Experimental Research on Citation Tone of Liangzhou Dialect in Gansu Province

Ying Li[a], Yonghong Li[b, *]

Key Laboratory of China's Ethnic Languages and Information Technology of Ministry of Education, Northwest Minzu University, Lanzhou, Gansu 730030, China

[a]1024715445@qq.com, [b]lyhweiwei@126.com

*Corresponding author

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Abstract: The Liangzhou dialect belongs to Lan-yin mandarin in the Northwest dialect. Based on the recording data of fieldwork, this paper will use the method of experimental phonetics to study the citation tone of Liangzhou dialect. In this experiment, by extracting the fundamental frequency and analyzing the pattern and vocal range, we concludes that Liangzhou dialect has three citation tones: Yinping (44), Yangping or Shang (24), and Qu (51).

1. Introduction

Liangzhou is the political, economic and cultural center of Wuwei City, Gansu Province. Liangzhou is located in the upper reaches of Shiyang River and the eastern section of Hexi Corridor. It borders Gulang, Tianzhu Tibetan Autonomous County, Jinchang, Minqin and Qinghai Province on all sides of southeast and northwest respectively. It always has the geographical advantage of 'linking a line to the desert and controlling the throat of the five counties'.

The study of Liangzhou dialect can be traced back to the "Longyou Dialect" written by Li Dingchao, a famous scholar in Gansu Province during the Republic of China. Although named after 'Longyou', it actually recorded the Wuwei dialect, which has important reference value for the study of Liangzhou dialect. In recent years, the researches focus on Liangzhou dialect is to discuss the phonology, and combine the Middle Ancient Sound and the Beijing dialect to reveal the phonetic changes and laws from the perspective of diachronic and synchronic. Before this, people mainly rely on the traditional method to distinguish and recognize the tone, and there is also a great difference in the tone value. Therefore, this paper will base on the experimental phonetic method and traditional auditory perception method to describe the citation tone of Liangzhou dialect.

2. Experimental description

2.1 Pronunciation Partner

This study selected a 33-year-old male speaker who has been living in Liangzhou district of Wuwei City. He is familiar with the Liangzhou dialect and has educated literate. Above all, he pronounces clearly.

2.2 Experimental equipment

We selected a professional recording studio to record. Recording equipment include laptop, mixer, external sound card and microphone. The recording software is Adobe Audition 3.0, the sampling rate is 44100s, with 16-bit resolution. The analyze software include Pratt5.0 and Matlab.

2.3 Pronunciation list

The pronunciation list was based on the Chinese Language Resources Survey Handbook and the Dialect Word Survey Table, combined with Various Rhymes. According to the classification of

voiceless (全清), secondary voiceless (次清), secondary voiced (次口) and voiced (全口), we selected 112 typical samples, as shown in Table 1.

Table.1. Pronunciation List

Tone / Sample	Ping	Shang	Qu	Ru
voiceless	东该灯风沙低	懂古鬼九左纸	冻怪半四化试	谷百搭节急 八色作雪竹
secondary voiceless	通开天窗初亏	统苦讨草取厂	痛快寸去破看	哭拍塔切刻 泼出七铁尺
secondary voiced	门龙牛油流云	买老五有马网	卖路硬乱外让	六麦叶月热 捏木浴袜玉
voiced	铜皮糖红甜全	动罪近后户弟	洞地饭树败事	毒白盒罚杰 绝直熟活习

2.4 Data extraction and analysis

Firstly, we use the Praat which is the speech analysis software to manually extract the fundamental frequency parameters of all samples. Use the statistical data of fundamental frequency to establish a standardized vocal range pattern, which includes the upper limit of the range (RH), the lower limit of range (RI), and the width of field (R). Next, we use MATLAB to run the normalized script program to normalize the fundamental frequency. Each example word corresponds to 30 fundamental frequency points. Then take the average of the selected frequency points of each tone. Finally, we convert the fundamental frequency value to five-degree value and make the corresponding T-value figure. When normalizing the fundamental frequency, we use the T value calculation method proposed by Shi Feng. The formula is:

$$T= [(lgf0-lgmin)/(lgmax-lgmin)]*5 \quad (1)$$

Among them, F0 represents the fundamental frequency value. Min refers to the lower limit of the fundamental frequency. Max is the upper limit of the modulation range. T represents the final normalized result. When the T value is converted to the fifth degree, we use the "precinct" strategy proposed by Liu Lili (2008). Based on the fundamental frequency perception, there is a floating range of ±0.1 per degree boundary. The specific corresponding relations are: In the range of 0-1.1, the corresponding fifth value is 1; in the range of 0.9-2.1, the corresponding fifth value is 2; in the range of 1.9-3.1, the corresponding fifth value is 3; in the range of 2.9-4.1, the corresponding fifth value is 4; and in the range of 3.9-5, the corresponding fifth value is 5.

