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Acoustic Analysis of the Monosyllabic Tone of Ya Dialect in Qingping, Lianjiang

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Abstract: This study investigates the monosyllabic tone of the Ya dialect in Qingping, Lianjiang through the use of acoustic experimentation. The Praat software is employed to obtain objective tone values and tone duration data from a sample. The results indicate that the Ya dialect in Qingping, Lianjiang comprises six tone categories, namely Yinping, Yangping, Shangsheng, Qusheng, Yinru, and Yangru, with corresponding tone values of 55, 35, 41, 44, 31, and 5. The order of tone duration, ranked from longest to shortest, is as follows: Yinping > Shangsheng > Qusheng > Yangping > Yinru > Yangru. Although the tone types align with traditional descriptions, the experimental values for most tone types slightly exceed the traditional values. This phonetic experiment provides a more precise documentation of the phonetic characteristics of the Ya dialect in Qingping, Lianjiang, contributing to the field of Chinese dialect research.

Keywords: Lianjiang, Qingping, Ya dialect, monosyllabic tone, experimental phonetics

1. Introduction

In China, Lianjiang City is a county-level city located in the southwestern region of Guangdong Province and the northern part of the Leizhou Peninsula. It falls under the administration of Zhanjiang City. The Lianjiang dialect comprises the Bai dialect, Ya dialect, and Li dialect, which correspond to the Guangdong dialect, Hakka dialect, and Minnan dialect, respectively [1]. The Ya dialect, also known as the Ai dialect, is a type of Hakka dialect spoken in western Guangdong and southern Guangxi. It has a population of over 5 million. The Ya dialect is characterized by the distinctive character "ya" which means "I" and is pronounced as [ŋai^{35}] in the local dialect. Approximately 40 percent of the population in Lianjiang uses the Ya dialect. The Ya dialect in Lianjiang is a Hakka language primarily spoken in the western and northern parts of Lianjiang [2], including Tangpeng, Shizeng, Heliao, Shijiao, Changshan, and some villages in Hechun, Shiling, Qingping, Gaoqiao, Yatang, Yingzai, Jishui, as well as a few villages in the riverbank of Hengshan and Anpu towns.

The Ya dialect has been influenced by the surrounding strong dialects, resulting in variations in accent from place to place. There is a growing trend of Cantonese and Mandarin Chinese replacing the Ya dialect, making it imperative to protect and preserve it. Previous studies on the Ya dialect focused on its phonetics and phonology, particularly its rhyme characteristics and current variations, using traditional dialectology methods. However, there has been no acoustic description based on speech experiments.

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Chen Y. L. [3] conducted an investigation on the Ya dialect in Dianbai, Maoming (Shalang accent) and summarized six monosyllabic tone classes and their values, namely Yinping (34), Yangping (213), Shangsheng (31), Qusheng (54), Yinru (2), and Yangru (5). However, there are noticeable tone differences between the Ya dialect in Dianbai and the Ya dialect in Lianjiang. Additionally, there are internal differences within the Lianjiang dialect between the Ya dialect in Shijiao and the Ya dialect in Qingping. As a result, there are currently no studies that fully capture the tone system pattern of the Lianjiang dialect.

Qingping Town, located in the western part of Lianjiang City, is home to villagers who speak the Ya dialect in Qingping, which differs slightly from the Ya dialect in Shijiao, the downtown area of Lianjiang. Traditional research on Hakka phonetics typically distinguishes between the Ya dialect in Shijiao and the Ya dialect in Qingping.

This paper utilizes the theory of experimental phonetics and supplements the pronunciation data of the Ya dialect in Qingping, Lianjiang through speech experiments conducted on computer software. It provides a detailed report on the acoustic experiment results of the monosyllabic tone of the Ya dialect in Qingping, Lianjiang, aiming to accurately and comprehensively reflect the features of the monosyllabic tone in the Ya dialect in Qingping, Lianjiang.

