12.19

Table 51: Peak F_0 values of the four phrases in sentence (16a) in Chapter 3 for speaker YK.

	ma’ri-no	a’ni-ga	no’n-da	ro’ze
1	308	242	238	227
2	308	238	214	226
3	320	234	227	261
4	324	230	230	222
5	315	238	243	240
6	315	237	223	235
7	313	228	230	236
8	297	230	222	227
9	325	228	238	255
10	333	249	249	234
11	316	232	234	249
average	315.8	235.1	231.6	237.5
SD	9.29	6.22	9.64	12.10

Table 52: Peak F_0 values of the four phrases in sentence (16b) in Chapter 3 for speaker YK.

	a'raki-ga	tano'n-da	dora'i-no	nio'i
1	292	234	248	211
2	307	229	245	202
3	318	223	255	244
4	320	217	266	221
5	305	217	252	210
6	326	230	265	207
7	325	222	282	237
8	306	223	246	212
9	307	232	271	215
10	338	234	293	235
11	329	241	267	232
average	315.7	227.5	262.7	220.5
SD	12.84	7.30	14.70	13.47

Table 53: Peak F_0 values of the four phrases in sentence (17a) in Chapter 3 for speaker YK.

	a'raki-to	ya'mano-ga	tano'n-da	dora'i
1	306	252	237	217
2	293	224	242	236
3	319	238	251	237
4	317	224	257	216
5	315	244	266	216
6	317	244	247	216
7	313	239	250	234
8	328	248	272	221
9	329	244	268	220
10	323	278	253	269
11	325	247	243	258
average	316.8	243.8	253.3	230.9
SD	9.93	13.84	10.86	17.41

Table 54: Peak F_0 values of the four phrases in sentence (17b) in Chapter 3 for speaker YK.

	a'mano-ga	a'isi-ta	yo'ojo-no	namae
1	321	219	249	196
2	302	239	252	198
3	283	221	272	216
4	324	232	254	205
5	331	209	272	212
6	319	271	258	220
7	316	224	258	209
8	312	207	238	208
9	342	211	277	216
10	325	228	287	231
11	324	214	266	231
average	318.1	225.0	262.1	212.9
SD	14.76	17.37	13.51	11.02

Table 55: Peak F_0 values of the four phrases in sentence (18a) in Chapter 3 for speaker YK.

	a'mano-no	o'nsi-ga	a'isi-ta	yo'ojo
1	304	233	233	229
2	327	233	245	241
3	325	206	231	223
4	315	219	220	230
5	343	226	219	205
6	319	220	243	225
7	307	218	238	226
8	321	213	243	207
9	356	244	273	236
10	327	233	268	218
11	337	239	261	243
average	325.5	225.8	243.1	225.7
SD	14.62	11.11	17.13	11.73

Table 56: Peak F_0 values of the four phrases in sentence (18b) in Chapter 3 for speaker YK.

	yo'oji-ga	era'n-da	omo'cha-no	namae
1	305	246	281	202
2	325	243	274	182
3	304	256	283	192
4	313	219	292	183
5	308	235	275	220
6	318	252	278	210
7	317	230	285	189
8	315	238	260	168
9	318	209	274	181
10	335	215	280	195
11	309	213	258	177
average	315.2	232.4	276.4	190.8
SD	8.70	15.63	9.62	14.50

Table 57: Peak F_0 values of the four phrases in sentence (19a) in Chapter 3 for speaker YK.

	ge'nkina	yo'oji-ga	era'n-da	omo'cha
1	304	229	250	205
2	313	257	265	206
3	348	242	278	236
4	322	249	249	265
5	309	226	287	209
6	319	227	271	235
7	327	228	289	198
8	308	205	249	197
9	329	221	243	224
10	324	215	269	223
11	309	213	263	207
average	319.3	228.4	264.8	218.6
SD	12.14	14.94	15.09	19.62

Table 58: Peak F_0 values of the four phrases in sentence (19b) in Chapter 3 for speaker YK.

	ma'ri-ga	no'n-da	ro'ze-no	ryo'o
1	287	239	240	239
2	302	249	260	241
3	279	239	249	238
4	281	233	249	248
5	263	229	244	243
6	261	237	238	232
7	289	232	231	237
8	279	237	264	248
9	272	233	233	240
10	273	244	255	227
11	285	240	253	243
average	279.2	237.5	246.9	239.6
SD	11.27	5.47	10.26	5.97

