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Experimental Study on Single-Word of Yudu Dialect

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Hakka Chinese is one of the seven major dialects in China. Yudu dialect, as one of social varieties of Hakka dialect, has great value of research. This research selected the dialect of Luoao Town as the research object, and analyzed the fundamental frequency and duration of six tones of four local male speakers. The results show that there are six tones in Luoao dialect: Tone 1 /33/, Tone 2 /22/, Tone 3 /31/, Tone 4 /53/, Tone 5 /54/, Short Tone 6 /54/. In addition, there are two findings: (1) The tone system of Yudu dialect has high and low registers, and (2) the dialect has two high-level falling tones that are merging on progress.

Keywords: Hakka Chinese, Yudu dialect, single-word pattern

Introduction

Yudu is located in the south of Jiangxi Province, covering an area of 2,893 square kilometers. There are 23 towns in the county. The proportion of Hakka people in Yudu accounts for more than 90% of the total number (Sun, 2016). The Hakka Chinese is popular in Yudu County, which belongs to the Yu-Gui district (“于桂片”) (“Yu” refers to “Yudu County in the south of Jiangxi”, while “Gui” refers to “Guidong County in the east of Hunan Province”). Xie (1998) conducted a study on the tone sandhi of the dialect of Gongjiang Town in Yudu. He pointed out that there are six monosyllabic tones and five tone sandhis in Yudu dialect. In 1998, Xie described the phonetic system of Yudu dialect in detail in *Yudu Dialect Dictionary*. In this dictionary, 24 initial consonants and 48 vowels in Yudu dialect were mentioned (see Figures 1 and 2). The five-scale pitch system developed by Chao (1930) was used to transcribe the six tones of Yudu dialects: Tone 1 /31/, Tone 2 /44/, Tone 3 /35/, Tone 4 /22/, Tone 5/42/, Tone 6 /5/. It is worth noting that the pronunciations and tones vary in different towns. Based on the results of Xie (1998), Sun (2016) explored the monosyllabic tone of the dialect of Lingbei town in Yudu. The T1-T6 in Lingbei dialect were transcribed as /31/, /22/, /15/, /11/, /54/, /5/. The results showed that Lingbei dialect tones are mostly flat tones and falling tones. This study chooses the dialect of Luoao Town as the research object. Because the town surveyed by Xie (1998) is located in the center of the county, this study selected the town far away from the urban area to investigate whether the tone of the town retained the single-word pattern surveyed by Xie (1998).

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p 疤布搬冰	p‘爬扶潘拍	m 骂妹慢忙	f 肺飞风饭	v 爱万王屋
t 多低胆灯	t‘舵土汤淡	n 拿男脓嫩		l 罗赖蓝浪
ʦ灾紫葬摘	ʦ‘粗次枪戳		s 苏事山想	
ʈʂ猪周针章	ʈʂ‘住赵陈唱		ʂ书烧深伤	
ʨ鸡浇金姜	ʨ‘轿牵共菊	ɳ女严娘玉	ɕ晓嗅险歇	
k 家高柑谷	k‘跪巧宽空	ŋ牙岩硬岳	h 下孝咸黑	
θ 五矮盐痒				

Figure 1. The initial consonants in Yudu dialect.

ɿ	ʅ	a	æ	ɐ	ɔ	ɛ	e	ɣ	ə	eu	ɨu
i		ia		uɐ	iɔ	iɛ	ie	iɣ		ieu	iu
u		ua	uæ	yɐ							ui
ĩ		ã			ɔ̃		ẽ		əŋ	ŋ̊a	
Î		iã			iɔ̃		iẽ		ɨəŋ		
		uã					uẽ				
							yẽ		iuʔ		
		aʔ			oʔ	ɛʔ	eʔ				
		iaʔ			ioʔ	iɛʔ	uɐʔ		uʔ		
		uaʔ					yeʔ				

Figure 2. The vowels in Yudu dialect.

Method

Recording

Four males between 30 and 55 years old were selected as speakers, who have been at home for nearly 10 years. They can speak dialect fluently. The Speaker 1, Speaker 2, and Speaker 3 are about 50 years old. They all have only received primary education. When they were young, they had gone out to work, but in the past decade or so, they had been working in the Yudu. The Speaker 4 is 33 years old and fluent in dialect and Mandarin. He has received higher education. Since graduating from college, he was at home without job due to illness.

