PITCH DOWNTREND IN NAGASAKI JAPANESE

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ABSTRACT

This paper analyzes phonetic realization of word tone in Nagasaki Japanese, which has two-contrastive word tones. A Tone A word is realized with a sharp pitch fall, and a Tone B word is realized with no pitch fall. Although many studies investigated the intonation in Tokyo Japanese, little attention has been paid to intonational structure in the dialect.

This study conducts two acoustic-phonetic experiments in Nagasaki Japanese, and reveals that 1) a pitch fall compresses the pitch range in the following words if the word also has a falling tone, and 2) F0 contour does not reflect the difference of branching structure. The results are different from pitch patterns in other Japanese dialects, and imply the need for further investigation of syntax-phonology mapping in many Japanese dialects.

Keywords: downtrend, Japanese dialect, downstep, syntax-phonology mapping

1. INTRODUCTION

This study examines the intonational structure of Nagasaki Japanese (henceforth NJ). We focus on the realization of pitch downtrend (pitch range compression), and demonstrate that the downtrend is not strongly affected by the difference of tonal melody and syntactic structure.

Japanese has played an important role in the study of intonation. In particular, many researches on the phonology-syntax connection has been conducted. Kubozono [6] and Selkirk and Tateishi [9] demonstrated that a falling pitch (i.e., accent) causes the lowering of pitch range in which the following words (more precisely the minor phrase) are realized in Tokyo Japanese. Moreover, they verified that the difference of syntactic structure is reflected in the F0 realization of sentences in Tokyo Japanese. Igarashi [4] conducted more experiments on the intonation of many Japanese dialects, and showed that the syntax-phonology mapping is found in most dialects.

Nagasaki Japanese is a dialect spoken in the central part of Nagasaki Prefecture. One of the characteristic features of the dialect is a “two-pattern” word tone system, which has two contrastive tones regardless of the mora length of the word [1]. A Tone A word has a sharp falling pitch, and a Tone B word has no pitch falling in the word. The location of high pitch in a Tone A word is placed on the second mora, of the word, except in the case of the two-mora prosodic word, where only the first mora has a high pitch. In contrast, the final mora has the highest pitch in a Tone B word.

This study reports an acoustic-phonetic realization of word tone in a sentence with a focus on the presence or absence of downstep (pitch range compression caused by pitch fall) and sensitivity of tonal realization for branching structure. Although Hirayama [2] and Sakaguchi [8] reported how the tonal pattern of a word is determined, they did not pay any attention to the acoustic-phonetic realization of tonal patterns in NJ. Ishihara [5] shows that downstep occurs also in Kagoshima Japanese, which has a “two-pattern” word tone system. However, he did not conduct experiments on the syntax-phonology mapping in Kagoshima Japanese. Thus, it is not clear how the syntactic structure of NJ and other dialects with a “two-pattern” word tone system affects the intonation.

2. METHOD

The aims of the experiments are 1) to examine whether downstep is observed in Nagasaki Japanese and 2) to see whether the syntactic effect on F0 realization is also found in the dialect.

2.1. Speech materials

Six sets of test sentences were designed. Dataset I and II examine tonal effects on downstep. Word pairs with different combination of tonal types (AA, BA, AB, and BB, where each of A and B refer to a tonal type) were designed. All test sentences are verb phrases consisting of a noun and a verb, and they have the same pitch configuration in pairs. Test sentences with the AA and AB combination contain two moras in the first word (with an accusative case particle), and sentences with the BA and BB combination contain one mora in the first word (with a nominative case particle). In other words, all test sentence pairs have the same tonal sequence such as LHLHL (AA and BA) or LHLLH (AB and BB). Examples of the test sentences are shown in Table 1.

Table 1: Examples of test sentences for Dataset I and II (An acute denotes the location of the highest pitch.

Dataset I:
(a) AA: umé-ba níru ‘(Someone) boils a plum.’
(b) BA: hi-nó moéru ‘It fires.’

Dataset II:
(a) AB: amé-ba motú ‘(Someone) has a candy.’
(b) BB: me-nó mierú ‘It can see (it).’

