An acoustic analysis on the allotonic variation of the initial rise in Tokyo Japanese in native speakers and learners

Hsiang-Yu Lei[1]

[1]National Taiwan University, Taiwan; Nagoya University, Japan
[1]*r01142001@ntu.edu.tw*

Abstract

Tokyo Japanese is characterized by an initial rise in pitch, which has an allotonic variation: the rise is weakened or flattened when the initial syllable includes a special mora (i.e. CVN or CVV; geminate excluded). The present study tested and measured the pitch rise of native speakers and learners in read speech. Results showed that both native speakers and learners demonstrated dependency on the existence of the special morae when realizing the initial syllable. Pitch height successfully helped learners enlarge the distinction between the two allotones.

Keywords: initial rise, boundary tone, allotone, Tokyo accent, special mora

1. Introduction

Tokyo Japanese is traditionally well known for its N+1 accent system, which literally means that for a mora length N, there exists N+1 types of lexical accents. The N+1 system was derived from two constraints, i.e., the first two morae must contain pitch accents with opposite tones (LH or HL), and once the pitch is dropped, it would not rise again. For instance, trimoraic words could have potentially four types of accents: HLL(L), LHH(H), LHH(L), and LHL(L). Recent studies tended to treat the initial LH as an intonational boundary tone rather than accentual properties ([1, 2]). The transfer from low to high pitch in the initial syllable of a prosodic phrase is called initial rise or lowering.

Initial rise in Tokyo Japanese is observed to be allotonic. As far back as the time when rise was treated as part of the lexical accentual properties, Hattori [3] reported that the pronunciation is different when the initial two morae are CVN or CVV rather than CVCV, as in (1) (bars on the top refers to H).

(1)	(a)	Ko.ma.gi.re (small pieces)	Ko.na.go.na (small pieces)
	(b)	Ko.o.ba.n (police box)	Ko.n.da.n (discussion)

Hattori [3] argued that (1)(a) and (1)(b) occur in complementary distribution and thus (1)(b) did not ruin the N+1 framework. The first two morae in (1)(a) are independent morae, which formed two light syllables, while the first two morae in (1)(b) are an independent mora followed by a special mora, forming a heavy syllable. As opposed to the independent mora, a special mora (including moraic nasals (N), the second unit of a long vowel (R) or diphthong (J), and geminates (Q)) could not independently exist in the initial position and must be preceded by other morae ([4, 5]). Similar observations of allotonic variation were reported by Kawakami [6], Akinaga [7], Kindaichi [8], etc.

Later studies tended to explain the LH as an intonational rise ([1, 2]). When Pierrehumbert and Beckman [1] reanalyzed accentual LH as an intonational rise, the allotonic variation were also mentioned and was transcribed by %L and %wL; the former refers to a low boundary tone and the latter refers to a weakened low boundary tone for cases with special morae initiated. The interpretation of LH at the intonation level implied that boundary tones interact with syllable structures in a mora-timed language.

Although theoretically interesting, quantitative acoustic studies were rare. Since pitch variation does not distinguish meaning, it had not attracted people's attention for a long time until Wang's empirical studies on this issue. Wang [9, 10] examined the pitch shape of words with an initial heavy syllable spoken by native speakers in read speech and in conversation. She concluded that in read speech, with the presence of a special mora, the pitch patterns are mainly observed as a parabolic rise or flat, depending on whether the initial consonant is voiced [9]. In conversation, the pitch pattern was mostly affected by the presence of prominence [10]. By comparing the rising range between Japanese natives and Taiwanese learners, Wang [11] found individual differences and concluded that learners are likely to perform the allotonic variation of initial rise, much like the Japanese natives if they have stayed in Japan for longer time.

10.21437/ISAPh.2016-10

In pedagogy, Lee [12] suggested that the accent of a word with special morae could be taught by drawing a line on the top of the first two components (representing two morae) of the Japanese writing system, as shown in (1)(b). This is opposed by Wang [11], where a parabolic rise rather than a flat contour was found to be the main pattern for tokens with a heavy syllable headed by a voiced consonant. However, it is still arguable whether the single bar is helpful for learners to distinguish rising variations.

It should be mentioned that Wang [9, 10] recorded only tokens with a special mora, and did not compare the data with those without a special mora. Also in Wang [11], although the rising pitch range of words with and without a special mora from both native speakers and learners were calculated, the results and conclusion were not statistically verified. This left a room for the current study to testify the allotonic variation carefully.

