Degree of Initial Lowering in Japanese as a Reflex of Prosodic Structure Organization

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ABSTRACT

In this paper we show a significant contrast in the realization of the Minor Phrase-initial rise in Japanese as a function of the XP vs. nonXP status of the syntactic branching structure at the left edge of which the rise is located. Sentences examined consisted of a sequence of lexically unaccented nouns followed by an accented verb. F0 values of both the L and the H edge tones of Minor Phrase are found to be more extreme at left XP edge, understood to be a prosodic Major Phrase edge. These differences produce an initial rise at Major Phrase edge that is significantly larger than that at Minor Phrase edge.

1. INTRODUCTION

Two distinct levels of prosodic phrasing are crucial to the characterization of Japanese sentence intonation. The Minor Phrase (aka Accentual Phrase, abbreviated MiP) consists of one or more prosodic words (Selkirk&Tateishi 1988). Its distinctive tonal property is the appearance at its left edge of a LH rise, typically referred to as "initial lowering". The Major Phrase (aka Intermediate Phrase, abbreviated MaP) consists of one or more Minor Phrases. Poser 1984 and Pierrehumbert and Beckman 1988 (together, PPB) argue that Major Phrase in Japanese is the domain of a radical post-accent downstep, which appears only when accent and post-accent material are in the same MaP. They construe this post-accent downstep, or "catathesis", as a lowering of the pitch range, triggered by the presence of the H* in the H*+L pitch accent. The pitch range of the sentence is said to be "reset" upwards at the left edge of a (subsequent) Major Phrase. This characterization of the properties of Major Phrase crucially relies on data from sentences containing accented lexical items. In this paper we report on a phonetic study of Japanese sentences which consist of unaccented lexical items and as a result would be predicted by PPB to not show the pitch range lowering associated with post-accent downstep nor the consequent pitch range upward reset at the left edge of Major Phrase. The question, then, is just what properties might appear as a reflection of MaP structure in all-unaccented sequences. This study proposes to fill this gap in our understanding of the role of prosodic phrasing in Japanese sentence intonation.

In sequences consisting only of unaccented lexical items, the only tonal events reliably present are instances of the initial LH rise that is found at the left edge of any MiP. Some MiP edges also coincide with the edge of the higher order MaP. The results of our experiment show that there are indeed differences in the realization of the initial rise between cases that are Major Phrase-initial and those that are simply Minor Phrase-initial.

A subsidiary goal of our experiment was to provide additional evidence for claims that have been made about the relation of prosodic structure to syntactic structure in Japanese. Selkirk and Tateishi 1991, Nagahara 1994 and Sugahara 2003 show that there is a strong tendency for the left edge of a syntactic maximal projection XP to coincide with the edge of a Major Phrase; they show that upward resetting of pitch after downstep appears at left XP edges. Moreover, Kubozono 1993 argues that the left edge of any syntactic branching structure, whether in a compound word or a phrase, coincides with the edge of a Minor Phrase, since initial lowering is always found at the left edge of any branching structure. So in our experiment we controlled for the presence and absence of the left edge of syntactic XP (thus for MaP edge) in the target sentences, hypothesizing that in the presence of XP edge we would find realizations of initial lowering which would contrast with those found in branching contexts lacking an intervening XP edge.