In order to contrast the six tones, this study selected three consonant-vowel words for each tone (see Table 1). Three vowels [a i u] were used for T1-T5, [iaʔ ɤʔ aʔ] for T6. Each word was recorded six times, and the four times with better recording quality and effect were selected. Finally, a total of 108 recordings were collected, of which 72 were selected as the analysis objects. The recording environment is a quiet room in the speaker’s home. Recording equipment is Praat and wired headphones. The recording sampling is 44,100 Hz. The 108 words were divided into six sections in terms of tones. Words of same tone are presented in PowerPoint respectively at 0.01 seconds switching speed. The recording materials were stored in WAV format.

Table 1

Word List of the Experiment

Tone 1	Tone 2	Tone 3	Tone 4	Tone 5	Tone 6
家 /ka/	蛇 /ʂa/	打 /ta/	怕 /p‘a/	白 /p‘a/	劈 /p‘iaʔ/
尾 /mi/	梨 /li/	李 /li/	帝 /ti/	利 /li/	剥 /pɤʔ/
肚 /t‘u/	扶 /p‘u/	普 /p‘u/	兔 /t‘u/	步 /p‘u/	拍 /p‘aʔ/

Annotation

After recording, the sound files of different groups were imported into Praat to be cut into single character file. The second step is to annotate the sound files. The annotation is divided into two tiers. The token boundaries were determined in the first tier, and the vowel boundaries were drawn in the second tier. Vowel duration is used as the whole carried of tone.

Extract the Fundamental Frequency Value and Vowel Duration

Fundamental frequency of vowel is the main carrier of tone. In order to ensure accuracy and objectivity, 11 fundamental frequency points of vowel segments were extracted as experimental data. The script was used to extract the fundamental frequency values of each sample tone segment at 11 points. Meanwhile, pitch duration took the same value of vowel duration in milliseconds. Finally, these data were imported into excel. Mean values of six tones were calculated for duration and fundamental frequency at the points measured (see Tables 2 and 3).

Table 2

Absolute Duration

Absolute duration (in ms)					
T1	T2	T3	T4	T5	T6
308.17	347.13	317.33	274.98	236.46	161.15

Table 3

Fundamental Frequency (in Hz)

Fundamental frequency (in Hz)											
	1	2	3	4	5	6	7	8	9	10	11
Tone 1	137.52	135.71	135.39	135.23	135.07	134.66	134.08	133.03	130.91	128.20	125.76
Tone 2	126.67	123.76	121.85	121.25	120.76	120.29	119.89	119.56	119.26	118.71	117.72
Tone 3	137.26	134.82	131.99	128.75	124.60	119.82	114.80	110.06	106.13	106.13	101.11
Tone 4	156.57	153.56	151.54	149.67	146.81	142.43	136.72	130.47	124.73	120.28	118.12
Tone 5	162.86	162.85	162.71	161.31	158.63	154.55	148.82	142.12	135.96	131.63	130.59
Tone 6	152.33	149.59	147.19	143.54	139.59	136.17	133.30	130.81	128.17	126.94	126.51

Data Processing

Filtering out the personal characteristics in the tone is the premise of analyzing the tone pattern. Each person's pronunciation has its own characteristics and is affected by external conditions (Yu, 2020). Normalization is used to eliminate interpersonal differences, extract constant parameters, and find commonalities in interlingual variation (Zhu, 2004). Therefore, the *T*-value is adopted to normalize the fundamental frequency and convert it into the five-scale value. As a symbol of tone, the five-scale value is the record of the actual phonetic psychological impression obtained by hearing, as well as various phonetic symbols including international phonetic symbols (Shi, 1990).

The formula of *T*-value calculation is $T = \{[\lg x - \lg (b)]/[\lg (a) - \lg (b)]\} * 5$, where "b" is the minimum in the tonal domain, "a" is the maximum in the tonal domain, and "x" is the mean value of frequency of the measured point. The *T*-value of each average fundamental frequency point was calculated by using the *T*-value formula. The calculation results are shown in Table 4. Pitch curve is visualized by excel based on the calculation results (see Figure 3).