2. Experimental materials and procedures

2.1. Experimental materials

In this study, two audio samples were obtained from speakers, and one speaker with superior recording quality was chosen for analysis. The selected speaker, Zhang J., is a 22-year-old male student from Lianjiang, Zhanjiang. He is a native Chinese speaker from Qingping, Lianjiang, and possesses a clear pronunciation accent without any physiological defects. Zhang J. primarily resides in Yingzai town of Lianjiang City and is proficient in speaking the Ya dialect, Cantonese in Lianjiang, and Mandarin. In his daily family communication, the Ya dialect in Qingping, Lianjiang is predominantly used.

To investigate the characteristics of the Ya dialect, a monosyllabic tone experiment was conducted, consisting of six key categories. Each key category comprised six test words, all of which were commonly spoken words in the Ya dialect in Lianjiang [4]. The specific details of the experiment can be found in the table below.

Table 1: Speech experiment word

Number	Tone Category	Word					
1	Yinping	夫	刀	巴	家	机	姑
2	Yangping	图	台	其	扶	爬	婆
3	Shangsheng	古	保	狗	府	补	改
4	Qusheng	布	豆	破	富	报	嫁
5	Yinru	八	骨	德	福	答	毕
6	Yangru	白	服	达	独	特	局

2.2. Experimental procedure

The recording was conducted in a quiet room in March 2023. Prior to recording, the speaker familiarized themselves with the survey data to mitigate any challenges related to pronunciation. The Chinese version of Praat software (developed by Boersma, Paul & Weenink, David; modified by Bei X. M. and Xiang N., 2020) was utilized on a computer to display the survey's sample words

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and record the audio. The audio was recorded in mono with a sampling rate of 44100Hz and a sampling accuracy of 16 bits. Each word was separated by a 3-second interval. After reading the sample words from the first three groups of key types, the speaker took a one-minute break before reading the sample words from the last three groups of key types. Once the recording was completed, the speech materials were segmented and annotated in Praat. Syllable names were marked using Chinese characters, while tone types were marked with numerical numbers (refer to Table 1). During the tone marking process, any elbow segments and descending tail segments that deviated significantly from the tone trend were removed, leaving only the basic tone segment.

Following the collection of monosyllabic tone samples, they were saved in WAV format and imported into Praat. The fundamental frequency (F0) and duration data were extracted using a script and analyzed with reference to narrowband speech maps and pitch maps. Based on the annotated tone, the F0 value for each individual word was extracted, and 9 measurement points were set for each sample word. This resulted in a total of 324 fundamental frequency data points (36 tones * 9 fundamental frequency values).

The data was then imported into Excel 2016 for analysis. The mean value and standard deviation of the original fundamental frequency values were calculated, and the T-value method [5] was employed to normalize the fundamental frequency values. The formula used for normalization was as follows:

$$T = (lgx - lgmin) / (lgmax - lgmin) * 5$$

Here, x represents the frequency of the measuring point, max represents the frequency of the upper limit of the modulation range, and min represents the frequency of the lower limit of the modulation domain.

After normalizing the fundamental frequency values, the Hertz data was converted to T-values. A line graph was then used to depict the normalized fundamental frequency data, resulting in a tone experiment diagram. To convert the T-values to five-degree values, the following method was employed: a T-value of 0-1 corresponded to 1 degree of the five-degree value, 1-2 corresponded to 2 degrees, 2-3 corresponded to 3 degrees, 3-4 corresponded to 4 degrees, and 4-5 corresponded to 5 degrees.

3. Experimental results and analysis

Pitch and duration are physical attributes of speech that play a crucial role in describing tone. This analysis will examine the monosyllabic tone pattern and duration pattern of the Ya dialect in Qingping, Lianjiang, based on the pitch and duration of the phonetic materials.

