A preliminary analysis of the relation between lexical pitch accent and prosodic phrasing in Goshogawara Japanese

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1. Introduction

This study presents the results of an experiment that investigates the relation between lexical pitch accent and prosodic phrasing in Goshogawara Japanese of younger generation. This variety belongs to the dialectal group of Aomori called Tsugaru dialects, as opposed to Nambu dialects [4]. Particular focus will be put on so-called 'ascending kernel' and 'pitch pattern alternation' in this dialect.

1.1 Ascending kernel/ pitch pattern alternation

The lexical pitch accent system of Goshogawara shares a number of features with Hirosaki Japanese (also a member of Tsugaru dialects). According to Uwano [10], Hirosaki has two specific features. One is what he refers to as '*ascending kernel'* defined as '*a power to ascend from here*' [13] In majorities of Japanese dialects including Tokyo, the syllable or mora that is lexically specified as accented shows a pitch fall, and thus the lexical pitch accent in these varieties is often called '*lowering kernel*' [12]. In Hirosaki, on the other hand, the accented syllable exhibits pitch *rise*.

Table 1 shows surface pitch patterns found in citation form of words in Hirosaki reported by Uwano [10]. Just as Tokyo, Hirosaki has both, words without lexical pitch accent (unaccented) and words with it (accented). It can be seen that unaccented words always have low pitch in all syllables but the final. The final high pitch shows rightward shift, when the word is pronounced with a particle, together constituting one *bunsetsu,* or prosodic word. For example, the high pitch of *sàkù**rá*** moves to the final syllable of the prosodic word, when a case particle such as *-ga* or *-kara* is attached to it: *sàkùrà-**gá***, *sàkùrà-kà**rá***. This predictable and regularly shifting high pitch is not regarded as a reflection of lexical pitch accent.

In pitch in the accented words, we see that the final syllable is always low, except for the words with the accent on the final syllable. In the latter case, the final syllable shows pitch fall as in *òtòkô*. Thus, the final low pitch is completely predictable, and hence not lexically specified.

The location of the first high pitch, on the contrary, is not predictable, and, unlike the final high pitch of the unaccented words, it is not variable. In the word *ùságì*, for instance, the first high pitch which occurs on the second syllable does not alter its location when followed by a particle: *ùságí-gà* and *ùságí-kárà*. The syllable that bears the first high pitch is, therefore, as lexically specified as accented in this dialect.

Uwano concludes that this pitch *rise* is determines lexical pitch accent for Hirosaki, and calls it ascending kernel. Henceforth, the location of the ascending kernel within a word will be annotated as '˩': *sakura* (unaccented); ˩*kicune, u*˩*sagi, oto*˩*ko* (accented).

The other feature characteristic of Hirosaki is what I will refer to as '*pitch pattern alternation*'. Uwano reports that the final low pitch found in accented words appears only when it is pronounced with a following juncture [10]. If the word is followed by no juncture, then it exhibits high–instead of low– pitch in the final syllable. Thus, a word *u*˩*sagi* is pronounced as *ùságì* with a juncture but as *ùságí* without it (see Table 2). Uwano calls the pitch pattern with the final low (with a juncture) as '*non-connective form*', and the one with the final high (without a juncture) as '*connective form*'. Note that this pitch pattern alternation is limited to accented words, i.e., unaccented words do not exhibit the alternation.

These two specific phenomena in Hirosaki, i.e. ascending kernel and pitch pattern alternation, are observed in Goshogawara of younger generation as well, except minor differences, such as location of the accented syllable within a word and the lack of the syllable-internal fall observed in non-connective form of the word with the final accent.

1.2 Research issues

1.2.1 Does 'ascending kernel' trigger downstep?

Researchers have observed for Tokyo (which has lowering kernel) that a series of accented words can show successive accentual falls, without resetting their accentual peak value [5, 12]. This iterative pitch range compression induced by lexical pitch accent is generally known as catathesis, or *downstep* [7, 9]. The first issue is whether downstep is also observed in dialects with ascending kernel such as Goshogawara.

