TWO TYPES OF FALLING WORD-TONE IN SHIRAHO, YAEYAMA, SOUTHERN RYUKYUAN

Kenan Celik
NINJAL
takamori.celik@gmail.com

Natsuko Nakagawa
Chiba University
nakagawanatuko@gmail.com

ABSTRACT

In this study, we report the discovery of a new word-tone type in one of the endangered Southern Ryukyuan languages, Shiraho, spoken in Ishigaki island, Japan. From our observations, we noticed that the tonal pattern that had been described as falling in the previous literature may actually have conflated two distinct tones, which correspond to two different tonal classes of the closest dialect Hateruma; Hateruma falling tone corresponds to Shiraho falling 1 (Fa1) and rising tone to falling 2 (Fa2). In order to confirm this, we conducted an acoustic analysis of the recordings of 3 speakers, analyzing respectively 17, 17, and 14 words pronounced in isolation. We measured the difference between F0 peak and average F0 of last 80ms of each word and found, for 2 speakers, a statistically significant difference between Fa1 and Fa2. Although no difference was obtained for the last speaker, further study using sentences with the target words followed by a case particle clearly showed that this speaker too possessed the tonal distinction. These results show that Shiraho possesses two distinct falling word-tones.

Keywords: Speech acoustics, speech prosody, phonetics of lesser documented and endangered languages

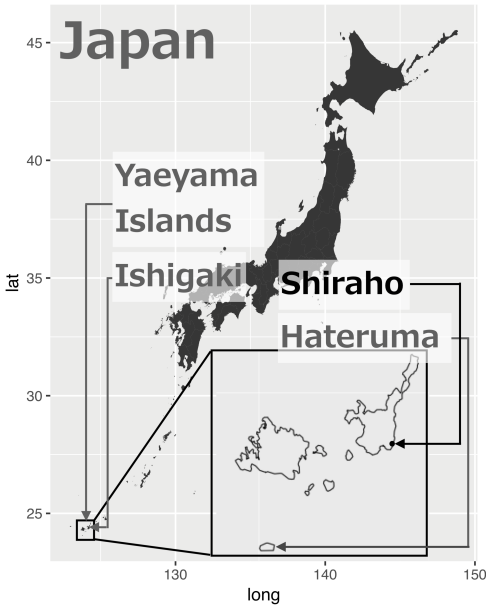
1. INTRODUCTION

1.1. Background information

Shiraho is a severely endangered dialect of Yaeyama traditionally spoken in the village of Shiraho, Ishigaki Island, Okinawa Prefecture, Japan ([7] for endangerment status, see Figure 1 for location). According to the authors' own observations, most fluent speakers of Shiraho are reckoned to be above 75, which gives us an estimate of 147 for the number of speakers (9.2% of the 1600 people living in Shiraho, [4]).

Among the many dialects classified as Yaeyama, the closest to Shiraho is that of Hateruma (Figure 2), spoken in the island of Hateruma, and the only one with which full mutual comprehensibility is reported. This is explained by the tight historical connection that the two dialects share. In 1771, after an important tsunami almost completely wiped out the original village of Shiraho, leaving only 28 survivors, 418 villagers from Hateruma island were resettled by order of the Ryukyuan Kingdom to rebuild Shiraho [14]. From this, we know that the two dialects descend from a common ancestor that was spoken only around 250 years ago.

Figure 1: Map of Japan and Yaeyama

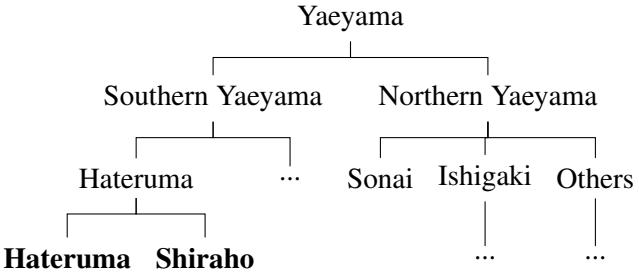


Shiraho remains, up to this date, critically underdescribed; only one short grammatical sketch [10] and a few studies on phonology are available [9, 13]. Shiraho is also superficially touched upon in some studies on the related dialect Hateruma [2, 5, 11].