Table 59: Peak F_0 values of the four phrases in sentence (16a) in Chapter 3 for speaker AM.

	ma'ri-no	a'ni-ga	no'n-da	ro'ze
1	269	236	231	240
2	263	234	231	243
3	267	234	227	244
4	294	251	253	255
5	271	241	236	238
6	279	234	235	246
7	285	241	239	248
8	279	239	233	238
9	306	244	241	246
10	280	240	236	234
11	276	243	235	232
average	279.0	239.7	236.1	242.2
SD	11.92	4.97	6.50	6.34

Table 60: Peak F_0 values of the four phrases in sentence (16b) in Chapter 3 for speaker AM.

	a'raki-ga	tano'n-da	dora'i-no	nio'i
1	299	241	256	232
2	272	232	245	238
3	303	247	255	234
4	318	243	239	233
5	286	238	246	239
6	288	234	238	244
7	285	242	236	238
8	273	244	239	247
9	292	247	242	240
10	297	237	232	238
11	268	236	233	234
average	289.2	240.1	241.9	237.9
SD	14.21	4.83	7.63	4.42

Table 61: Peak F_0 values of the four phrases in sentence (17a) in Chapter 3 for speaker AM.

	a'raki-to	ya'mano-ga	tano'n-da	dora'i
1	311	265	252	247
2	287	252	240	244
3	286	262	235	249
4	300	258	245	254
5	276	241	235	240
6	273	247	237	238
7	292	253	238	239
8	268	246	236	239
9	292	252	249	249
10	274	247	236	243
11	265	240	244	240
average	284.0	251.2	240.6	243.8
SD	13.58	7.68	5.69	5.02

Table 62: Peak F_0 values of the four phrases in sentence (17b) in Chapter 3 for speaker AM.

	a'mano-ga	a'isi-ta	yo'ojo-no	namae
1	281	229	246	220
2	281	234	257	210
3	286	242	257	224
4	296	263	250	224
5	265	233	237	224
6	273	235	240	212
7	284	242	244	220
8	281	227	249	216
9	275	233	244	211
10	284	232	240	220
11	278	229	240	221
average	280.4	236.3	245.8	218.4
SD	7.56	9.62	6.49	5.05

Table 63: Peak F_0 values of the four phrases in sentence (18a) in Chapter 3 for speaker AM.

	a'mano-no	o'nsi-ga	a'isi-ta	yo'ojo
1	276	240	241	243
2	267	238	244	250
3	287	232	230	244
4	311	253	241	245
5	295	239	240	243
6	271	227	233	239
7	270	248	244	246
8	281	243	240	244
9	292	250	238	244
10	284	248	237	233
11	308	239	240	247
average	285.6	241.5	238.9	243.5
SD	14.13	7.50	4.08	4.21

Table 64: Peak F_0 values of the four phrases in sentence (18b) in Chapter 3 for speaker AM.

	yo'oji-ga	era'n-da	omo'cha-no	namae
1	306	249	249	225
2	284	235	245	210
3	269	238	252	218
4	287	238	248	208
5	281	249	253	212
6	271	242	244	212
7	288	242	254	208
8	278	237	235	211
9	272	232	236	212
10	295	248	261	224
11	279	233	234	217
average	282.7	240.3	246.5	214.3
SD	10.53	5.94	8.28	5.67

Table 65: Peak F_0 values of the four phrases in sentence (19a) in Chapter 3 for speaker AM.

	ge'nkina	yo'oji-ga	era'n-da	omo'cha
1	280	245	239	243
2	274	247	231	237
3	275	240	233	244
4	310	243	238	249
5	264	240	234	233
6	270	244	235	244
7	272	246	240	243
8	270	241	231	234
9	270	246	232	236
10	276	240	232	244
11	276	243	226	234
average	276.1	243.2	233.7	240.1
SD	11.46	2.52	3.91	5.16

Table 66: Peak F_0 values of the four phrases in sentence (19b) in Chapter 3 for speaker AM.