It is often argued that the lowering effect found in Tokyo results from properties of the lowering kernel, which, by definition, has 'a power to lower the next' [13]. It is important to note that the definition of ascending kernel, i.e. 'a power to ascend from here', does not predict downstep. In Uwano [10], however, we can find descriptions that speak of downstep-like phenomena for Hirosaki. He reports that in an accented-accented combination, such as *ya*˩*ma* ˩*aru* 'there is a mountain', the accented syllable of the second word shows mid pitch, *yàmá **ā**rù*, whereas in an unaccented-accented combination, such as *sake* ˩*aru*

'there is sake', pitch of the accented syllable remains high, *sàké **á**rù*.

Similar description can be found in Uwano [13] for Shizukuishi Japanese, which, just as Hirosaki, has ascending kernel and pitch pattern alternation. He considers the lowering effect to be a 'vestige' left over when ascending kernel historically developed from the lowering kernel.

Whatever historical origin it may have, if the ascending kernel really has pitch lowering effect, then it should be defined as such. In other words, the phonological representation of the ascending kernel should include an element that triggers downstep. Obviously, it is necessary to further investigate the downstep effect that ascending kernel might have, and to propose a correct representation of the kernel.

1.2.2 What is the domain for the pitch pattern alternation?

The second issue is to examine whether in Goshogawara a domain for pitch pattern alternation coincides with a domain for downstep.

A phrase-size domain for the pitch pattern alternation is proposed by Uwano for Shizukuishi, where he postulates a *two-level* hierarchy of prosodic phrasing: namely *prosodic word* (*bunsetsu*) at the lowest level and *tonal phrase* (*ku*) at the highest [13]. He claims that an accented word exhibits non-connective form only when it is located at the final position of the tonal phrase.

The two-level prosodic hierarchy involving tonal phrases has been postulated earlier for Tokyo as well [5], in which the tonal phrase is defined as a domain for phrase-initial delimitative rise. Since downstep effect is assumed to be reset at the boundary of this domain, the tonal phrase proposed for Tokyo can be seen congruent with a domain for downstep. It seems, therefore, reasonable to speculate that the tonal phrase defined for the dialects with ascending kernel might as well serve as the domain for downstep.

Pierrehumbert and Beckman, on the other hand, propose a deeper phrasing structure for Tokyo, in which they postulate *four* levels of phrasing including prosodic words [9]. If Goshogawara has as complex a phrasing structure as they assume for Tokyo, then it would be possible that a domain for pitch pattern alternation is hierarchically either lower or higher than that for downstep.

1.2.3 Where does the final low pitch of non-connective form come from?

The third issue is whether the final low pitch of non-connective form is a reflection of post-lexical (phrase-level) L tone or that of lexical (word-level) L tone. Uwano seems to prefer the former alternative. In the analysis of Shizukuishi, he states that the low pitch (or fall) of non-connective form "is not a property of word but of *phrase-final position*" [14].

However, the consideration of the L tone as belonging to a phrase makes it difficult, if not impossible, to explain why an unaccented word in the phrase-final position does not show the final low pitch in Hirosaki. One solution would be to propose the rule that refers to the accentedness of the phrase-final word: for example, the rule which deletes the phrase-final L if the word is not accented.

Hattori [2], on the other hand, finds it awkward to apply the rule only to the accented words, and claims that this L is a property of the accented word itself. He hypothesizes that an ascending kernel has a lowering effect on the accentual peaks of the following words. In the present study we test this on Goshogawara: if pitch accent in this dialect triggers downstep, then it would be plausible that the final low pitch of non-connective form is a reflection of a lexical L.

2. Experiment

2.1 Data collection

2.1.1 Speech materials

Three sets of test sentences were designed. They were originally written in standard Japanese, and then translated by the two speakers of Goshogawara (the participants).

Dataset I, illustrated in Table 3, examines downstep effects. It contains (a) a test sentence with consecutive accented words and (b) a sentence with an unaccented word followed by an accented word. If downstep occurs in Goshogawara, then F0 difference between the peak of the first word and the peak of the second word in (a) should be significantly smaller than in (b).