The present study is an empirical research to analyze the allotonic variation acoustically. There are three research goals. The first goal is to verify the impressionistic observations of allotonic variations of initial rise in Tokyo Japanese. The second is to discover whether learners produce this variation even if it was not taught at school. The third goal is to investigate whether single bars printed on the top of the words would help learners distinguish the two pitch heights.

2. Experiment

2.1. Materials and Participants

Fifty Japanese words, including 40 targets with cross-moraic rise, and 10 fillers with an accent on the first mora, were prepared, as shown in Table 1. The 40 targets contained only sonorants in the first two morae. One reason for this is to reduce the potential phonetic effect of voicelessness, and another reason is to ensure that pitch measurements would not be bothered by consonantal perturbations. The canonical accent type, familiarity, word frequency of each word were controlled based on *Lexical Properties of Japanese* [13]. The entire word list table is given in Appendix.

Three Tokyo Japanese native speakers and three learners (Mainland Mandarin speakers, having learned Japanese for 1 to 2 years) were recorded. The native speakers were born and raised in Tokyo Japanese spoken areas ([14], [15]) and had not left their hometown for more than a month before the age of 18. The learners in this study had passed the highest level (N1) of the Japanese Language Proficiency Test (JLPT) and had stayed in Japan for less than 4 months.

2.2. Procedure

The tokens were repeated in three blocks and presented randomly on the screen with *kanji* and *kana*. In the first block, only words were presented. In the second block, small icon showing the place of accent is added. This block represents the presence of both the word and the phonological accent type information together. In the last block, bars on every *kana* are provided, distinguishing tokens with special mora from others, as printed in most of the beginners' textbooks of Japanese. For tokens with a special mora, both the first unit were drawn with higher lines, as suggested by Lee [12]. In this block, phonetic pitch accents of every single mora rather than simple phonological categories were provided. Figure 1 illustrates two examples of the three blocks.

The experiment was taken place in a soundproof room at Nagoya University from December 2015 to February 2016.

2.3. Measurement

The initial rise of pitch is operationally defined as the comparison between the pitch maximum and minimum. The pitch maximum refers to the highest pitch appeared in the first two morae and the pitch minimum refers to the lowest pitch appeared before the highest one. Consonant intervals are avoided. Figure 2 is an example of measurement.

Table 1: Test word design.

The presence of special mora	Target words		Fillers
	Non-accented	Accented	Head-accented
+ Special mora	10	10	10
− Special mora	10	10	

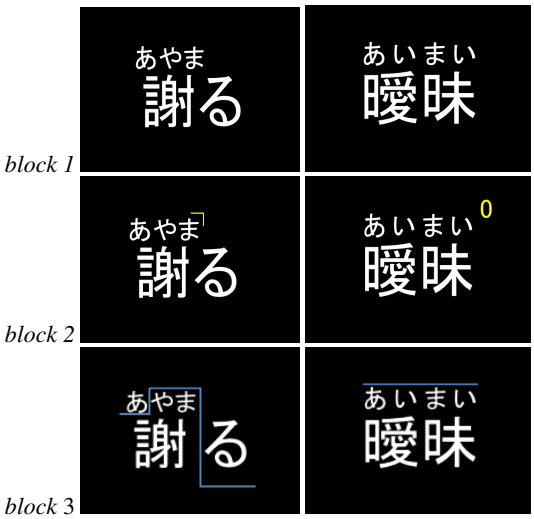

Figure 1: An example of target word *ayamaru* "to apologize" *a*nd *aimai* "vagueness" on the screen. In Block 2, if there is no accent, a small "0" is marked on the top right to indicate such.

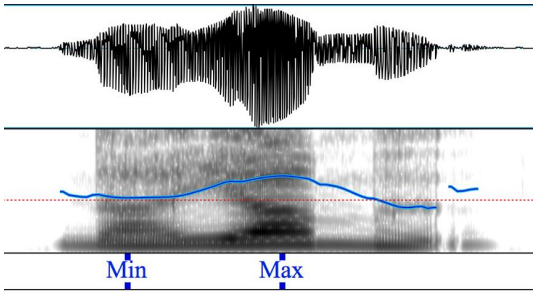

Figure 2: An example of labeling and measurement: *nayamu* "to worry".

3. Results

A total of 482 tokens, including all three blocks from learners and the first block from native speakers were analyzed. The second and third blocks for Japanese natives were not included due to unnatural emphasis on accents. Data were converted into semitones. Results are shown in Figure 4.