	ma'ri-ga	no'n-da	ro'ze-no	ryo'o
1	177	128	140	120
2	170	124	141	120
3	181	139	153	121
4	184	127	157	122
5	181	118	130	117
6	179	130	127	123
7	175	126	140	134
8	185	133	151	118
9	174	134	139	115
10	177	128	137	107
11	183	143	147	120
average	178.7	130.0	142.0	119.7
SD	4.41	6.66	8.86	6.15

Table 67: Peak F_0 values of the four phrases in sentence (16a) in Chapter 3 for speaker SK.

	ma'ri-no	a'ni-ga	no'n-da	ro'ze
1	184	157	139	143
2	181	165	115	164
3	182	178	127	121
4	182	175	121	124
5	178	156	122	119
6	183	170	122	117
7	179	160	122	128
8	179	157	124	134
9	171	163	123	118
10	183	167	115	117
11	179	165	125	118
average	180.1	164.8	123.2	127.5
SD	3.45	6.98	6.12	13.96

Table 68: Peak F_0 values of the four phrases in sentence (16b) in Chapter 3 for speaker SK.

	a’raki-ga	tano’n-da	dora’i-no	nio’i
1	177	120	159	148
2	188	126	172	113
3	191	128	134	108
4	188	118	137	110
5	188	120	153	112
6	188	125	163	120
7	185	127	154	115
8	197	119	145	118
9	186	123	146	110
10	183	136	145	117
11	190	124	148	115
average	187.4	124.2	150.5	116.9
SD	4.75	4.93	10.66	10.44

Table 69: Peak F_0 values of the four phrases in sentence (17a) in Chapter 3 for speaker SK.

	a’raki-to	ya’mano-ga	tano’n-da	dora’i
1	205	152	175	129
2	195	153	145	152
3	191	146	155	127
4	177	143	150	133
5	184	159	136	124
6	180	141	162	140
7	178	153	147	139
8	180	139	144	119
9	190	151	142	120
10	190	147	141	114
11	178	158	145	127
average	186.2	149.3	149.3	129.5
SD	8.44	6.31	10.55	10.46

Table 70: Peak F_0 values of the four phrases in sentence (17b) in Chapter 3 for speaker SK.

	a'mano-ga	a'isi-ta	yo'ojo-no	namae
1	179	137	164	121
2	190	128	139	137
3	185	154	152	122
4	181	131	139	127
5	186	129	131	121
6	183	139	134	119
7	179	124	141	134
8	179	146	149	124
9	179	148	145	122
10	179	136	134	116
11	177	137	140	123
average	181.5	137.2	142.5	124.2
SD	3.80	8.77	9.10	5.98

Table 71: Peak F_0 values of the four phrases in sentence (18a) in Chapter 3 for speaker SK.

	a'mano-no	o'nsi-ga	a'isi-ta	yo'ojo
1	180	159	158	146
2	178	145	139	120
3	188	149	132	113
4	186	144	125	112
5	176	142	122	113
6	185	129	133	114
7	184	144	148	119
8	185	131	139	112
9	187	164	124	116
10	170	130	128	120
11	170	156	121	118
average	180.8	144.8	133.5	118.5
SD	6.24	11.21	11.10	9.21

Table 72: Peak F_0 values of the four phrases in sentence (18b) in Chapter 3 for speaker SK.

	yo'oji-ga	era'n-da	omo'cha-no	namae
1	178	137	149	116
2	184	147	146	114
3	183	132	159	117
4	187	139	145	120
5	179	131	132	108
6	185	137	144	130
7	185	123	131	126
8	186	135	155	128
9	186	130	140	127
10	185	127	141	112
11	177	134	139	123
average	183.2	133.8	143.7	120.1
SD	3.35	6.12	8.19	6.92

Table 73: Peak F_0 values of the four phrases in sentence (19a) in Chapter 3 for speaker SK.

	ge'nkina	yo'oji-ga	era'n-da	omo'cha
1	191	159	146	126
2	192	173	130	126
3	189	144	148	128
4	184	135	124	120
5	190	159	119	124
6	186	143	127	115
7	189	138	140	122
8	181	135	133	125
9	186	134	139	128
10	188	136	132	118
11	181	133	131	112
average	187.0	144.5	133.5	122.2
SD	3.59	12.69	8.54	5.10

Table 74: Peak F_0 values of the four phrases in sentence (19b) in Chapter 3 for speaker SK.