1.2. Linguistic features of Shiraho

Shiraho is classified as a dialect of Yaeyama, which belongs to the Southern branch of the Ryukyuan languages, of the Japonic language family ([12], p. 15 and Figure 2, modified from [6], p. 555). As such, it shares many broad morpho-syntactic properties with the other Japonic languages, namely agglutinative

Figure 2: Yaeyama family



morphology, dependent marking and SV/AOV word order.

Just like Hateruma, Shiraho has voiceless resonants /r̥/, /n̥/, and /m̥/; strongly aspirated voiceless stops; and devoiced vowels between voiceless consonants [1, 9]. Phoneme inventory of Shiraho is shown in (1) and (2).

(1) **Vowels**: i, ɨ, u, e, o, a

(2) **Consonants**: p, b, t, d, k, g, ts, tʃ, ɸ, s, z, ʃ, ʒ, h, ɾ̥, ɾ, m̥, m, n̥, n, j, w

Although Shiraho and Hateruma are thought to have separated only 250 years ago and are still to this day mutually comprehensible, there are also notable dialectal differences, like for example the vowel /ɛ/, found in Hateruma but not in Shiraho [5, 11].

1.3. Research question

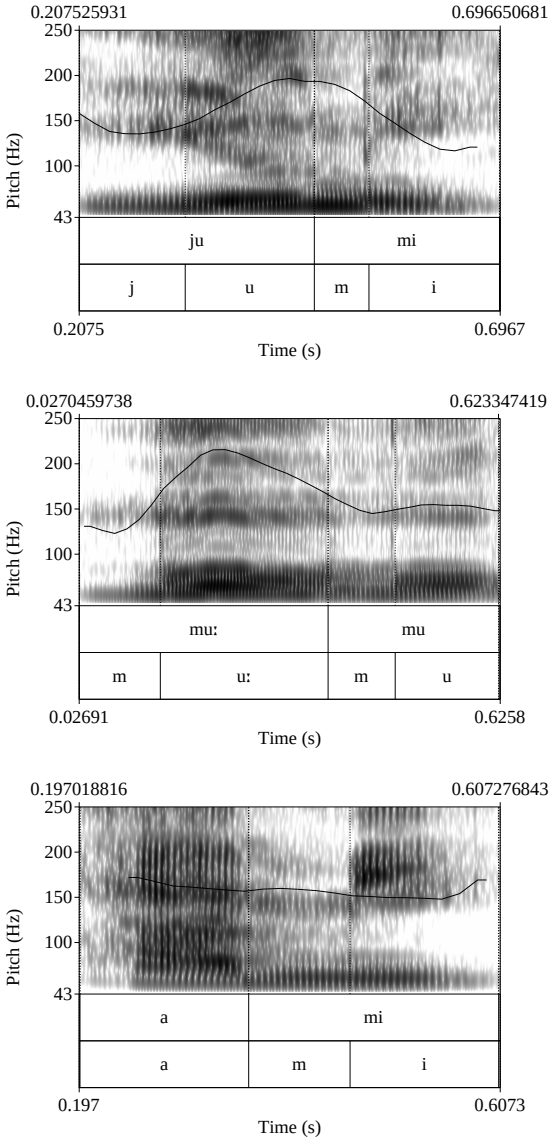
Table 1: Word tones in Hateruma & Shiraho

Hateruma	Shiraho (Previous Studies)	Shiraho (This study)
Falling	**Falling**	**Falling 1 (Fa1)**
Rising		**Falling 2 (Fa2)**
Flat	Flat	Flat

All previous studies that have dealt with the lexical word-tone system of Shiraho have independently reached the same conclusion, namely that Shiraho only possessed two distinctive word-tones, flat and falling. [2, 9, 13]. On the other hand, Hateruma has been described as having not two, but three distinctive word-tones, flat, falling, and rising [2]. According to one comparative study [2], the rising tone found in Hateruma has merged into the falling tone in Shiraho, while the flat tone corresponds between the two dialects (see Table 1).

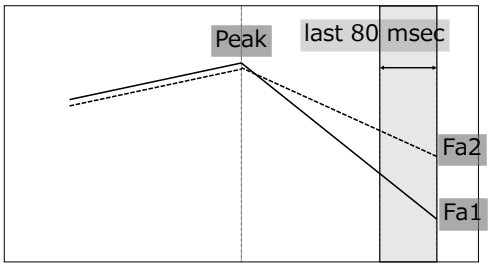
However, a naive examination of approximately 800 words recorded through our own fieldwork in Shiraho has led us to questioning this claim. According to the authors' observations, monomorphemic words classified as falling in the previous literature could further be classified into two distinct classes. The words precisely corresponding to a falling word-tone in Hateruma (henceforth, Fa1) were consistently found to sound "more falling" than those corresponding to a rising word-tone (henceforth, Fa2). For example, as can be seen in Figure 3, [jumi] 'bride', which corresponds to a falling word-tone in Hateruma, is characterized by a steep fall in pitch at the end of the word, whereas [mu:mu] 'thigh', which corresponds to a rising word-tone, does not exhibit such a steep fall in pitch, although the overall pitch pattern can still be described as "falling" (we also added a flat tone word in the figure for comparison).