Table 4

Normalized Fundamental Frequency

Fundamental frequency											
	1	2	3	4	5	6	7	8	9	10	11
Tone 1	3.25	3.11	3.09	3.07	3.06	3.03	2.98	2.90	2.73	2.51	2.31
Tone 2	2.38	2.14	1.97	1.92	1.88	1.84	1.80	1.77	1.74	1.70	1.61
Tone 3	3.23	3.04	2.82	2.55	2.21	1.79	1.34	0.90	0.51	0.19	0.00
Tone 4	4.58	4.38	4.24	4.11	3.91	3.60	3.17	2.69	2.27	1.93	1.80
Tone 5	5.00	5.00	4.99	4.90	4.73	4.46	4.07	3.63	3.24	2.92	2.92
Tone 6	4.33	4.14	3.97	3.70	3.41	3.15	2.92	2.72	2.51	2.40	2.37

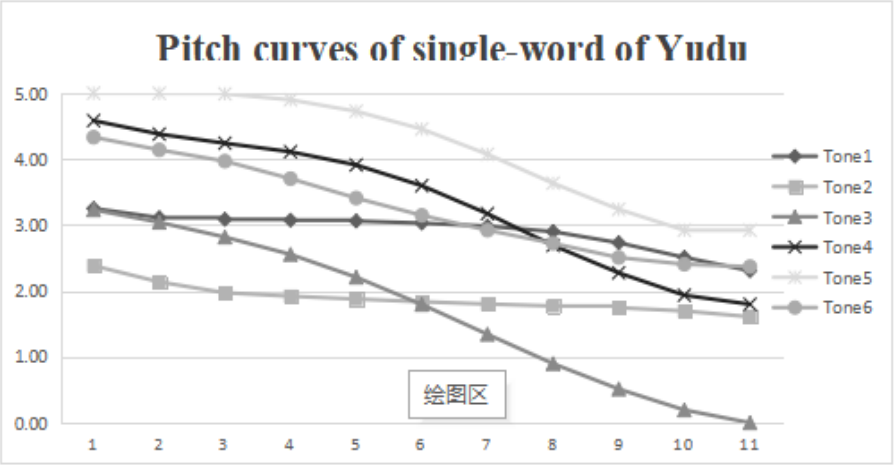

Figure 3. The pitch curves of Yudu dialect.

The duration of a single word is another important parameter to be concerned when examining tones. In this study, the duration of the vowel segment is taken as the analysis object. The absolute duration (AD) is shown in Table 2. Due to the influence of internal factors such as speaker's speaking habits, state, emotion, and external factors such as environmental atmosphere, it is difficult to ensure the consistency of speech speed even for the same speaker. Therefore, like the fundamental frequency normalization, the absolute duration of the extraction is standardized (the RD in Table 5). The formula is: $NDi = Di / (\sum Di)$, where Di is the absolute tone length, N is the number of tone classes in the dialect, and NDi is the relative tone length after standardization (Sun, 2016). The study firstly calculated the average value of all tones, and then calculated the ratio of the duration of each tone to the average value. The bar charts of absolute and relative duration are presented respectively in Figures 4 and 5.

Table 5

The Absolute Duration and Relative Duration

	T1	T2	T3	T4	T5	T6
AD	308.17	347.13	317.33	274.98	236.46	161.15
RD	1.12	1.27	1.16	1.00	0.86	0.59

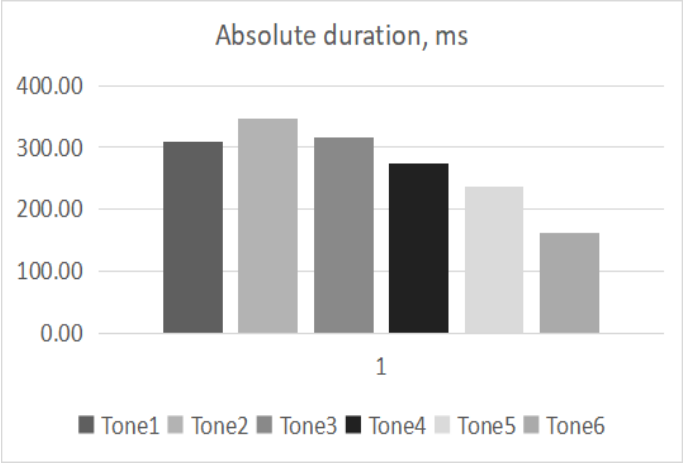

Figure 4. The bar graph of absolute duration.