Datasets III-VI are designed to investigate whether the syntactic structure affects intonation in NJ. In all the datasets, sentences with a left-branching structure (henceforth LB) are paired with those with a right-branching structure (henceforth RB). In LB sentences, the verb *aru* requires one argument, and first nouns (*ani* and *oya*) modify second nouns (*oden* and *udon*).[1] Thus, first and second nouns form a large noun phrase. In contrast, in RB sentences, the verb *toru* requires two arguments, that is nominative and accusative nouns. The first noun connects with the nominative marker and the second noun connects with the accusative marker, so two nouns does not form a noun phrase. Each dataset contains the same combination of tonal types and mora length. Examples of the test sentences are listed in Table 2.

Table 2: Examples of test sentences. Square brackets indicate branching structure. (bold face means measure targets).

Dataset III: tonal combination = AA
(a) LB: [[**aní-no odén-no**] arú] ‘There is brother's oden.’
(b) RB: [**aní-ga** [**odén-ba** torú]] ‘My brother takes oden.’

Dataset IV: tonal combination = AB
(a) LB: [[**aní-no udon-nó**] arú] ‘There is brother's udon.’
(b) RB: [**aní-ga** [**udon-bá** torú]] ‘My brother takes udon.’

Dataset V: tonal combination = BA
(a) LB: [[**oya-nó odén-no**] arú] ‘There is parents' oden.’
(b) RB: [**oya-gá** [**odén-ba** torú]] ‘My parents take oden.’

Dataset VI: tonal combination = BB
(a) LB: [[**oya-nó udon-nó**] arú] ‘There is parents' udon.’
(b) RB: [**oya-gá** [**udon-bá** torú]] ‘My parents take udon.’

2.2. Measurement and analysis

Three native speakers of Nagasaki Japanese who are all females, K (81 years-old), S (63 years-old), and T (57 years-old) participated in the experiment. The subjects read the test sentences five times. Recordings were made using Roland R-09 at a sampling rate of 44.1 kHz with an AT810F Audio-technica microphone. Recorded materials were analyzed using Praat software (ver. 5.1.11). All data were time-normalized. The normalized contours were computed by taking 10 F0 points within each mora and averaging them across the repetitions.

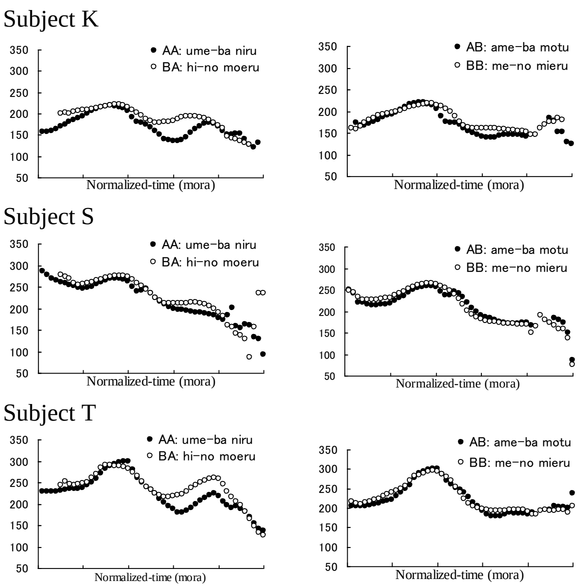
The relative P2 height, defined as the highest F0 value of the second prosodic word (P2) divided by the highest F0 value of first prosodic word (P1), is measured in order to see if downstep occurs and if syntactic structure affects the pitch range in NJ.

3. RESULTS

3.1. Datasets I and II: Tonal contrast

Figure 1 illustrates the time-normalized F0 contours of Dataset I and II for all subjects. As can be seen from the figure, F0 peak of the second prosodic word in the AA combination is lower than that in the BA combination. In contrast, we did not find any difference in the F0 peak between the AB and BB combinations.

Figure 1: Time-normalized F0 contours for Dataset I (left) and Dataset II (right).



A statistical test is used to support the observation. T-tests were conducted for each subject separately (Tables 3 and 4). The result shows that the difference is significant for all subjects in Dataset I (AA vs. BA) but not in Dataset II (AB vs. BB).