3.1. Study of pitch

The fundamental frequency is the determining factor for the pitch of a tone. The shape of a tone is based on the variation of the fundamental frequency of speech, known as the F0 curve, which changes over time and in relation to the level of the fundamental frequency. Therefore, in order to study the pitch of a tone, it is necessary to begin with an examination of the fundamental frequency. The following information presents the tone pattern diagram and basic frequency data of the Ya dialect in Qingping, Lianjiang, obtained through experimentation.

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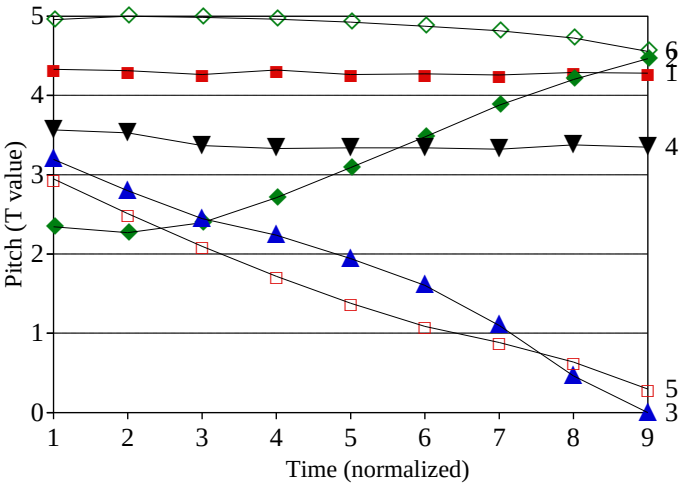

Figure 1: Tonal T-value chart of the speaker

Table 2: Tonal T-value table of the speaker

tone	dot1	dot2	dot3	dot4	dot5	dot6	dot7	dot8	dot9
1	4.33	4.31	4.27	4.32	4.27	4.27	4.26	4.29	4.28
2	2.34	2.27	2.4	2.71	3.09	3.48	3.88	4.2	4.46
3	3.19	2.8	2.45	2.24	1.94	1.6	1.1	0.46	0.01
4	3.57	3.53	3.37	3.33	3.34	3.34	3.32	3.38	3.35
5	2.95	2.51	2.1	1.72	1.38	1.09	0.89	0.64	0.3
6	4.96	5	4.99	4.96	4.93	4.88	4.82	4.73	4.56

Based on the analysis of the tone trend shown in Figure 1 and the fundamental frequency data presented in Table 2, the characteristics of the voice tone in the Ya dialect of Qingping, Lianjiang, as well as the changes in the tone values of each tone class, can be determined. By considering the curvature of the mean curve of the fundamental frequency of monosyllabic words and the pattern of tone, the following analysis results can be obtained:

Yinping (Tone 1) is a flat tone located in the upper part of the modulation domain. It has a starting point T-value of 4.33, a stopping point T-value of 4.28, and a fluctuation range of 0.07. In the five degree modulation domain, the five-degree value can be recorded as 55.

Yangping (Tone 2) is an ascending tone that starts from the lower part of the modulation domain and rises to the upper part. It has a starting point T-value of 2.34, a stopping point T-value of 4.46, and a fluctuation range of 2.19. It falls within the three degree modulation domain to the five degree modulation domain, and the five-degree value can be recorded as 35.

Shangsheng (Tone 3) is a descending tone that starts from the upper part of the modulation domain and falls to the lower part. It has a starting point T-value of 3.19, a stopping point T-value of 0.01, and a fluctuation range of 3.18, which is larger than the Yinru modulation. It falls within the four degree modulation domain to the one degree modulation domain, and the five-degree value can be recorded as 41.

Qusheng (Tone 4) is a flat tone located in the upper part of the tone domain. It has a starting point T-value of 3.57, a stopping point T-value of 3.35, and a fluctuation range of 0.25. It falls within the four degree tone domain, and the five-degree value can be recorded as 44.