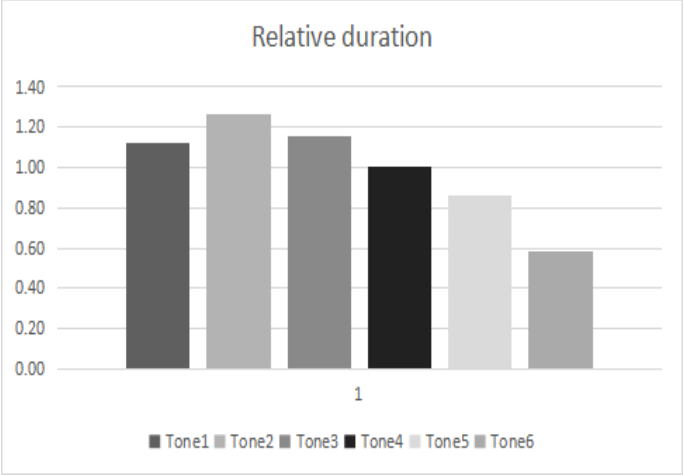

Figure 5. The bar graph of relative duration.

Results and Discussion

Single-Word Pattern

Liu (2006) proposed that the conversion of T value to five-scale value is the conversion between intervals, so there is a transition region between two registers, and the boundary of each register allows 0.1 to float up and down. In addition, because the beginning and end of the tone are unstable, this experiment only focuses on the eight points in the middle of the fundamental frequency. Therefore, from the Table 4 and Figure 3, we can conclude that there are six tones of single-words in Luoao Town dialect: Tone 1 /33/, Tone 2 /22/, Tone 3 /31/, Tone 4 /53/, Tone 5 /54/, Short Tone 6 /54/.

It can be clearly seen that the tones of the dialect are all falling tones and flat tones and there are two registers: the higher register and the lower register. Tone 1 is a flat tone in the higher register, while the Tone 2 is a flat tone the lower register. Tone 4 is a falling tone starting at the higher register. In contrast, Tone 3 is a falling tone in the lower register. Tone 6 sounds like a high-level falling tone with the shortest duration. It is worth noting that Tone 5 and Tone 4 both belong to the high-level register. It is difficult to identify these two tones. This will be discussed in the next part.

Form the Table 5, Figure 4, and Figure 5, the duration pattern of the six tones can be drawn. Tone 2 has the longest duration, followed by Tone 3 and Tone 1, then Tone 4, Tone 5, and finally Tone 6. The tone values of Tone 5 and Tone 6 are the same in terms of five-scale pitch system. However, the two are significantly different in terms of duration.

A Merge in Progress

In the description of the single-word pattern, both Tone 4 and Tone 5 are found to be falling tones in the higher register. This study speculates that the two tones are merging. By drawing the fundamental frequency diagrams of the two tones of each speaker, we find that the fundamental frequency curves of these two tones of each speaker overlap to different extent (see Figures 6 and 7).

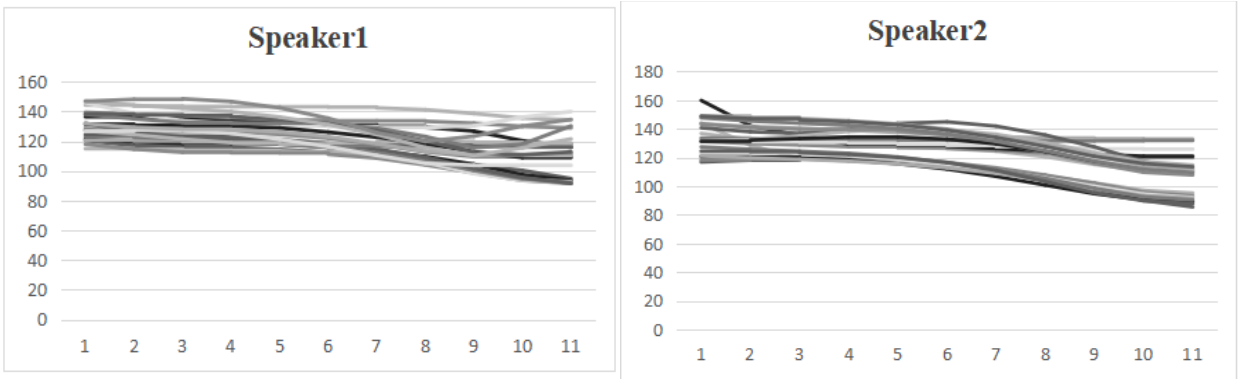

Figure 6. The fundamental frequency curves of T4 and T5 of Speaker 1 and Speaker 2.