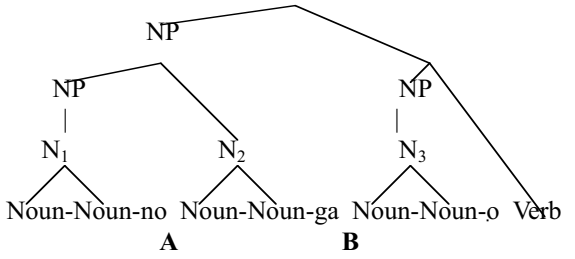
2. THE EXPERIMENT

2.1 DESIGN OF THE TARGET SENTENCES

The target sentences that were recorded involved minimal pairs which differed in syntactic phrase structure but were otherwise identical in properties relevant to sentence prosody. The first set of minimal pairs consisted of sentences with a subject-object-verb (SOV) structure. In one of the contrasting SOV sentences the medial (compound) noun, N2, was the head of the subject noun phrase (= Structure I); in the other, N2 was a genitive argument of the following object noun phrase (= Structure II), cf. Figures 1 and 2. The letters A and B below the syntactic trees mark the positions of relevant syntactic contrast. In line b of the figures are the prosodic phrase organizations that we hypothesized at the outset, and that are given support by our results. Parentheses mark MiPs ;

ISBN 1-876346-48-5

a.



b. {(LH)(LH)}{(LH)}

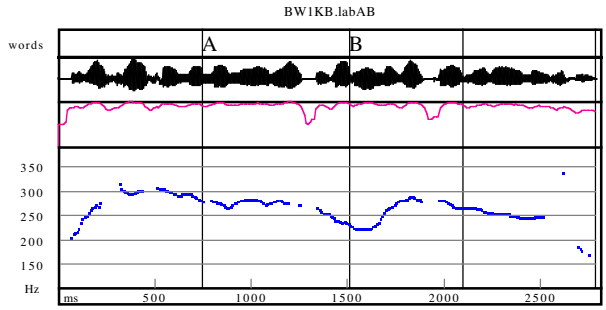


Figure 1. SOV Structure I: syntactic tree, prosodic structure and representative pitch track

The sentences in (1) and (2) provide examples of the sorts of SOV minimal pair used in our materials. Representative pitch tracks for these sentences are included in the corresponding figures.

(1) Wagashiyasan-no **A** mameuriyaku-ga **B** memogaki-o moraimashita. (Figure 1)

'The Japanese candy-store's bean-seller received some notes.'

(2) Wagashiyasan-ga **A** mameuriyaku-no **B** memogaki-o moraimashita. (Figure 2)

'The Japanese confectioner received the bean-seller's notes.'

The other set of minimal pairs examined consisted of double object sentences (SOOV), cf. Figures 3 and 4. Here the relevant syntactic contrast is in the parsing of the medial noun N3, which is either head of the dative object (Structure III) or an argument of the following direct object (Structure IV). Sentences (3) and (4) are representative of the minimal pairs in these SOOV sentences.

(3) Jichitai-ga Yanagidamura-no **A** namagomisyorijoo-ni **B** yaneita-o okurimashi-ta. (Figure 3)

'The municipal government sent roof boards to the garbage treatment center in Yanagida village.'

(4) Jichitai-ga Yanagidamura-ni **A** namagomisyorijoo-no **B** yaneita-o okurimashi-ta. (Figure 4)

'The municipal government sent the roof boards of the garbage treatment center to Yanagida village.'

In these target sentences we controlled for every other

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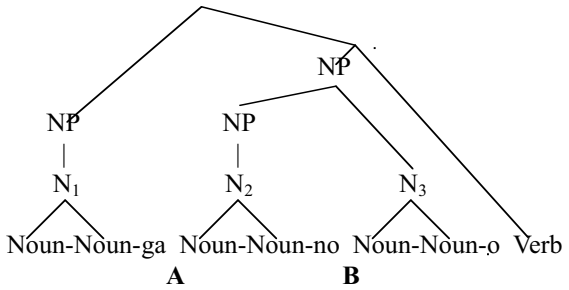

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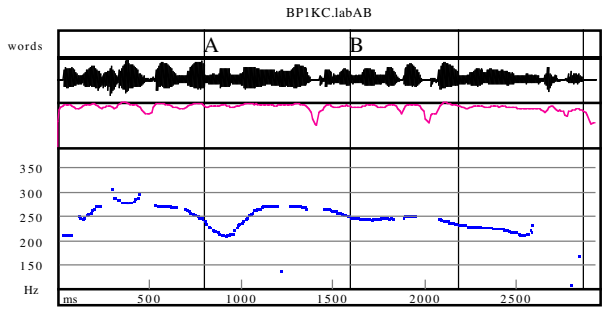