Dataset II and Dataset III were designed in order to investigate the domains for downstep and pitch pattern alternation. It is known that right-branching syntactic structure introduces a prosodic boundary at which downstep effect is blocked. This phenomenon has been reported for Tokyo [7], as well as for Japanese dialects without lexical pitch accent [8]. Also, it is reported for Tokyo that discoursal focus blocks downstep in a similar way [9, 6]. Providing that these syntactic and pragmatic factors also function to reset pitch range in Goshogawara, Dataset II and III make it possible to identify the domains for downstep for pitch pattern alternation. If non-connective form always appears at the right edge of the domain for downstep, then the domain for pitch pattern alternation coincides with the one for downstep.

Dataset II shown in Table 4 contains test sentences with left-branching and right-branching structure. In left-branching sentence (a), the adjective *a⌜oi* 'blue' modifies an immediately following noun *⌜yane* 'roof', and *a⌜oi ⌜yane* as a whole modifies the noun *i⌜e* 'house'. In the right-branching sentence (b), *a⌜oi* (conjugated as *a⌜oku-te*) modifies *i⌜e*, passing through *de⌜ke:* 'big', which also modifies *i⌜e*. It is expected that in the right branching sentence (b), downstep effect would be reset at the boundary between *a⌜oku-te* and *de⌜ke:*.

Table 5 shows Dataset III, a set of test sentences for investigating focus effects. All the sentences have a structure with two clauses: Y-*daba* ˥*aru-batte*, X-*daba* ˥*ne:-na*. 'There are Y, but there aren't X', where Y and X are noun phrases. These phrase are a combination of either accented or unaccented adjective (*ame:* 'sweet' or *u˥me:* 'good-tasting') and either accented or unaccented noun (*ame* 'candies' or *ma˥me* 'beans'). The test sentences are in short dialogues, in which the focus falls on either the adjective or the noun in the test sentences. For example, test sentence (a) was preceded by *a˥omori-sa ame: ma˥me* ˥*aru-n-zu?* 'Are there sweet beans in Aomori?'.

Although there are 16 target word combinations in Dataset III (four pairings of accented and unaccented words, two clauses and two types of focus position; 4 x 2 x 2 = 16), the present study will report results of four of them for the lack of the space: namely, Aa, Ua, aA, uA combination in the first clause (where 'a' or 'u' indicates accented or unaccented word, respectively, and the capital represents the focus).

It is expected that downstep effect would be blocked when focus falls on the noun (aA, uA). Also, I expected that focus on the accented adjective (Aa) would enhance downstep effect, while focus on the unaccented adjective (Ua) would not. This would confirm the existence of downstep in Goshogawara.

2.1.2 Subjects, recording, and analysis procedure

Two female speakers (K and M) participated in the experiment. Both were 21 years old and spent their life in Goshogawara (0-14), Hirosaki (15-17) and Tokyo (18-21). Speakers read entire set of the translated sentences five or six times. The recordings were made using Marantz PMD 660 and saved onto a Compact Flash memory card at a 48 kHz sampling rate. Recoded materials were analyzed using the Praat software [1].

2.2 Results

2.2.1 Downstep

A clear downstep effect was observed. Figure 1 shows F0 contours for Dataset I. It can be seen that in the accented-accented condition (a), the peak in the second word is lower than the unaccented-accented condition (b), the second peak is at the same level as, or even higher than the first. Figure 2 demonstrates mean F0 values of the second peak divided by the value of the first for both conditions.

2.2.2 Domain for downstep

Pitch range reset was found in the utterance with right-branching structure. Figure 3 illustrates F0 contours for Dataset II. It is shown that in left-branching utterance (a), downstep occurs interactively throughout the utterance. In right-branching utterance (b), on the other hand, pitch peak of the second word is almost as high as the peak of the first. Figure 4 illustrate the relative mean F0 values of the second peak.

The F0 contours for Dataset III are shown in Figure 5. A remarkable downstep effect was observed in the utterance with focus on the accented adjective (a), whereas it was not found in the utterance with focus on the unaccented adjective (b). Thus, downstep effect found in 2.2.1 was confirmed.