Figure 3: [jumi] 'bride' (Fa1), [mu:mu] 'thigh' (Fa2), [ami] 'rain' (speaker) (flat) (speaker A)



Based on these observations, we formulated the following hypothesis: the falling tone reported for Shiraho conflates two different tones corresponding to Hateruma falling and rising tones. More specifically, words corresponding to a falling tone in Hateruma (Fa1) and words corresponding to a rising tone (Fa2) are distinguished in Shiraho by the degree of fall in pitch, with Fa1 words consistently showing a steeper fall in pitch than Fa2 words (see model in Figure 4). In order confirm our observations, we conducted an acoustic analysis focusing on the difference between F0 peak and F0 average level at the end of the word.

Figure 4: Hypothesized model



2. ACOUSTIC ANALYSIS

2.1. Method

We elicited words from three speakers (speaker A male born 1933, speaker B male born 1932, speaker C female born 1936) during fieldwork sessions in September and December 2018. Each word was recorded (ZOOM H4 and internal microphone) pronounced in isolation in a quiet environment. The speaker was asked to pronounce each word only once, unless asked to repeat the word by the authors. In the case several tokens were obtained for the same word, the clearest recording was chosen.

From the elicited words, we extracted the words that satisfied the following conditions: (1) there is a cognate word in Hateruma, whose tone is either rising or falling; (2) mono-morphemic; (3) constituted by 2 or more syllables; (4) beginning with a voiced segment. We thus obtained 17 words for speakers A and B and 14 for speaker C (see Appendix). Words were classified into two groups based on the tonal correspondences with Hateruma (Fa1 corresponding to falling tone and Fa2 to rising tone). We used Praat [3] to automatically extract the F0 peak and the average F0 of the last 80 msec of each word (see Figure 4 for the assumed model).

2.2. Results

For speakers A and B, the difference between F0 peak and F0 average of last 80 msec was significantly smaller for Fa2 words compared to Fa1 words (two sample t-test, $p = 0.045$ and $p = 0.006$ respectively, Figure 5, 6). However, no significant difference was observed for speaker C ($p = 0.186$, 7). We still found a significant difference between Fa1 and Fa2 in the F0 average of the last 80 msec ($p = 0.016$).

3. DISCUSSION

3.1. Two types of falling tones in Shiraho

The results above show that there is a clear and consistent distinction in pitch pattern between Fa1 and Fa2 words pronounced in isolation for speakers A and B. Fa1 words are characterized by a steeper fall in pitch than Fa2 words.

No distinction has been found for speaker C, but there may be several explanations for this. First, the set of words analyzed could have been too small. Secondly, the assumptions of our model may have failed to fully capture the difference between Fa1 and Fa2 (although it worked well for speakers A and B). Lastly, it may simply be the case that this speaker does make any distinction between the two groups of words. However, in a follow-up study with speakers B and C, in which target words were pronounced followed by a case particle in a full sentence, Fa1 and Fa2 words showed a clear distinction in pitch pattern for both speakers (see [8] for details).

Since Fa1 and Fa2 classification was based on Hateruma's tone classes, we can confidently argue from the results above that what had been reported as a falling tone in Shiraho actually consists of two different tones (as further evidence, we also found a minimal pair [peri] 'drought' Fa1 vs. [peːri] 'vinegar' Fa2, elicited from speaker A).

There still remain, however, some issues concerning the defining features of Fa1 and Fa2. Although we have showed that the two word-tones are distinguished by the scope of pitch falling (in the case of two speakers), there still may be some other characteristic differences. For example, the first syllable of Fa2 di-syllabic words tends to be pronounced either with a longer vowel (as in [muːmu] 'thigh' in Figure 3), or as a heavy syllable by gemination of the following consonant (see list in Appendix). At this point, we do not know whether this phenomenon is purely prosodic, caused by the superimposition of Fa2 word-tone's pattern, or simply lexical (i.d. underlying long vowel/geminate).