	ma'ri-no	a'ni-no	ro'ze-no	ryo'o
1	300	229	253	204
2	327	217	250	214
3	315	220	252	204
4	296	208	224	181
5	311	217	251	198
6	315	230	243	193
7	316	233	260	196
8	327	233	260	217
9	324	234	258	221
10	331	241	269	223
11	320	224	257	217
average	316.5	226.0	252.5	206.2
SD	10.56	9.23	11.06	12.74

Table 75: Peak F_0 values of the four phrases in sentence (20) in Chapter 3 for speaker YK.

	a'mano-no	o'nsi-no	yo'ojo-no	namae
1	303	243	250	212
2	308	211	256	252
3	320	220	254	228
4	314	225	252	210
5	310	220	252	214
6	318	223	267	215
7	320	226	256	205
8	318	224	254	217
9	335	225	287	241
10	327	237	290	237
11	326	251	278	233
average	318.1	227.7	263.3	224.0
SD	8.77	10.93	14.19	14.37

Table 76: Peak F_0 values of the four phrases in sentence (21) in Chapter 3 for speaker YK.

	ma’ri-no	a’ni-no	ro’ze-no	ryo’o
1	272	247	241	255
2	265	236	242	248
3	303	265	260	233
4	273	238	245	238
5	279	244	240	253
6	265	235	243	239
7	273	236	231	238
8	294	236	238	241
9	260	231	242	246
10	273	239	237	243
11	278	239	235	241
average	275.9	240.5	241.3	243.2
SD	12.09	8.77	7.03	6.41

Table 77: Peak F_0 values of the four phrases in sentence (20) in Chapter 3 for speaker AM.

	a’mano-no	o’nsi-no	yo’ojo-no	namae
1	286	253	255	225
2	317	252	252	213
3	304	240	253	217
4	279	251	254	221
5	291	237	246	208
6	298	247	249	218
7	299	253	238	239
8	278	241	245	215
9	305	241	233	228
10	274	244	246	222
11	285	238	246	218
average	292.4	245.2	247.0	220.4
SD	12.78	5.94	6.48	7.91

Table 78: Peak F_0 values of the four phrases in sentence (21) in Chapter 3 for speaker AM.

	ma'ri-no	a'ni-no	ro'ze-no	ryo'o
1	178	167	146	122
2	173	180	150	119
3	178	166	127	113
4	179	184	135	110
5	173	158	126	111
6	179	162	128	116
7	181	169	131	107
8	176	169	113	114
9	182	172	124	114
10	179	158	129	114
11	179	168	125	113
average	177.9	168.5	130.4	113.9
SD	2.74	7.73	9.82	3.92

Table 79: Peak F_0 values of the four phrases in sentence (20) in Chapter 3 for speaker SK.

	a'mano-no	o'nsi-no	yo'ojo-no	namae
1	186	154	162	133
2	175	157	146	128
3	192	169	130	122
4	166	147	131	114
5	183	148	159	121
6	177	150	131	123
7	185	155	134	128
8	175	151	131	136
9	180	153	139	121
10	181	138	119	112
11	174	153	161	127
average	179.5	152.3	140.3	124.1
SD	6.76	7.20	13.96	6.96

Table 80: Peak F_0 values of the four phrases in sentence (21) in Chapter 3 for speaker SK.

	V1	P1	V2	P2	V3	P3	V4	P4	V5
1	206	276	268	268	185	236	223	223	216
2	210	285	271	271	235	245	230	230	212
3	194	277	267	267	201	231	219	219	205
4	192	274	262	262	230	236	218	218	200
5	204	292	282	282	199	242	224	224	215
6	198	290	273	273	255	255	240	240	228
7	193	280	268	268	180	233	216	216	209
8	208	289	274	274	200	238	218	218	205
9	208	285	275	275	199	233	215	215	192
10	201	288	280	280	247	253	232	232	209
11	196	280	270	270	247	247	226	226	207
average	200.9	283.3	271.8	271.8	216.2	240.8	223.7	223.7	208.9
SD	6.33	5.89	5.56	5.56	25.79	7.86	7.40	7.40	8.85

Table 81: F_0 values of peaks and valleys of the four phrases in sentence (23a) in Chapter 3 for speaker YK.