Figure 2. SOV Structure II: syntactic tree, prosodic structure and representative pitch track

property beyond the syntax that might conceivably have an effect on the prosodic phrasal organization or on the phonetic realization of the various of LH tonal movements. Each noun is a binary-branching compound, a structure which would call for the presence of a MiP break, and hence a LH rise, at its left edge. Each compound noun consists of at least 5 moras, and is thus heavy enough to stand alone as a MiP and as a MaP as well (Shinya 2003). The first two syllables contain either identical-height vowels or vowels that are rising in sonority, so any inherent pitch does not add to the F0 rise.

2.2 ELICITATION PROCEDURE

In order to provide the target sentences with as natural a discourse context as possible, they were each embedded in a distinct three sentence narrative, which was read as a whole by the speaker. To further deflect attention from the syntactic structure itself, and thereby avoid the intentional production of prosodic contrasts within the minimal pairs, no recording session included sentences that were members of the same minimal pair.

Three female native speakers of Tokyo Japanese in their early twenties who were exchange students at UMass/Amherst (KK, RH, TT) read the materials in the course of four recording sessions spaced one or two days away from each other. The sessions were designed so that four repetitions of a narrative with a particular target sentence would appear in one session and two in the next, for a minimum of six repetitions per speaker of any individual sentence. There were three minimal pairs of the SOV type and three minimal pairs of the SOOV type, for a total of twelve different sentence types. Each narrative

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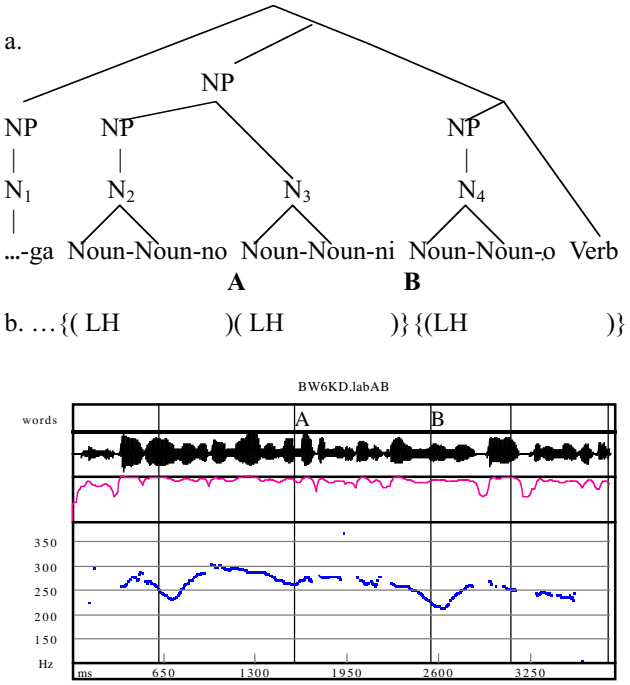

Figure 3. SOOV Structure III: syntactic tree, prosodic structure and representative pitch track

was written on a separate index card (in Japanese). Within a session, the reading materials were presented in a series of blocks consisting of randomized narratives from this experiment as well as fillers from a related experiment.

Recordings were made onto a CD in a sound-attenuated booth with 44kHz sampling frequency and 16bit quantization level. The data were transformed (16kHz, 16bit) for measurements which used Pitchworks.

2.3 Measurements

In every token of the target sentences, an initial rise was found at the left edge of each of the component compound nouns. The L of the rise was measured at the start of the vocalic nucleus of the initial syllable, and the H target was measured at the endpoint or peak of the rise.