A two-way ANOVA on native speakers' and learners' block 1 was conducted. Results showed that there are significant main effects of speakers' group ($F(1, 243) = 124.54$, $p < 0.001$) and mora type ($F(1, 243) = 93.93$, $p < 0.001$), and a significant interaction effect of the both ($F(1, 243) = 29.30$, $p < 0.001$), as illustrated in Figure 3. Another two-way ANOVA on learners among the three blocks was performed. Results showed that there are a significant main effect of mora type ($F(1, 243) = 93.93$, $p < 0.001$), a near-significant effect on blocks ($F(2, 355) = 2.997$, $p = 0.05$), and a significant interaction effect of the both ($F(2, 355) = 3.289$, $p < 0.05$), as illustrated in Figure 4. Pairwise comparison showed that the rise of non-special mora words are higher than that of special ones in all the blocks, and the discrepancy of rise is greater in learners' block 3 than block 2 ($F(1, 231) = 4.02$, $p < 0.05$).

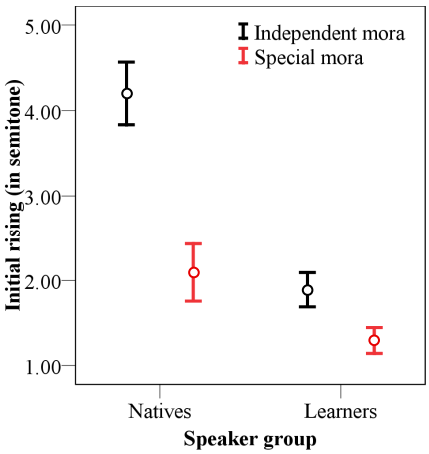

Figure 3. Results of initial rise of native speakers and learners. Bars stand for 95% confidence intervals. Black stands for the absence of special mora while red stand for the presence of special mora.

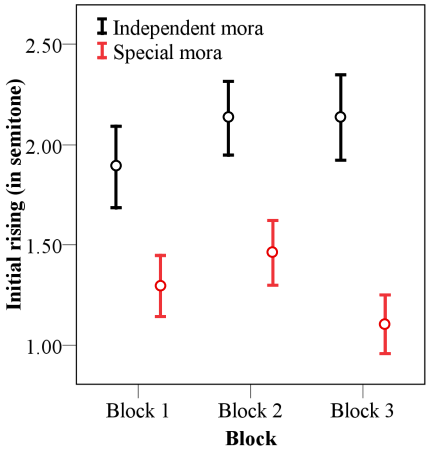

Figure 4. Results of initial rise of learners among the three blocks. Bars stand for 95% confidence intervals. Black stands for the absence of special mora while red stand for the presence of special mora.

4. Discussions

For Japanese native speakers, the rising range for tokens with a special mora is significantly less than that for tokens with only independent morae. The results agree with previous impressionistic observations as described by Hattori [3], Akinaga [7], etc.

As for learners, results showed that the entire rise is smaller in range in comparison with native speakers' production. This is reasonable since the L1 of the learners in the current study is Mainland Mandarin, and studies have revealed that Mandarin-speaking Japanese learners have narrower range in Japanese read speech than native speakers [16, 17]. Interestingly, the learners also showed structure-dependent rise, even though was not taught or emphasized throughout their L2 learning. The production of the two allotones could be acquired unconsciously. The interaction effect between native speakers' and learners' block 1 implies that learners showed less distinction than the natives.

With bars distinguishing the pronunciation of words with and without a special mora, learners suppressed the pitch change of cases with special mora to enlarge the distinction of the two allotones. The results suggest that Lee's [12] teaching strategy is efficient, and the rise was not totally flattened but remained about one semitone. One reason is that the block 3 of the current study was not long enough training session for flattening the allotonic rise. The other possibility is that in Tokyo Japanese, the allotone of initial rise of words with a special mora is not totally flattened ([9, 11]) but relatively weakened in pitch change, and it is realized as a flat contour in cognition ([3, 7]).

The current study focused on the production of native speakers and learners. Further tests on

application of education are required to discover whether learners could only imitate the pitch height of native speakers or they acquire boundary tone units. Also, further tests on perception of Tokyo Japanese native speakers would help us reveal whether the two allotones have sharp a perceptual boundary and at what level the rise would be judged unnatural. This would provide us with more knowledge of suprasegmental phonology and approaches of teaching methodology on allotone pronunciation.