Also, it can be seen from (c) and (d), focus on the following accented noun blocks downstep: the second peak is as high as the first. Figure 6 plots relative mean F0 values. Thus, as in Tokyo, focus functions as pitch range resetting in Goshogarawa, as well[1].

2.2.3 Domain for pitch pattern alternation

The final low pitch of accented words, characteristic of non-connective form, was perceived only for the final word of the test sentences. This can be seen from the F0 contours for Dataset I-III (Figure 1, 3, 5): F0 does not fall inside a prosodic word for all the accented words but the final. This means that non-connective form appears only for the final prosodic word in the utterance. It is important to note that non-connective form is not observed at the prosodic word immediately before the boundary of the downstep domain (most notably in the word *a˥okute* of the Figure 3(b)). Therefore, it can be concluded that the domain for the pitch pattern alternation is hierarchically higher than the downstep domain.

3. Discussion and explanation of findings

3.1 Downstep and its trigger

The main finding of the present study is that the lexical pitch accent, i.e the ascending kernel of Goshogawara triggers downstep.

Some of the past researchers attribute the downstep found in Tokyo to properties of the lowering kernel, which is defined as 'a power to lower the next' [13]. By contrast, the previous definition of ascending kernel, i.e. 'a power to ascend from here' [13] does not predict downstep, and therefore it should be revised.

I propose that the representation of pitch accent of Goshogawara contains a HL tonal sequence. That is, it has not only H which is realized as an accentual peak, but also L following it. As in Pierrehumbert and Beckman's framework for Tokyo [9], I assume that in Goshogawara the HL tonal sequence triggers downstep. The main difference between the two varieties should lie in the linking of the L. The tone-linking rule will be proposed in 3.4.

3.2 The final-low pitch of non-connective form

The postulation of L following H in the representation of the pitch accent has another independent ground. It is

[1] The resetting seems to be manifested not only as raising of the peak but as lowering of the accentual valley (see Fig 5 (b) - (d)). This needs to be investigated in depth.

the final low pitch found in the non-connective form.

I propose that the final low pitch of the non-connective form is a realization of the L of the lexical pitch accent. Now that we have evidence for downstep in Goshogawara, an interpretation of the final low pitch as a *lexical* L should receive superiority over the view where it is seen as a *post-lexical* tone. The present study presented an empirical support for the view of Hattori [2] concerning ascending kernel.

I will further elaborate this formulation of lexical pitch accent by proposing the tone-linking rules.

3.3 Domains for downstep and pitch pattern alternation

The other finding is that the domain for downstep does not coincide with the one of pitch pattern alternation; the former is hierarchically lower than the latter. The *two-level* prosodic hierarchy postulated for Shizukuishi [14] can not account for the prosodic structure of Goshogawara.

I propose a *three-level* prosodic hierarchy with two phrase-size domains above prosodic words (***ω***). Following Pierrehumbert and Beckman [9], I call the phrase that serves as a domain for downstep as *intermediate phrase* (***ι***). Downstep occurs inside ***ι*** and is blocked at the ***ι***-boundary. The highest phrase is referred to, again following Pierrehumbert and Beckman [9], as *utterance* (***υ***), which functions as a domain for pitch pattern alternation [2]. The non-connective form appears when the accented word is located at the ***υ***-final position.

3.4 Prosodic structure modeling

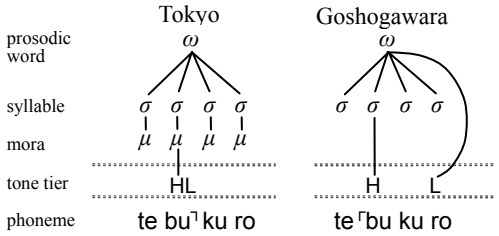
On the basis of these findings, I postulate a prosodic tree for Goshogawara that is similar to the one developed for Tokyo [9]. For this paper I will restrict the description to accented words only.