	V1	P1	V2	P2	V3	P3	V4	P4	V5
1	214	278	264	264	256	256	224	224	206
2	208	277	266	266	246	246	233	233	212
3	215	270	264	264	241	241	224	224	202
4	211	264	252	252	231	231	208	208	189
5	212	271	271	271	258	258	223	231	219
6	202	282	277	277	248	248	227	227	208
7	207	268	264	264	238	238	215	215	196
8	222	280	275	275	246	246	219	219	206
9	214	285	271	271	255	255	224	224	207
10	199	292	281	281	268	268	230	230	216
11	207	285	276	276	259	259	216	222	195
average	210.1	277.5	269.2	269.2	249.6	249.6	222.1	223.4	205.1
SD	6.13	8.09	7.83	7.83	10.23	10.23	6.83	6.98	8.67

Table 82: F_0 values of peaks and valleys of the four phrases in sentence (23b) in Chapter 3 for speaker YK.

	V1	P1	V2	P2	V3	P3	V4	P4	V5
1	221	250	249	249	230	245	245	245	242
2	225	265	258	258	221	236	232	232	226
3	230	284	259	259	227	249	239	239	230
4	214	252	245	245	220	235	226	226	224
5	216	251	240	240	215	230	230	230	224
6	217	249	247	247	208	234	226	226	215
7	214	260	250	250	226	230	226	226	221
8	220	256	243	243	197	230	230	230	223
9	213	247	239	239	218	232	232	232	229
10	237	265	246	246	210	238	226	236	229
11	212	267	244	244	219	247	233	233	228
average	219.9	258.7	247.3	247.3	217.4	236.9	231.4	232.3	226.5
SD	7.54	10.48	6.18	6.18	9.11	6.71	5.77	5.64	6.43

Table 83: F_0 values of peaks and valleys of the four phrases in sentence (23a) in Chapter 3 for speaker AM.

	V1	P1	V2	P2	V3	P3	V4	P4	V5
1	233	250	246	246	241	241	218	224	223
2	227	249	240	240	234	234	210	216	216
3	230	252	244	244	222	234	230	230	223
4	236	251	244	244	242	242	212	229	229
5	222	249	243	243	228	233	226	233	233
6	229	245	240	240	233	233	209	220	215
7	229	245	238	238	230	237	210	228	224
8	225	246	238	238	224	231	217	229	229
9	237	257	250	250	249	249	215	229	225
10	232	247	241	241	232	232	213	228	228
11	225	243	237	237	233	233	214	234	234
average	229.5	248.5	241.9	241.9	233.5	236.3	215.8	227.3	225.4
SD	4.48	3.77	3.75	3.75	7.61	5.28	6.41	5.10	5.84

Table 84: F_0 values of peaks and valleys of the four phrases in sentence (23b) in Chapter 3 for speaker AM.

	V1	P1	V2	P2	V3	P3	V4	P4	V5
1	137	168	161	161	130	140	121	131	116
2	123	168	145	161	145	145	124	138	102
3	135	172	163	163	128	150	131	131	118
4	116	163	153	153	104	123	121	121	106
5	135	173	167	167	103	149	130	130	119
6	139	176	170	170	141	154	137	137	133
7	140	169	162	162	124	144	135	135	121
8	145	160	151	151	107	133	117	117	105
9	142	170	159	159	126	145	118	129	111
10	141	169	155	155	119	138	117	125	115
11	134	164	153	153	107	132	130	130	98
average	135.2	168.4	158.1	159.5	121.3	141.2	125.5	129.5	113.1
SD	8.18	4.42	7.09	5.77	13.97	8.71	6.99	6.13	9.54

Table 85: F_0 values of peaks and valleys of the four phrases in sentence (23a) in Chapter 3 for speaker SK.

	V1	P1	V2	P2	V3	P3	V4	P4	V5
1	130	157	136	146	130	130	119	121	109
2	132	164	146	160	126	137	103	121	117
3	127	180	158	165	144	144	107	124	117
4	143	162	133	152	125	149	125	125	105
5	134	162	146	146	127	127	112	112	105
6	133	168	141	156	143	143	125	125	115
7	132	164	144	155	148	148	112	127	118
8	140	167	150	150	132	132	115	124	107
9	137	156	134	146	128	128	109	113	106
10	135	159	143	143	131	131	118	118	107
11	129	154	150	150	135	135	111	125	108
average	133.8	163.0	143.7	151.7	133.5	136.7	114.2	121.4	110.4
SD	4.53	6.85	7.20	6.43	7.60	7.65	6.71	4.81	5.00

Table 86: F_0 values of peaks and valleys of the four phrases in sentence (23b) in Chapter 3 for speaker SK.