Thus, the result suggests that the pitch fall of Tone A compresses pitch range of a following word only in the case where the word has another pitch-fall, i.e., Tone A. In contrast, downstep effect cannot be observed when Tone B word is followed.

Table 3: Height of P2 relative to P1 for Dataset I. Means and individual analysis. Standard deviation in parentheses.

Subject	(a)AA	(b)BA	*df*	*t*	*P*
K	.816(.037)	.955(.043)	8	-5.405	<.001***
S	.698(.056)	.948(.026)	8	-9.012	<.001***
T	.748(.038)	.936(.058)	8	-6.026	<.001***

Table 4: Height of P2 relative to P1 for Dataset II. Means and individual analysis. Standard deviation in parentheses.

Subject	(a)AB	(b)BB	*df*	*t*	*P*
K	.766(.061)	.825(.029)	8	-1.907	=.092
S	.742(.056)	.719(.036)	8	0.741	=.479
T	.774(.178)	.735(.141)	8	0.383	=.711

3.2. Datasets III-VI: Syntactic contrast

Figures 2, 3 and 4 illustrate the time-normalized F0 contours of Datasets III-VI for all subjects. Notice that Subject K produced a target word *oden* with Tone B in Dataset III, so we excluded the result.

Figure 2: Time-normalized F0 contours for Datasets IV-VI for Subject K. Dataset III is excluded because she produced another tonal type for the dataset.

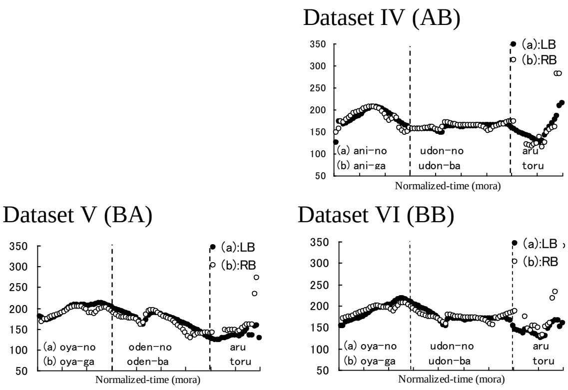


Figure 3: Time-normalized F0 contours for Datasets III-VI for Subject S.

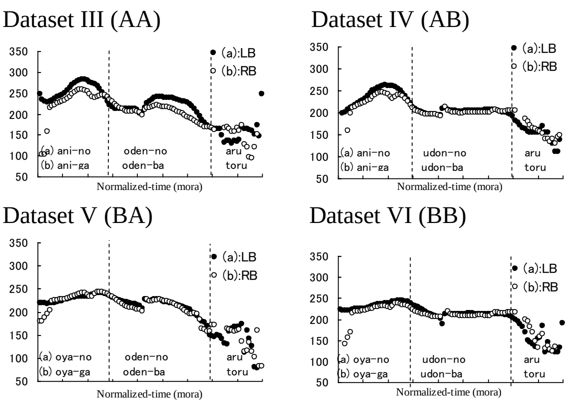
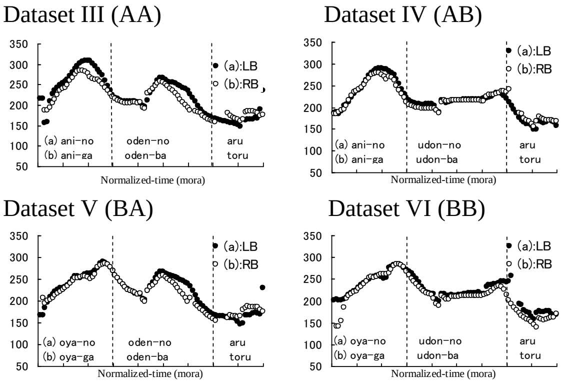


Figure 4: Time-normalized F0 contours for Datasets III-VI for Subject T.



It is well-known that the right-branching syntactic boundary expands pitch range in Tokyo and other Japanese dialects, whereas the left-branching syntactic boundary does not. Thus, we expect that the relative height of P2 to P1 for the right-branching structure will be higher than that for the left-branching structure in NJ.