3. Experimental results and discussion

3.1 Fundamental frequency and vocal range

Extract the fundamental frequency of all selected samples, and normalize the processing to obtain the average value of fundamental frequency of the four tones. The data of fundamental frequency such as the maximum value, minimum value, and the average value of initial point, middle point and final point are plotted into a table for comparative analysis, and the range and span can be obtained. The fundamental frequency parameter tables of Liangzhou dialect are shown in Table 2, Table 3, Table 4 and Table 5.

Table.2. The fundamental frequency table of Ping (Hz)

Frequency \ Tone	Ping			
	Voiceless	Secondary voiceless	Secondary voiced	Voiced
Initial point value	122.04	120.08	100.86	106.44
Middle point value	125.71	120.5	119.29	113.88
Final point value	120.64	114.58	136.07	128.32
Maximum value	125.74	121.1	136.07	128.32
Minimum value	120.64	114.58	100.86	106.44

As for the Ping, according to the voiceless and voiced opposition of initial consonants, Ping can be divided into Yinping and Yangping. Among them, the voiceless sound belongs to Yingping, the voiced sound belongs to Yangping, and Liangzhou dialect is also the same. In Liangzhou dialect, the maximum value of Yinping is 125.74Hz, the minimum value is 114.58Hz, and the the field width is 11.16Hz. The maximum value of Yangping is 136.07Hz, the minimum value is 100.86Hz, and the field width is 35.21Hz. The range span of Yangping is obviously larger than that of Yinping. Combined with the average frequency of each point, it shows that the Yinping is a flat tone and the Yangping is a rising tone.

Table.3. The fundamental frequency table of Shang (Hz)

Frequency \ Tone	Shang			
	Voiceless	Secondary voiceless	Secondary voiced	Voiced
Initial point value	107.77	106.96	104.44	140.43
Middle point value	121.95	116.45	118.61	127.59
Final point value	130.54	126.71	130.33	94.37
Maximum value	130.54	126.71	130.33	140.43
Minimum value	107.77	106.96	104.44	94.37

As for the Shang, the fundamental frequency value of voiceless, secondary voiceless and secondary voiced are relatively close, where in the maximum fundamental frequency is 130.54 Hz, the minimum fundamental frequency is 104.44 Hz, and the field width is 26.1 Hz. In addition, it is found that their fundamental frequency and field width are close to that of Yangping, and the trend of frequency is the same, so the combination of Yangping and Shang is a rising tone. However, the fundamental frequency of the voiced Shang is quite different from the former three.

Table.4. The fundamental frequency table of Qu (Hz)

Frequency \ Tone	Qu			
	Voiceless	Secondary voiceless	Secondary voiced	Voiced
Initial point value	137.34	142.02	133.94	138.66
Middle point value	123.41	120.55	119.95	123.07
Final point value	92.29	88.37	86.39	88.27
Maximum value	137.34	142.02	133.94	138.66
Minimum value	92.29	88.37	86.39	88.27

As for the Qu, the maximum fundamental frequency is 142.02 Hz, the minimum fundamental frequency is 86.39 Hz, and the field width is 55.63 Hz. The span of the range is large, which is an obvious falling tone. The fundamental frequency parameters of the voiced Shang and the Qu are close, and the trend is consistent, so the voiced Shang is merged into the Qu as a falling tone.

Table.5. The fundamental frequency table of Ru (Hz)

Frequency / Tone	Ru			
	Voiceless	Secondary voiceless	Secondary voiced	Voiced
Initial point value	128.02	137.64	127.28	102.80
Middle point value	119.45	118.04	121.27	114.18
Final point value	93.89	91.91	88.48	124.26
Maximum value	128.02	137.64	128.31	124.26
Minimum value	93.89	91.91	88.48	102.80

As for the Ru, it has disappeared in the Liangzhou dialect. The average fundamental frequency of the voiceless, secondary voiceless and secondary voiced of Ru are close, and can be merged into a tone. Their field width is 48.92Hz close to the Qu, and the trend is also consistent. So the voiceless, secondary voiceless and secondary voiced of Ru is merged into the Qu. At the same time, it is found that the fundamental frequency value of the voiced Ru is consistent with Yangping and Shang, so combine them into a tone.