	V1	P1	V2	P2	V3	P3	V4
1	240	272	259	259	234	234	208
2	192	268	261	261	227	227	193
3	224	273	257	257	227	227	179
4	174	286	271	271	239	239	208
5	205	292	273	273	239	239	208
6	214	286	256	256	229	229	179
7	229	281	268	268	229	229	198
8	229	290	280	280	231	231	194
9	240	293	271	271	231	231	198
10	224	292	284	284	254	254	215
11	233	305	281	281	249	249	167
average	218.5	285.3	269.2	269.2	235.4	235.4	195.2
SD	19.77	10.47	9.49	9.49	8.64	8.64	14.22

Table 87: F_0 values of peaks and valleys of the three phrases in sentence (25a) in Chapter 3 for speaker YK.

	V1	P1	V2	P2	V3	P3	V4
1	205	277	261	261	230	230	204
2	195	273	267	267	229	229	164
3	202	286	266	266	238	238	188
4	216	278	264	264	226	226	205
5	212	278	268	268	231	231	205
6	197	286	267	267	226	226	208
7	236	292	278	278	238	238	206
8	238	280	261	261	236	236	198
9	236	285	271	271	220	220	185
10	225	300	280	280	233	233	185
11	244	295	281	281	239	239	207
average	218.7	284.5	269.5	269.5	231.5	231.5	195.9
SD	17.06	8.00	6.87	6.87	5.76	5.76	13.23

Table 88: F_0 values of peaks and valleys of the three phrases in sentence (25b) in Chapter 3 for speaker YK.

	V1	P1	V2	P2	V3	P3	V4
1	232	261	251	251	214	231	220
2	220	267	247	247	207	230	229
3	224	256	246	246	214	230	229
4	220	267	242	242	214	233	228
5	238	267	249	249	218	239	234
6	221	255	245	245	216	233	225
7	227	254	246	246	221	234	234
8	227	252	242	242	232	232	229
9	210	265	240	240	229	229	228
10	223	249	247	247	217	230	229
11	217	247	237	237	211	223	221
average	223.5	258.2	244.7	244.7	217.5	231.3	227.8
SD	7.15	7.18	3.91	3.91	7.05	3.72	4.24

Table 89: F_0 values of peaks and valleys of the three phrases in sentence (25a) in Chapter 3 for speaker AM.

	V1	P1	V2	P2	V3	P3	V4
1	235	255	243	243	210	226	225
2	216	256	247	247	218	230	229
3	227	256	250	250	211	228	228
4	231	261	257	257	216	231	229
5	242	274	265	265	243	243	238
6	225	244	239	239	204	217	215
7	229	248	247	247	210	228	225
8	223	247	244	244	219	233	225
9	222	249	246	246	213	228	223
10	229	255	247	247	216	232	225
11	230	249	246	246	213	225	224
average	228.1	254.0	248.3	248.3	215.7	229.2	226.0
SD	6.57	7.94	6.78	6.78	9.54	6.01	5.26

Table 90: F_0 values of peaks and valleys of the three phrases in sentence (25b) in Chapter 3 for speaker AM.

	V1	P1	V2	P2	V3	P3	V4
1	135	168	158	158	116	157	141
2	149	167	144	159	108	133	128
3	132	166	156	156	123	145	132
4	146	162	151	151	114	135	122
5	149	158	151	151	117	135	125
6	143	163	154	154	116	130	118
7	140	165	153	153	124	135	127
8	133	158	149	149	118	123	112
9	146	160	149	149	125	134	120
10	162	169	156	156	113	135	124
11	124	155	145	145	113	131	124
average	141.7	162.8	151.5	152.8	117.0	135.7	124.8
SD	9.95	4.41	4.29	4.09	4.99	8.36	7.21

Table 91: F_0 values of peaks and valleys of the three phrases in sentence (25a) in Chapter 3 for speaker SK.