5. Conclusions

Both native speakers and learners showed allotonic variation of initial rise; the former showed a greater distinction. The results verified previous impressionistic observations. Given the hint of bars distinguishing words with a special mora from others, learners could produce greater distinction of the two allotone of initial rise. The results left a room for further studies on how the allotones are perceived by native speakers and acquired by learners.

6. Acknowledgements

The author would like to thank Prof. Akira Utsugi, Nagoya University and Prof. Janice Fon, National Taiwan University, who provided valuable suggestions and support.

7. References

[1] Pierrehumbert, J. B., Beckman, M. E. 1988. *Japanese Tone Structure*, The MIT Press.

[2] Maekawa K. 1998. *Phonetics.* Tokyo: Iwaha Shoten. In Japanese.

[3] Hattori, S. 1954. The Japanese accent in a view of phonology. *Kokugo kenkyu* 2(2), 37-65. In Japanese.

[4] Kubozono, H. 1998. The universality of mora and syllable. *Journal of the Phonetic Society of Japan*, 2(1), 5-15. In Japanese.

[5] Nasu, A. 2009. The structure and stability of special mora. *Bungei Gengo Kenkyu (Linguistcs)*, 53-71. In Japanese.

[6] Kamikawa, S. 1956. Phrase initial intonation. *Kokugogaku.* 25. Reprinted in *Studies of Japanese Accent.* (1995) 64-75. Tokyo: Kyuko Shoin. In Japanese.

[7] Akinaga, H. 1968. About the special mora. *Koza nihongo kyoiku* 4, 36-51. In Japanese.

[8] Kindaichi, H. 1965. Pronunciation of careful speech. *Journal of Japanese Language & Literature.* 34(2). Reprinted in *The research of Japanese phonology.* (1967) Tokyo: Tokyodo. In Japanese.

[9] Wang, H. C. 1999. About the initial one syllable LH-pitch. *Journal of Japanese Language & Literature in Taiwan.* 14, 213-241. In Japanese.

[10] Wang, H. C. 2002. The actual condition of one syllable LH-pitch in Japanese conversation. *Bulletin of the Graduate School of Education, Hiroshima University*, 51, 291-300. In Japanese.

[11] Wang, H. C. 2003. *Basic research of teaching methodology of Japanese accent for Taiwanese learners: from the aspect of comparisons between Mandarin four tones and Japanese pitch accent.* Dissertation. School of Education, Hiroshima University. In Japanese.

[12] Lee, W. H. 1997. Spoken Japanese language education in Hong Kong. *Spoken Japanese Language Education: Looking to the 21st Century.* 121-126. In Japanese.

[13] Amano, S., Kondo, T. (editor) 1999. NTT database series Nihongo-no Goitokusei (Lexical properties of Japanese), Tokyo: Sanseido. In Japanese.

[14] Kindaichi, H. (supervision), Akinaga, K.(editor) 2011. *The New Janpanese Accent Dictionary*, Tokyo: Sanseido. In Japanese.

[15] Hirayama, T. 1968. *The Dialects of Japan*, Tokyo: Kodansha. In Japanese.

[16] Hirano, H., Hirose, K., Minematsu, N., Kawai, G. 2006. Prosodic Features and Evaluation of Japanese Sentences Spoken by Chinese Leaners. *Proceedings of the auditory research meeting* 36(1), 149-154. In Japanese.

[17] Hirano, H., Hirose, K., Kawai, G., Minematsu, N. 2008. F0 features of Japanese Sentences Read Aloud by English, Chinese, and Naive speakers *IEICE technical report. Speech* 108(116), 43-48. In Japanese.

Appendix: Test word list

Target words (+Cross-morae initial rise)				Filters (−Cross-morae initial rise)
−initial special mora		+initial special mora		
−accent	+accent	−accent	+accent	(+accent)
理由	間もなく	来年	饅頭	もみじ
瑠璃色	七色	内容	餡パン	趣味
耳鳴り	悩む	りんご	烏龍茶	荷物
胸元	無意味	類語	竜宮	そば
割合	謝る	難問	愛らしい	罠
濡れ髪	青空	にんじん	安全装置	アニメ
家元	前祝い	入院	インテリア	シリーズ
マラソン	マリンバン	曖昧	マンゴスチン	スーパー
アミノ酸	ユニーク	ワープロ	ユーエスビー	ランダム
アルカリ	イルミネーション	マイナス	インターネット	イヤリング