3. RESULTS AND DISCUSSION

Below each of the distinct syntactic structure types in Figures 1-4 are representative pitch tracks which illustrate the prosodic contrast that correlates with the presence or absence of a syntactic XP edge in the A and B contexts in the sentences. For example, in an SOV-I sentence, the lack of an XP edge before the head noun N2, at A, correlates with an initial rise that is much smaller than that observed at the edge of the object N3 at B in the same sentence, which is separated from the N2 by an XP edge. The opposite pattern is seen in the pitch track for SOV-II sentences, where this time N2 is part of the object noun phrase and has an XP boundary at its left edge (and corresponding large initial rise), while N3, the head of the object phrase, at B, lacks any preceding left edge of XP, and shows a much smaller initial rise. As for the SOOV cases, the pitch tracks in Figures 3 and 4 show there to be

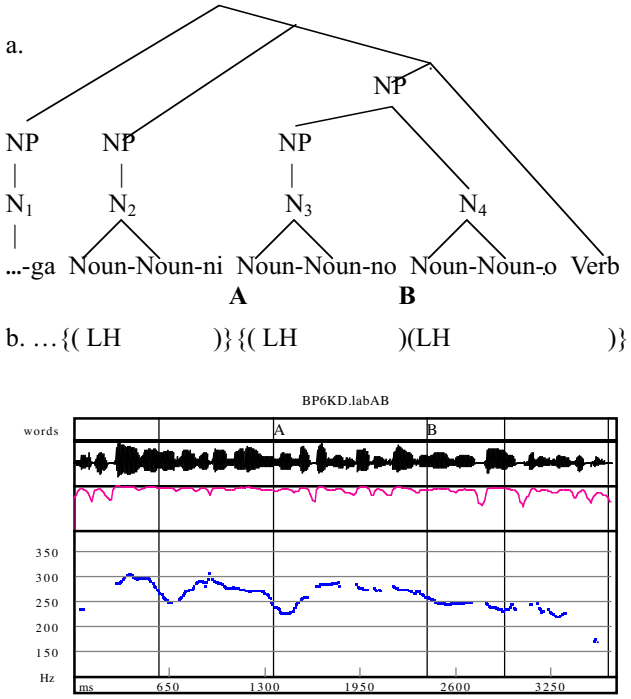

Figure 4. SOOV Structure IV: syntactic tree, prosodic structure and representative pitch track

analogous contrasts in pitch patterns corresponding to the two members of the syntactic minimal pairs. These contrasts can be seen again in the graphs in Figures 5 and 6, which display the mean values of the pooled SOV (Structures I, II) and SOOV (Structures III, IV) sentence types, respectively, for speaker KX, for example.

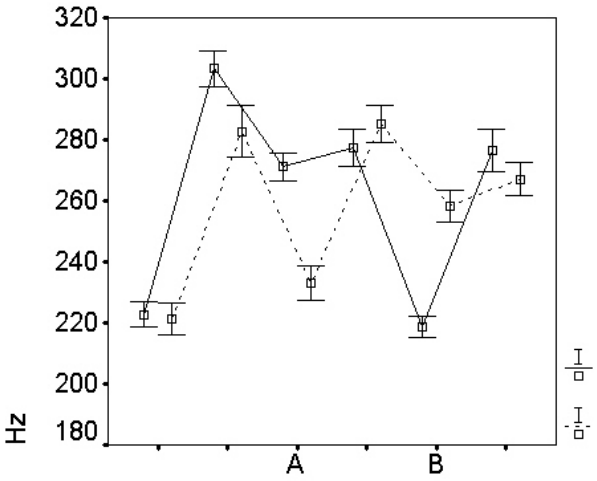

Figure 5: Means of L-H targents at left edge of Nouns 1-3 in SOV Structure I (full) and II (dotted) for KX

Statistical analysis of our data shows an absolutely significant pattern, consistent across all three speakers, of contrast between the XP and nonXP contexts with respect to three measures: (a) the amount of initial rise, (b) the value of the phrase-edge L itself and (3) the amount of descent from the phrasal H in the preceding word to the H in a following word.