In summary, the tone of the Liangzhou dialect has undergone a significant merger. The Ping is divided into Yinping and Yangping. The voiced Ru is merged into the Shang. The voiced Shang is merged into the Qu. The voiceless, secondary voiceless and secondary voiced of Ru is merged into the Qu. The Yangping and Shang are merged into a tone. Finally, the Liangzhou dialect has three tones, namely Yinping, Yangping or Shang, and Qu. The evolution of the ancient and modern tones of Liangzhou dialect is shown in Figure 1.

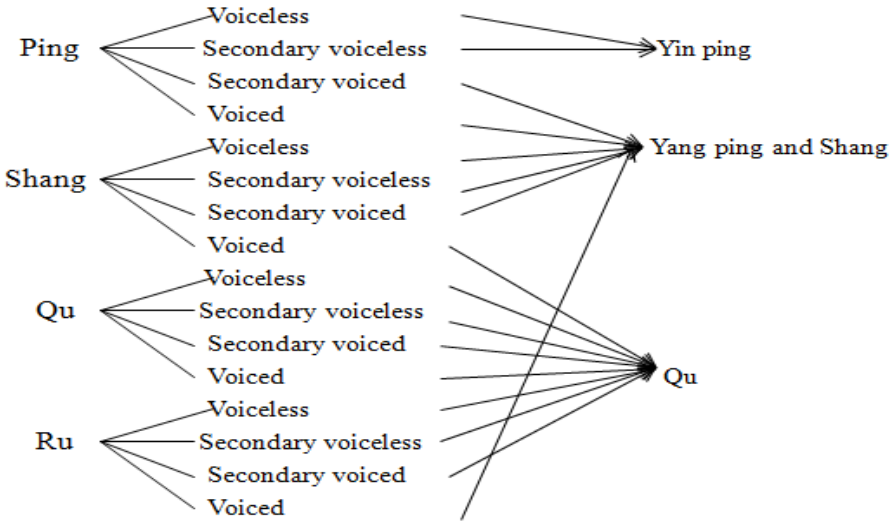

Figure 1. The evolution of the ancient and modern tones

3.2 Fifth degree value

According to the T-value algorithm, we convert the normalized average of the fundamental frequency into traditional fifth-degree value. We obtain the corresponding five-degree value of each tone and draw the T-value curve. The abscissa is the number of tone points and the ordinate is the fifth degree value. Specifically seen in Figure 2, Figure 3, Figure 4, and Figure 5.