I introduced above the concept of a bitonal pitch accent for both Tokyo and Goshogawara (i.e. HL sequence). In Pierrehumbert and Beckman's model, H of the HL in Tokyo is linked to the accented mora, with the HL nevertheless behaving as a cluster, i.e. constituting an undividable unit at some level of analysis. Thus, the HL sequence in Tokyo is realized as a sharp pitch fall at the accented mora.

In Goshogawara, on the contrary, the H and L of the HL sequence are assumed to be more loosely connected than in Tokyo. This can be seen in the fact that, while the H is consistently realized at the surface as a pitch peak around the accented syllable, the L appears only in non-connective form. Recall that the final low pitch of the non-connective form was regarded as the L of the HL.

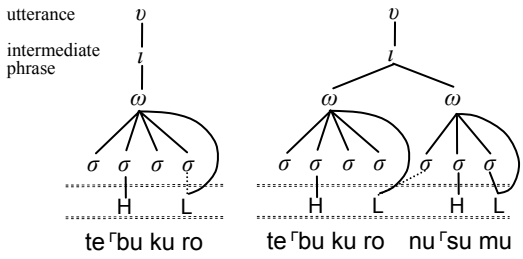
The specific behavior of the HL tonal sequence in Goshogawara can be accounted for by proposing that the H is linked to the accented syllable, while the L is not associated with any syllable at the first stage of derivation. Instead, the L is linked to the prosodic word node. The association of L to the ***ω***-node assures that the L is affiliated to the word.

Below is the prosodic tree lower than the level of ***ω*** for Goshogawara (right) and the one for Tokyo (left) proposed in [9] for the sake of comparison. The word illustrated is *tebukuro* 'glove' which has a lexical accent on the second syllable in both dialects. (I tentatively assume that the lowest node of the prosodic tree in Goshogawara is syllable, while it is mora for Tokyo.)



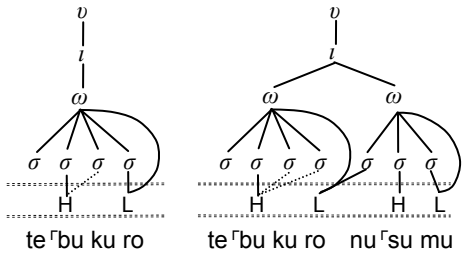
In order to obtain the surface pitch pattern, two types of tone linking rules will be proposed: one is the *Secondary Association Rule* that concerns the L and the *Tone Spreading Rule* that concerns the H.

The application of the Secondary Association Rule depends on property of ***υ***-node. Recall that a domain for pitch pattern alternation was ***υ*** and that non-connective form appears only when the accented word is located at the ***υ***-final position. Thus, the Secondary Association Rule can be formulated as following: 'if the ***ω*** is at the ***υ***-final position, link the L to the ***ω***-final syllable, but if the ***ω*** is not at the ***υ***-final position, link the L to the first syllable of the following ***ω***'.

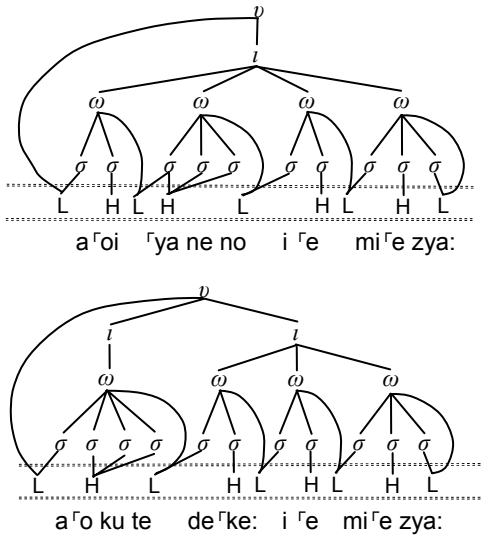


The Tone Spreading Rule can be applied as 'spread the H from left to right over the tonally unspecified syllables'. As will be shown below, after the application of the two rules, the accented ***ω*** *tebukuro* in the ***υ***-final position exhibits the non-connective form, while the same ***ω*** in the ***υ***-internal position shows connective form.