	V1	P1	V2	P2	V3	P3	V4
1	104	165	157	157	120	141	141
2	146	170	160	160	129	129	118
3	167	182	171	171	137	157	143
4	158	171	162	162	119	150	127
5	132	150	134	134	112	141	141
6	152	164	154	154	131	148	140
7	133	163	152	152	134	142	140
8	158	170	161	161	135	146	141
9	106	160	151	151	114	135	114
10	124	157	147	147	110	136	136
11	136	163	152	152	112	139	136
average	137.8	165.0	154.6	154.6	123.0	142.2	134.3
SD	19.87	7.97	9.09	9.09	9.90	7.42	9.59

Table 92: F_0 values of peaks and valleys of the three phrases in sentence (25b) in Chapter 3 for speaker SK.

	V2	P2	V3
1	174	276	168
2	182	254	169
3	191	281	182
4	180	290	179
5	180	282	174
6	198	280	179
7	192	276	182
8	197	271	176
9	193	292	187
10	200	295	201
11	188	281	180
average	188.6	279.8	179.7
SD	8.15	10.72	8.61

Table 93: F_0 peak and valley values of the second phrase in sentence (11a) in Chapter 4 for speaker YK.

	V2	P2	V3
1	212	310	190
2	234	302	186
3	222	309	181
4	236	307	176
5	266	301	186
6	236	316	197
7	243	319	183
8	234	270	184
9	240	288	182
10	264	314	194
11	238	300	198
average	238.6	303.3	187.0
SD	14.94	13.40	6.66

Table 94: F_0 peak and valley values of the second phrase in sentence (11b) in Chapter 4 for speaker YK.

	V2	P2	V3
1	175	276	164
2	172	288	166
3	178	251	161
4	186	302	175
5	177	296	169
6	181	307	175
7	185	296	186
8	194	291	184
9	158	296	183
10	211	304	200
11	189	295	191
average	182.4	291.1	177.6
SD	12.88	14.99	11.70

Table 95: F_0 peak and valley values of the second phrase in sentence (12a) in Chapter 4 for speaker YK.

	V2	P2	V3
1	235	295	170
2	225	299	167
3	198	325	178
4	245	293	188
5	244	303	180
6	182	298	180
7	205	307	188
8	191	295	185
9	185	292	187
10	187	299	197
11	166	305	205
average	205.7	301.0	184.1
SD	26.00	8.87	10.47

Table 96: F_0 peak and valley values of the second phrase in sentence (12b) in Chapter 4 for speaker YK.

	V2	P2	V3
1	189	277	172
2	198	285	215
3	194	295	178
4	192	302	180
5	201	311	226
6	189	310	189
7	194	285	182
8	193	306	188
9	196	283	178
10	224	311	197
11	198	299	191
average	197.1	296.7	190.5
SD	9.22	11.90	15.81

Table 97: F_0 peak and valley values of the second phrase in sentence (13a) in Chapter 4 for speaker YK.

	V2	P2	V3
1	264	312	180
2	258	315	209
3	261	331	189
4	269	319	189
5	259	328	200
6	265	318	194
7	271	316	181
8	279	323	186
9	277	312	187
10	282	310	191
11	274	330	193
average	269.0	319.5	190.8
SD	7.91	7.17	7.91

Table 98: F_0 peak and valley values of the second phrase in sentence (13b) in Chapter 4 for speaker YK.

	V2	P2	V3
1	188	284	179
2	191	297	183
3	189	268	168
4	195	306	184
5	185	303	187
6	198	321	196
7	198	305	190
8	198	292	194
9	202	310	194
10	204	306	201
11	204	305	199
average	195.6	299.7	188.6
SD	6.29	13.57	9.29

Table 99: F_0 peak and valley values of the second phrase in sentence (14a) in Chapter 4 for speaker YK.

	V2	P2	V3
1	242	303	176
2	255	314	189
3	181	302	179
4	245	311	180
5	252	315	191
6	265	328	193
7	272	325	185
8	263	319	194
9	275	312	196
10	276	325	201
11	254	310	196
average	299.7	314.9	189.1
SD	13.57	8.25	7.70

Table 100: F_0 peak and valley values of the second phrase in sentence (14b) in Chapter 4 for speaker YK.