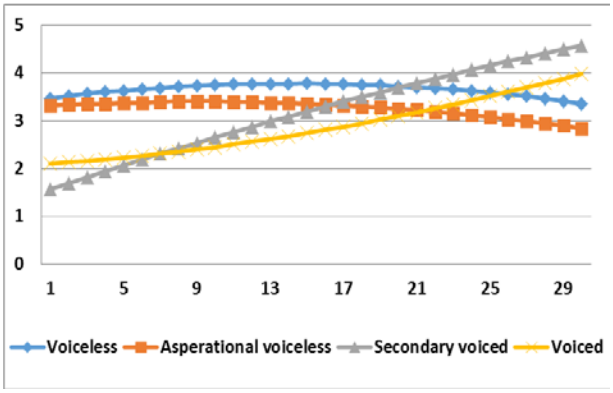

Figure 2. T-value curve of Ping

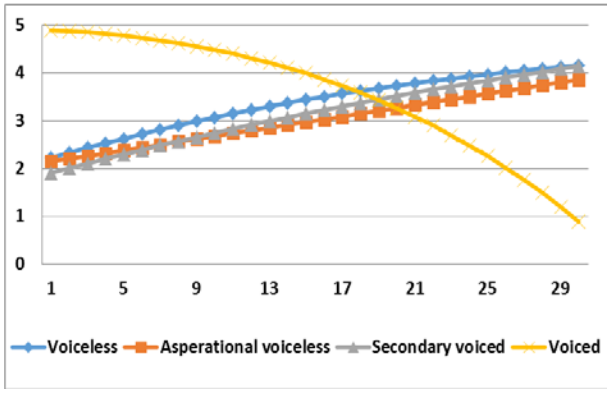

Figure 3. T-value curve of Shang

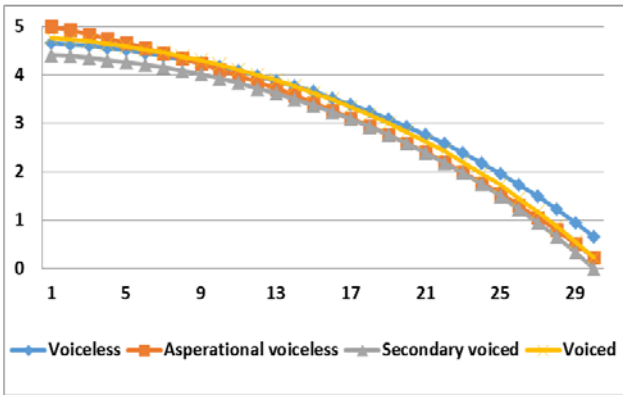

Figure 4. T-value curve of Qu

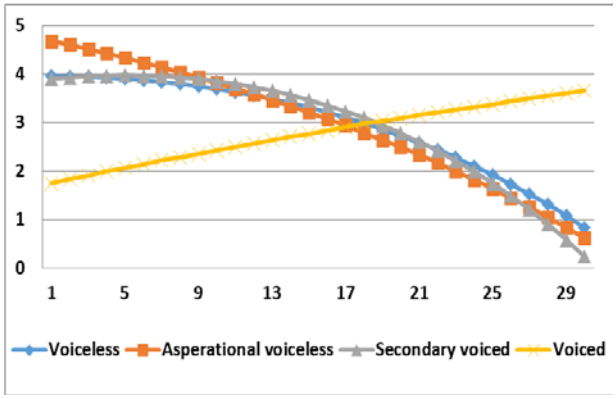

Figure 5. T-value curve of Ru

Through the above four figures, we can clearly see the type and value of each tone in Liangzhou dialect. In order to understand and compare the various types more intuitively, we draw a T-value curve of Liangzhou dialect, as shown in Figure 6.

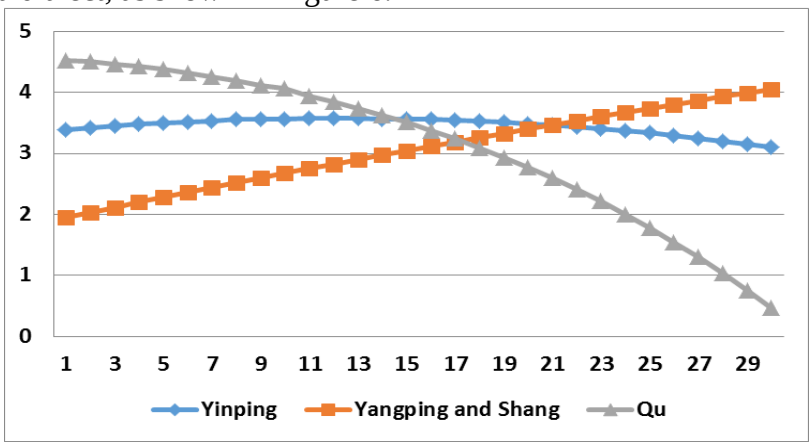

Figure 6. T-value curve of Liangzhou dialect

Combining with the method of auditory perception, this paper draws the following conclusions: Liangzhou dialect has three tones, in which Yinping is a flat tone with the tone value of 44, Yangping or Shang is a rising tone with the tone value of 24, and Qu is a falling tone with the tone value of 51.

4. Conclusion

By analyzing the acoustic characteristics of the tones of Liangzhou dialect, this paper compares the fundamental frequency parameters and the vocal range, concludes that Liangzhou dialect has three ciation tones: Yinping (44), Yangpingd or Shang (24), and Qu (51). This paper makes a

preliminary study on the ciation tone with the method of experimental phonetics, so as to provide some reference for further study of Liangzhou dialect in the future.

Acknowledgments

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References

[1] Kong Jiangping. Basic Course of Experimental Phonetics [M]. Beijing: Peking University Press, 2013.

[2] Li Guisheng.The phonological tone of Liangzhou dialect and its corresponding relationship with Middle Ancient pronunciation and Beijing dialect [J]. Journal of Hexi University, 2009, 25 (01): 11-15.

[3] Wu Zongji, Lin Maocan. Summary of Experimental Phonetics [M]. Beijing: Higher Education Press, 1989.

[4] Zhang Shengyu. The Chinese Dialect of Hexi Corridor [J]. Dialect, 1993 (4): 253-264.

[5] Zhu Xiaonong. Shanghai Tone Experiments [M]. Shanghai: Shanghai Education Press, 2004.