[2] The empirical foundation for postulating ***υ*** for Tokyo seems not solid enough in Pierrehumbert and Beckman's study. In the intonation annotation scheme for Tokyo, called Japanese Tone and Break Indices (J_ToBI) [15, 3], the ***υ*** and ***ι*** of the Pierrehumbert and Beckman's model are merged into a single prosodic phrase called 'intonation phrase'. By contrast, Goshogawara has a clear support for postulating ***υ***; namely the pitch pattern alternation taking place in this domain.



Finally, I will propose the complete prosodic tree by showing how the ***υ*** can be divided into ***ι***;s. Below are prosodic trees for the ***υ*** with left and right branching structure for the test sentence (see also Figure 1). Note that I postulated the low tone affiliated to ***υ***, which has the secondary association to the ***υ-***initial syllable. This tone is needed to provide the starting point of the accentual rise of ***υ***-initial ***ω***.



It can be seen that the ***υ*** with left-branching structure consists of a single ***ι***, so that downstep occurs in whole *υ*. On the other hand, the ***υ*** with left-branching structure has two ***ι***;s with an ***ι***-boundary between the first and second ***ω***;s. At the ***ι***-boundary, the downstep effect is blocked and peak value of the accentual H of the second ***ω*** is reset. Inside the second ***ι***, downstep occurs and continues until the end of the ***υ***.

4 Conclusion

The present study examined prosodic structure of Goshogawara Japanese of the younger generation. The results revealed that lexical pitch accent (ascending kernel) triggers downstep and its domain is hierarchically lower than the domain for pitch pattern alternation. Also, a HL lexical pitch accent that triggers downstep was proposed. The L of this HL manifests as the final low pitch of the non-connective form. Finally, to model the prosodic structure of this dialect, a prosodic tree was proposed with two levels of phrase above prosodic word, along with a set of tone linking rules.

Further research is needed to determine the phrasing of a string with unaccented words. Impressionistic observation indicates that unaccented words behave differently from the past description about the dialects with ascending kernel. Also it is necessary to investigate phonetic alignment of F0 events, such as valley and peak of accentual rise, which would surely contribute to the understanding of the prosodic structure of Goshogawara.

Acknowledgements

I would like to thank Kikuo Maekawa and Akira Utsugi for helpful discussion. Any errors or omissions are, of course, my own.

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Table 1: Surface pitch pattern in Hirosaki (non-connective form). Adopted from [10]. 'σ' indicates syllable. The diacritics are in accordance with IPA, where ˋ, ˊ and ˆ indicate low-level, high-level and fall, respectively.

N of σ's	Unaccented	Accent on 1st σ	Accent on 2nd σ	Accent on 3rd σ
1	é 'handle'	ê 'picture'		
2	kàzé 'picture'	sárù 'monkey'	yàmâ 'mountain'	
3	sàkùrá 'cherry'	kícúnè 'fox'	ùságì 'rabbit'	òtòkô 'man'

Table 2: Surface pitch pattern with a juncture (connective form) in Hirosaki. Adopted from [10].

N of σ's	Unaccented		Accent on 1st σ		Accent on 2nd σ		Accent on 3rd σ	
1	é…	è-gá…	é…	é-gá…				
2	kàzé…	kàzè-gá…	sárú…	sárú-gá…	yàmá…	yàmá-gá…		
3	sàkùrá…	sàkùrà-gá…	kícúné…	kícúné-gá…	ùságí…	ùságí-gá…	òtòkó…	òtòkó-gá…

Table 3: Dataset I

a.	**accented**	maꜜme-kara taꜜberu-yo.
	-accented	'I will eat from the beans.'
b.	**unaccented**	ame-kara taꜜberu-yo.
	-accented	'I will eat from the candies.'

Table 4: Dataset II

a.	**left-branching**	aꜜoi ꜜyane-no iꜜe miꜜe-zya:
		'I see a house with blue roof.'
b.	**right-branching**	aꜜoku-te deꜜke: iꜜe miꜜe-zya:
		'I see a blue big house.'