Yinru (Tone 5) is a descending tone that starts from the upper part of the tone field and falls to the

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lower part. It has a starting point T-value of 2.95, a stopping point T-value of 0.3, and a fluctuation range of 2.65. The decrease in pitch is slightly smaller than the upper tone. It falls within the three degree tone field to the one degree tone field, and the five-degree value can be recorded as 31.

Yangru (Tone 6) is a flat tone located in the upper part of the tone domain. It has a starting point T-value of 4.96, a stopping point T-value of 4.56, and a fluctuation range of 0.44. It falls within the five degree tone domain, and the five-degree value can be recorded as 55 or 5.

Figure 1 indicates that the monosyllabic tones in the Ya dialect of Qingping, Lianjiang are primarily level tones (Yinping, Qusheng, and Yangru) and falling tones (Shangsheng and Yinru), with only Yangping being a rising tone. Other regions, such as Luchuan, Yulin, and Dianbai, Maoming, do not have all the tones found in the Ya dialect.

It is important to note that the fundamental frequency values of Yangping and Yangru are located in the five degree tuning domain at the upper part of the domain. Compared to Yinping, they have a smaller fluctuation range and a gentler tone. Yangru has a higher average fundamental frequency value and overall pronunciation. To distinguish it from Yinping, Yangru in the Ya dialect of Qingping, Lianjiang is temporarily marked with a value of five degrees.

In summary, the five-degree tones of the Ya dialect in Qingping, Lianjiang can be summarized as follows: Yinping (55), Yangping (35), Shangsheng (41), Qusheng (44), Yinru (31), and Yangru (5).

Through a literature search, it was found that there is no acoustic experimental study on the tone of the Ya dialect in Qingping, Lianjiang. The phonology and phonetics of the Ya dialect in Qingping, Lianjiang are only briefly mentioned in traditional literature. Li R. L. et al. [6] recorded the description results of the monosyllabic tones of the Ya dialect in Qingping, Lianjiang, which slightly differ from the experimental results obtained in this study.

The basic tone types of the six key classes are the same, such as Yangping being a rising tone and Shangsheng being a falling tone. The main difference lies in the five-degree values of Yangping, Shangsheng, Qusheng, and Yinru. Both the experimental values and the traditional values of Yangping fall within the three five-degree domains, but the experimental values are one degree higher than the traditional values. The modulation amplitude of the experimental values of Shangsheng and Yinru is larger than that of the traditional values, and the modulation head of the experimental values is one degree higher than the traditional values. The experimental value of Qusheng is higher than the traditional value, and the turn and tail of the former are one degree higher than the latter.

In terms of pitch of monosyllabic tones, the experimental results are generally higher than the traditional description results, but the difference does not exceed one degree.

3.2. Study of duration

Duration is a significant aspect to consider when examining tone. Therefore, it is essential to describe and analyze the duration in order to comprehend the monosyllabic tone duration pattern of the Ya dialect in Qingping, Lianjiang. Additionally, it is important to compare the specific duration of the level tone and entering tone in the Ya dialect of Qingping, Lianjiang. The duration data acquired from the experiment are presented below:

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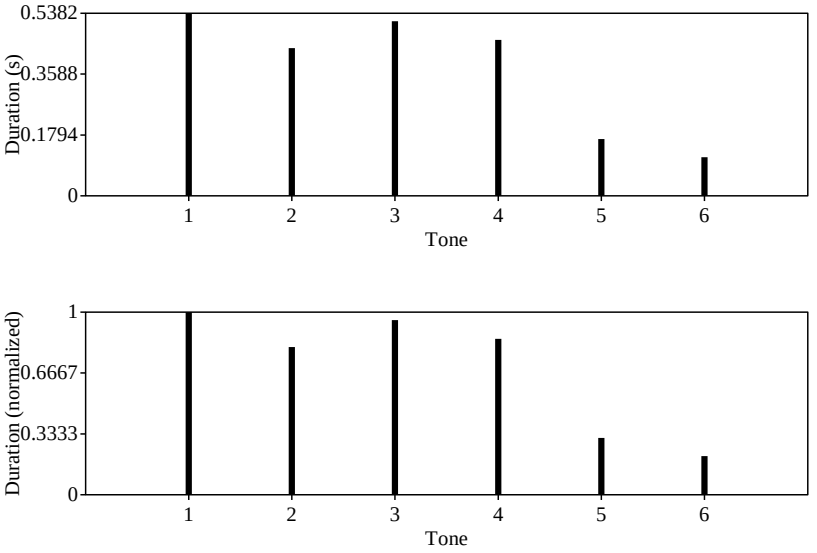