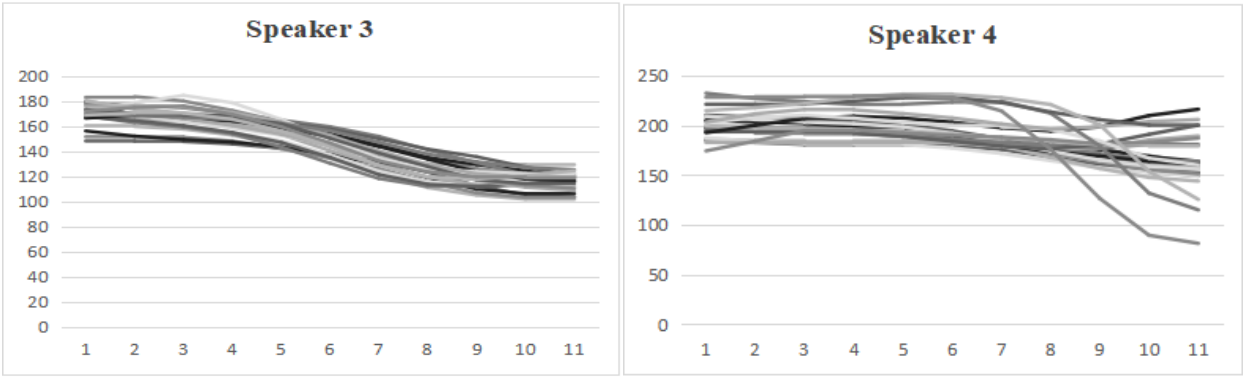

Figure 7. The fundamental frequency curves of T4 and T5 of Speaker 3 and Speaker 4.

Wang, Liu, and Zhang (1988) suggested that the similarity of auditory sense, the influence of continuous tone, and the influence of other dialects are the main causes for the merge of tones. Although there was no relevant research on the tone pattern of the town 10 years ago, referring to the research of Xie (1998), it can be found that the tone registers of Luoao dialect are quite different, but it is similar to the registers of Mandarin tones. Given the improvement of the quality of education in the region in recent years, it is possible that the dialect has been influenced by Mandarin. As we all known, the merge of two falling tones in Mandarin, Yang Qu, and Yin Qu is a fact, which can be also demonstrated in the merging of Tone 4 and Tone 5 in Luoao dialect.

In general, the six tones in this study are quite different from those in previous studies, which may be caused by the influence of Mandarin or other dialects. Although they belong to the dialects of Yudu County, the dialect tone of different town is also significantly different. There is a common phenomenon that the same word has

different sounds in different towns in this country. The specific cause of the merge of Tone 4 and Tone 5 is a direction for researchers to explore in the future.

Conclusions

This research conducted a phonetic experiment, combined with Praat and excel data statistical tools, to analyze the six tones of Yudu dialect. The tone values of the six tones of Yudu dialect are: Tone 1 /33/, Tone 2 /22/, Tone 3 /31/, Tone 4 /53/, Tone 5 /54/, Short Tone 6 /54/. The relative durations of six tones are: Tone 1 (1.12), Tone 2 (1.27), Tone 3 (1.16), Tone 4 (1.00), Tone 5 (0.86), Short Tone 6 (0.59). In addition, there are two findings: (1) Single-word pattern of Luoao dialect has high and low tone registers: the higher register and the lower register; and (2) The second is that the dialect has two high falling tones that are merging on progress.

In general, the six tones of Luoao dialect are all falling tones and flat tones, but the results are significantly different from the previous record of other towns in Yudu. It should be noted that there are several limitations of this research: Firstly, because the four speakers have worked or studied in other counties, their pronunciation may be influenced by other language varieties. For example, the Speaker 4 pronounced "尾 mi" as "mei". Secondly, due to the low frequency of dialect use among young people, and with the popularization of compulsory education, more and more people use Mandarin in daily communication, so it is very difficult to find suitable speakers. In this study, only four speakers were found. In the future research, it is necessary to increase the number of samples and group them according to different ages and genders to obtain more accurate conclusions (Yu, 2020).

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