Table 5: Dataset III. Only the first clauses were measured. 'a' and 'u' in the second column indicates an accented or unaccented word respectively, with the capital representing the focused one).

a.	Aa	**UꜜME: maꜜme**-daba ꜜaru-batte, AME: maꜜme-daba ꜜne:-na.
		'There are GOOD-TASTING beans, but there aren't SWEET beans.'
b.	Ua	**AME: maꜜme**-daba ꜜaru-batte, UꜜME: maꜜme-daba ꜜne:-na.
		'There are SWEET beans, but there aren't GOOD-TASTING beans.'
c.	aA	**uꜜme: MAꜜME**-daba ꜜaru-batte, uꜜme: AME-daba ꜜne:-na.
		'There are good-tasting BEANS, but there aren't good-tasting CANDIES.'
d.	uA	**ame: MAꜜME-**daba ꜜaru-batte, ame: AME-daba ꜜne:-na.
		'There are sweet BEANS, but there aren't sweet CANDIES.'

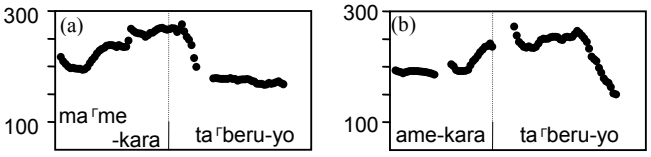

Figure 1: F0 contours for Dataset I. Accented-accented combination (a) and unaccented-accented combination (b). Produced by M.

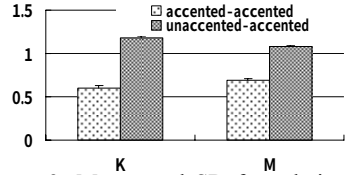

Figure 2: Means and SD for relative F0 value of the second peak of Dataset I.

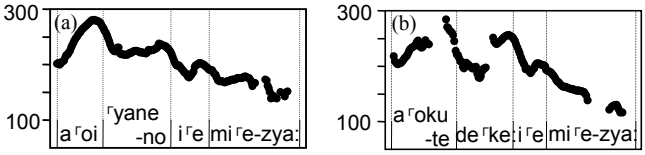

Figure 3: F0 contours for Dataset II. Left-branching structure (a) and right-branching structure (b). Produced by M.

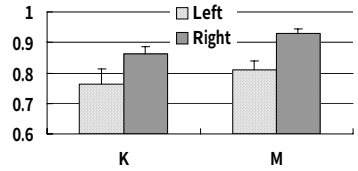

Figure 4: Means and SD for relative F0 value of the second peak of Dataset II.

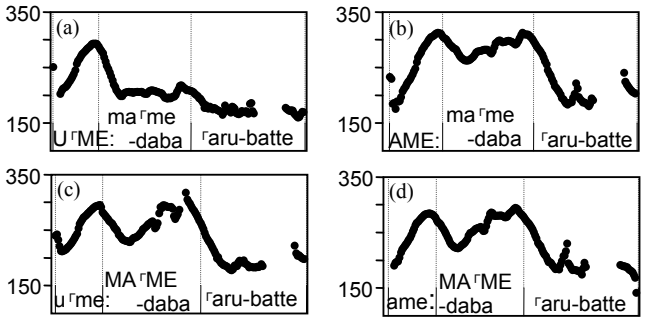

Figure 5: F0 contours for Dataset III. Aa (a), Ua (b), aA (c) and uA (d). Produced by M.

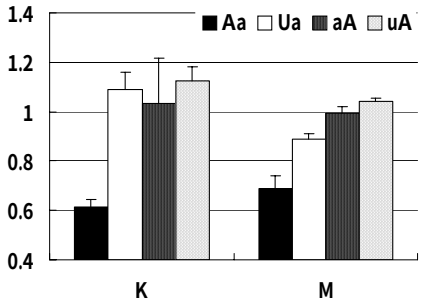

Figure 6: Means and SD for relative F0 value of the second peak of Dataset III.