However, as we can see from the figures, it is hard to find pitch range expansion in sentences with a right-branching structure. The observation above is supported using a statistical test. A t-test is conducted for all subjects separately. The results are shown in Tables 5-8.

Table 5: Height of P2 relative to P1 for Dataset III (AA). Means and individual analysis. Standard deviation in parentheses. The result of subject K is excluded because she produced another tonal type for the dataset.

Subject	LB-AA	RB-AA	*df*	*t*	*P*
S	.858(.035)	.865(.056)	8	-0.2428	=.814
T	.861(.026)	.902(.015)	7	-2.8893	=.023*

Table 6: Height of P2 relative to P1 for Dataset IV (AB). Means and individual analysis. Standard deviation in parentheses.

Subject	LB-AB	RB-AB	*df*	*t*	*P*
K	.821(.011)	.849(.036)	6	-1.266	=.252
S	.808(.017)	.860(.021)	8	-4.1617	=.003**
T	.798(.016)	.819(.022)	8	-1.6616	=.135

Table 7: Height of P2 relative to P1 for Dataset V (BA). Means and individual analysis. Standard deviation in parentheses.

Subject	LB-BA	RB-BA	*df*	*t*	*P*
K	.898(.078)	.956(.034)	6	-1.3535	=.224
S	.951(.048)	.943(.034)	8	0.2797	=.786
T	.924(.023)	.906(.043)	8	0.8104	=.441

Table 8: Height of P2 relative to P1 for Dataset VI (BB). Means and individual analysis. Standard deviation in parentheses.

Subject	LB-BB	RB-BB	*df*	*t*	*P*
K	.804(.076)	.891(.088)	8	-1.6669	=.134
S	.876(.063)	.928(.082)	8	-1.1058	=.301
T	.860(.030)	.824(.020)	8	2.2469	=.054

A significant difference between the branching structures is observed only in the case where the first prosodic word has Tone A. However the result is found not for all subjects. In sum, we did not find positive evidence for the presence of a mapping relation between intonational structure and branching structure in NJ.

4. DISCUSSION AND CONCLUSION

4.1. Tonal effect

The results of Datasets I and II reveal that downstep occurs in the case where the following word contains a falling-pitch pattern, i.e., Tone A, and suggests that a pitch-fall triggered by Tone A would continue into the following words. In contrast, downstep is not observed in the case where the second prosodic word has Tone B. This may be because of the small number of mora in the post-focal utterance-final word. In other word, downstep undergoes *undershoot* in this case. Igarashi reports that the final rise in Kobayashi Japanese takes undershoot when a word has a small number of syllables and is preceded by a focal word [3]. Moreover, F0 falls at the utterance final position in Tokyo Japanese [7]. The present experiment has a similar situation, because the second prosodic word contains only two moras, and the target sentences in Datasets I and II consist of only two words, that is nouns and verbs, so nouns may have focal prominence. Thus, it would be needed to test sentences that have longer moras in the second and non-utterance-final prosodic word in future.

A further experiment of other sentence types needs to be conducted. In a study on Kagoshima Japanese, Ishihara [5] conducted a production experiment on downstep in different syntactic types, i.e., S (*N-nom+V*), NP (*Adj+N*), and Possessive (*N-gen+N*), and showed that downstep occurs most clearly in the Possessive type. The present experiment uses the S type according to Ishihara's classification, thus there is a possibility that downstep occurs in different syntactic types in NJ.

4.2. Syntax-phonology mapping

We did not find any positive evidence for the presence of sensitivity for syntactic structure in NJ prosody. This is not a unique characteristic of the Nagasaki dialect. Igarashi reports a similar tendency in Kobayashi [3] and Kagoshima Japanese [4]. However, it still remains unclear what linguistic features affect these dialectal variations. Further studies on these dialects will improve our understanding on the syntax-phonology connection in Japanese (dialects), and contribute to the advancement of interface theory in general. Moreover, the present experiment does not control information structure (focus), so it will be needed for further experiment which control it.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

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[1] In NJ, a nominative case is represented by *-no* or *-ga*. According to my pilot study, there may be some syntactic restriction on the proper use of the nominative case. However, we will not go into the details here due to space limitations.