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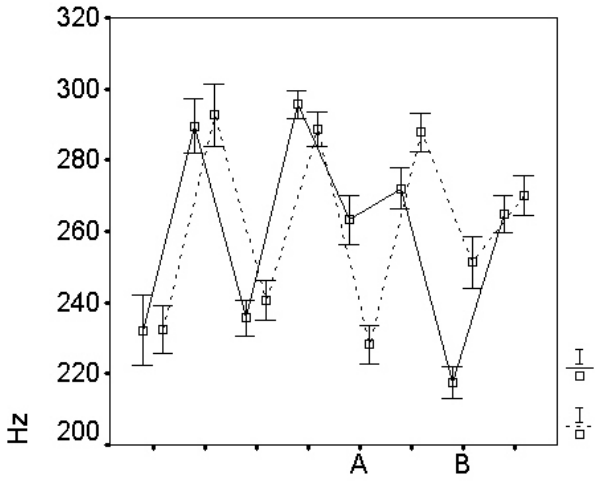

Figure 6: Means of L-H targents at left edge of Nouns 2-4 in SOOV Structure III (full) and IV (dotted) for KX

Initial rise. The mean amount of initial rise in Hz in the XP edge case is significantly larger than the mean amount of the initial rise in the corresponding nonXP edge case, for each speaker and each A or B location (t-test scores ranged from t(34)=18.8 to t(13)= 3.4; $p \leq .001$ in all cases, except for one case of $p \leq .002$). The mean differences ranged from 52 Hz to 20 Hz.

L edge tone. The mean value of the L tone at XP-edge was significantly lower than the mean value of L tone at nonXP-edge, ranging from 49Hz to 12 Hz lower (t-test scores ranged from t(29)= -15.3 to t(33)= -3.38; $p \leq .001$ in all cases). PPB claim that an MaP-initial L is lowered; our investigation provides data showing this claim to be correct.

The descent between successive H tones. Mean values of the Hn - Hn+1 difference are significantly smaller in the XP edge case than in the nonXP edge case (t-test scores range from t(48)= -9.9 to t(34)=-3.1; $p \leq .001$ in all cases, except for one case where $p \leq .002$). The phrasal H tone in the XP edge case may even be higher than the H tone that precedes. This phenomenon would appear to be analogous to, if not the same phenomenon as, the upward "resetting" reported at XP left edges in all- accented sentences by [2], [7] and [9].

4. CONCLUSIONS

To sum up, the characterization that we propose of the findings of this experiment on the phrase-initial LH rise (aka "initial lowering") in all unaccented sequences in Japanese sentences is as follows. At Major Phrase edge, (i) a low extreme value for the L tone of the LH rise is selected, (ii) the value for the H of the LH rise is "reset" upwards, and hence (iii) the amount of initial rise at MaP edge is considerable. At MiP edge within MaP, (i) a non-extreme value of L is selected, (ii) the following H tone undergoes a downtrend with respect to the preceding H, and hence (iii) the amount of initial rise is not considerable at MiP edge alone.

In the results and discussion section of this paper, the data concerning the pitch contours of the target sentences was reported in correlation with the presence or absence of an XP edge in the syntax. But the phonological analysis we give in the preceding paragraph, casts these results in terms of the MaP and MiP composition of the sentence. It makes the assumption that it is not the syntactic structure itself, but rather its mapping into a prosodic structure, that is relevant to the intonational analysis. The argument for making this step is that, quite generally, the prosodic structure analysis of the sentence is truly autonomous with respect to the syntactic structure, and governed by properly phonological constraints which also contribute to defining the distribution of MiP and MaP edges (Selkirk 2000). The prediction is thus that it is not only and not always in the context of left edge of XP that one finds the contrasts reported. A more sustained examination of the various interacting constraints in Japanese will show whether this prediction is indeed borne out.

[Research reported here was funded by NSF grant BCS-0004038.]

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