Figure 5: Speaker A

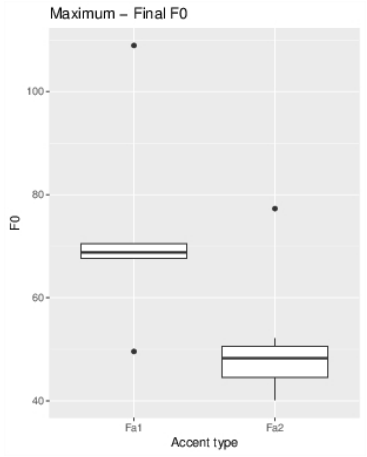


Figure 6: Speaker B

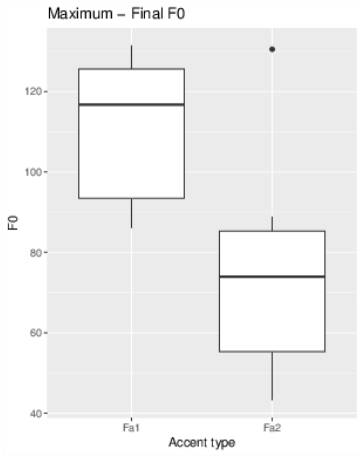
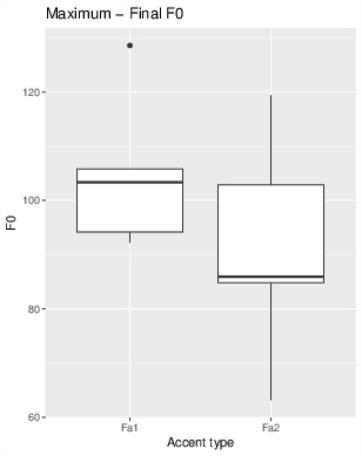


Figure 7: Speaker C



3.2. The origin of Fa2: comparison with Hateruma

Shiraho's flat, Fa1 and Fa2 tones correspond to Hateruma's flat, falling and rising tones. The first two correspondences are straightforward, but Fa2 :: rising raises the issue of which of the two patterns is the older one. It should be noted that Hateruma's rising word-tone can actually be pronounced with two different pitch patterns, LH and HLH ([2], L:low, H:high, M:mid). On the basis of the correspondence Hateruma HLH :: Shiraho HM (Fa2), the 'incompleteness' of the pitch fall observed in Fa2 as compared to Fa1 could be explained, historically, by the fact that Fa2 originates in a rising pattern. Interestingly, it is precisely such a change that has been proposed to explain some correspondences in tones found in the Nothern Ryukyuan dialects ([15], p.72).

4. CONCLUSION

In this study, we showed that Shiraho's falling tone actually conflated two different tones, falling 1 (Fa1) and falling 2 (Fa2), corresponding to Hateruma falling and rising tones. Based on acoustic analysis, we found that Fa1 is characterized by a steeper fall in pitch than Fa2. We have also discussed the possibility that Fa2 originates from a rising tone, which would explain the 'slightly falling' characteristic of the pitch pattern.

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APPENDIX

- Ha: Tone types in Hateruma
- A, B, C: Speakers

Item	Meaning	Ha	A	B	C
uʃi	'cow'	F	✓		✓
amiʃi̥i̥na	'sugar cane'	F	✓	✓	✓
bidumu	'man'	F	✓	✓	✓
iʃi	'stone'	F	✓	✓	
mitʃi	'road'	F		✓	
neːri	'right'	F		✓	
utu	'sound'	F		✓	
nni	'bosom'	F	✓	✓	✓
judari	'drool'	F			✓
duʃi	'friend'	F	✓		
iga	'squid'	F	✓		
juda	'branch'	F	✓		
naːbi	'cauldron'	R	✓	✓	✓
midumu	'woman'	R		✓	✓
miːsu	'miso'	R		✓	✓
ntta	'soil'	R		✓	✓
juːru	'night'	R	✓	✓	✓
baːsa	'banana'	R	✓	✓	✓
batta	'belly'	R	✓	✓	✓
naːda	'tear'	R	✓	✓	✓
nuːdu	'throat'	R	✓	✓	✓
baima	'we (excl.)'	R	✓	✓	
gaˈja	'thatch'	R	✓		
matta	'crotch'	R	✓		

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