Figure 2: Tone duration chart of the speaker

Table 3: Tone duration table of the speaker

tone	duration(s)	relativeDuration
1	0.538	1
2	0.436	0.809
3	0.514	0.956
4	0.46	0.854
5	0.168	0.312
6	0.114	0.212

Relative duration refers to a value obtained by normalizing the average absolute duration of each tone, allowing for a clear and intuitive representation of duration differences. The calculation method involves dividing the mean absolute duration of a monosyllabic tone by the largest average absolute duration across all tones.

Based on the absolute duration data presented in Figure 2 and Table 3, the longest duration is observed in the Yinping tone (Tone 1), with an average duration of 0.538 seconds. Conversely, the shortest duration is found in the Yangru tone (Tone 6), with an average duration of 0.114 seconds. When considering the relative duration of the six tones, excluding Yinping which serves as the reference, Shangsheng (Tone 3), Qusheng (Tone 4), and Yangping (Tone 2) exhibit durations close to the mean. In contrast, the two Rusheng tones (Tone 5 and Tone 6) have durations that are only about 1/5 to 1/3 of the other four tones. This indicates a clear opposition between the level tone and the entering tone in the Ya dialect of Qingping, Lianjiang, with the level tone being significantly longer than the entering tone. Notably, the Yinping and Yangru tones, both belonging to the 55 tone category, exhibit the largest difference in duration among all tones.

In summary, the long to short duration pattern in the Ya dialect of Qingping, Lianjiang can be described as follows: Yinping > Shangsheng > Qusheng > Yangping > Yinru > Yangru.

4. Conclusion

This paper utilizes the methodology of experimental phonetics to gather phonetic materials and data

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on the Ya dialect in Qingping, Lianjiang. It examines the tone values of monosyllabic words and analyzes the duration of these tones in the dialect. Additionally, it compares the findings of this experiment with those of previous studies.

Through acoustic analysis, this study identifies the monosyllabic tone values of six key classes in the Ya dialect of Qingping, Lianjiang. These classes include Yinping (55), Yangping (35), Shangsheng (41), Qusheng (44), Yinru (31), and Yangru (5). The study also determines the duration of these tones, finding that Yinping and Shangsheng have the longest duration, followed by Qusheng and Yangping, and Yinru and Yangru have the shortest duration. The order of duration from longest to shortest is: Yinping > Shangsheng > Qusheng > Yangping > Yinru > Yangru. Comparing these results with previous research, the monosyllabic tone values obtained in this experiment are largely consistent with traditional values, with the experimental values tending to be slightly higher.

It should be noted that the pronunciation of the Ya dialect in Lianjiang is influenced by surrounding dialects, leading to a degree of synergy between the Ya dialect and other dialects, such as Cantonese. Consequently, the authenticity of the dialect speech materials cannot be fully guaranteed. Furthermore, the accuracy of the experimental data is also influenced by factors such as the age and number of dialect users.

In future research on the Ya dialect in Lianjiang, it is recommended to increase the number of speakers with representative accents and consider additional factors such as gender, age, social class, and local residency duration. These considerations will contribute to a more comprehensive and complete description of the tone characteristics of the Ya dialect in Lianjiang, thereby facilitating the study of Chinese dialects.

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