

Experimental Research on Bi-Syllable Tone of Dingxi Dialect in Gansu Province

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Abstract: This paper mainly uses the combination of acoustic experiment and auditory perception to analyze the bi-syllable tone of Dingxi dialect. The main purpose is to reveal the phonetic facts and rules of its transposition. There are 11 basic transposition forms in the dissyllabic phrases of Dingxi dialect, including 4 kinds of level tone category, 3 kinds of rising tone category, and 4 kinds of departure tone category.

1. Introduction

Dingxi City, located in the central part of Gansu Province, was the important town of the ancient “Silk Road” and was known as the “Gansu Throat and Lanzhou Gateway”. Dingxi dialect belongs to the Central Plains’ Mandarin and it is also a sub-dialect of the Qinlong section. There are mainly researches on its phonetic. Zhang Wenxuan and Deng Wenjing (2005) summarized the phonetic system and compared it with the Beijing dialect to highlight the phonetic features of Dingxi dialect. Sun Lixin (2014) analyzed the rhythm, different reading and bi-syllable tone of it from the perspective of diachronic and synchronic. With the rapid development of experimental phonetics, the tone of dialects is quantitatively analyzed in the form of experimental methods and data. This will not only deepen people's understanding of the tone of Chinese dialects, but also better learn and promote Mandarin.

When the static tone, that is, the citation tone, enters the context of the language combination, the original tone and mode are often changed, resulting in the tone sandhi. The bi-syllable tone is the smallest unit of tone sandhi, and it is also the starting point for examining the dialect mode. This thesis will be based on the experimental study of the citation tone of Dingxi dialect, continue to use the method of acoustic experiment to explore the bi-syllable tone, and further summarize the types and rules of the tone sandhi.

2. Experimental description

2.1 Pronunciation partner

This study selected a 25-year-old female speaker who has been living in Dingxi City. She speaks authentic Dingxi dialect and has a clear pronunciation.

2.2 Pronunciation table

The evolution of the citation tone of Dingxi dialect is that the level tone category is not divided into yinping and yangping, the voiced of the rising tone category is attributed to the departure tone category and the entering tone category is all classified into the level tone category. The specific adjustment values are level tone category (24), rising tone category (51) and entering tone category (33). For the convenience of writing, we use T1, T2 and T3 to represent the tones. The three tones match each other and we can get 9 combinations. Under each combination, 10 commonly used and

stable phrases in daily life are selected, and a total of 90 dissyllabic phrases are used. But only 45 common phrases are presented here. The specific pronunciation vocabulary is as follows:

Table.1. Vocabulary of Dingxi dialect

Latter Former	T1(24)	T2(51)	T3(33)
T1(24)	doctor airplane peanut watermelon youth	factory smooth and steady deposit length add and subtract	egg secretary convenience timber temperament
T2(51)	train open maintain hapless pitiful	fruits umbrella insurance tiger timid	advertising disgusting glasses road descendant
T3(33)	car careful health remuneration electric lamp	newspaper size comparison represent letter paper	strive politics offender take pictures plant trees

2.3 Experimental equipment

The recording location is selected in a professional studio. Recording equipment includes laptops, mixers, external sound cards and microphones. The recording software is Adobe Audition 3.0, the sampling rate is 44100Hz, with 16-bit resolution. The analysis software includes Praat5.0 and Matlab, which Praat5.0 is used to segment and mark speech samples and extract the experimental data. Each example is read 3 times and saved as a file in WAV format.

2.4 Speech segmentation and marking

First, the speech is segmented, and the saved recording files are segmented and classified into units. Then, use the speech analysis software Praat to mark, remove the elbow and tail of the tone, and determine the bearing section of the tone. The specific annotations are shown below:

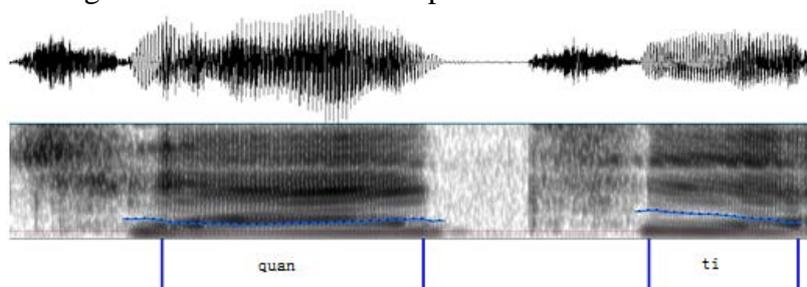


Figure 1. The example diagram of tone bearing segment labeling

2.5 Data extraction and analysis

Converting the fundamental frequency data obtained from acoustic experiments into a pitch perception that is in line with human hearing is also the key to assisting tone research with experimental methods. Firstly, using the Praat, manually extract the fundamental frequency parameters of all samples. Secondly, using the Matlab to run the normalized script program, and take the tone category as a unit, and normalize all experimental data according to the trend of the fundamental frequency curve. Then through formula operation, according to the way of five-degree value, the T value is transformed into T value. Finally, the T values of each combination are

averaged, and the corresponding T-value graph is made. Combined with the sense of hearing, the disyllabic tone of Dingxi dialect is combined and classified to determine the final modes of tone sandhi. When normalizing the fundamental frequency, we use the T value calculation method proposed by Shi Feng. The formula is:

$$T = [(\lg f_0 - \lg \min)/(\lg \max - \lg \min)] * 5 \quad (1)$$

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 register. 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 correspondence is as follows:

Table.2. Correspondence between T value and fifth degree

T value	0-1.1	0.9-2.1	1.9-3.1	2.9-4.1	3.9-5
Fifth degree	1	2	3	4	5

3. Experimental result and discussion

3.1 Experimental result

This paper mainly discusses the tone sandhi forms of Dingxi dialect from two aspects of tone type and tone value. There are two types of tone sandhi: transposition tone and non-transposition tone. Transposition tone means the type and value of tone all changed, such as the level contour changed to a falling contour. Non-transposition tone means the type of tone do not changed but only the value changed. Meanwhile, we will use "T1+X" to represent the combinations of T1, and so on. The details are as follows:

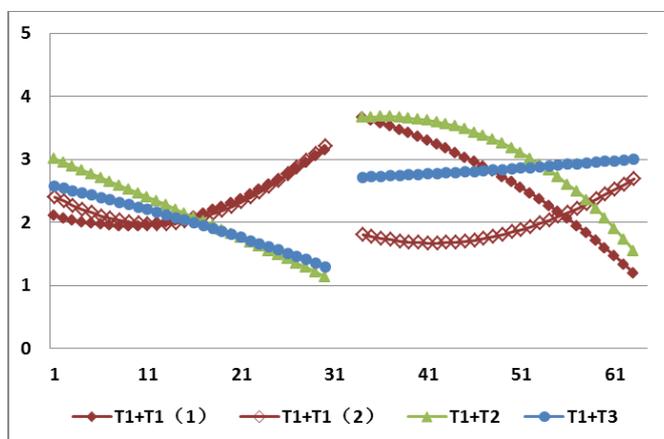


Figure 2. T value curve of "T1+X"

As can be seen from the Figure 2, in the "T1+X" combinations, there are four types of tone sandhi, wherein the T1+T1 combination has two types of tone sandhi. When T1 is used as the front word, there are roughly two cases. In the T1+T1 combination, the former word T1 remains unchanged, and the latter word T1 is affected by the combination, resulting in two different transpositions. In the T1+T2/T3 combinations, the curve of the former word T1 is almost consistent, and the starting point is at the third level, but the slope is slightly different. In combination with the sense of hearing and the "boundary" theory, the end points are respectively at the first level and second level. Compared with the result of the citation tone adjustment, T1 changes from the rising contour to the falling contour, and the value is changed from 24 to 31 and 32, which is the transposition tone. Overall, T1+T1 is changed from the original value of 24+24 to 24+41/23, T1+T2 is changed from 24+51 to 31+42, and T1+T3 is changed from the original value of 24+33 to 32+33.

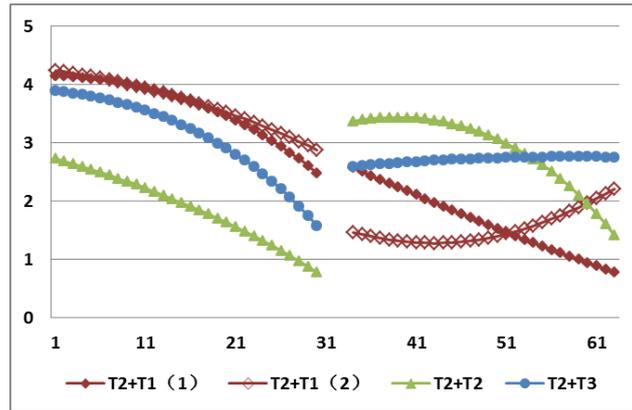


Figure 3. T value curve of "T2+X"

As can be seen from the Figure 3, in the "T2+X" combinations, there are four types of tone sandhi, wherein the T2+T1 combination has two types of tone sandhi. When T2 is used as the front word, the four curves have the same direction, which are all falling contour, but also different in slope and level. Compared with the result of citation tone adjustment, T2 is not affected by the combination and changes its mode. The specific value will change due to the latter word, indicating that T2 is a non-transposition tone. So, T2+T1 is changed from the original value 51+24 to 53+31/23. T2+T2 is changed from 51+51 to 31+42, and T2+T3 is changed from the original value 51+33 to 42+33. The results showed that the combination of T1+T2 and T2+T2 were 31+42. Compared with the multiple pronunciations of the speakers, there was no difference in the sense of hearing, so they were combined into a form of transposition.

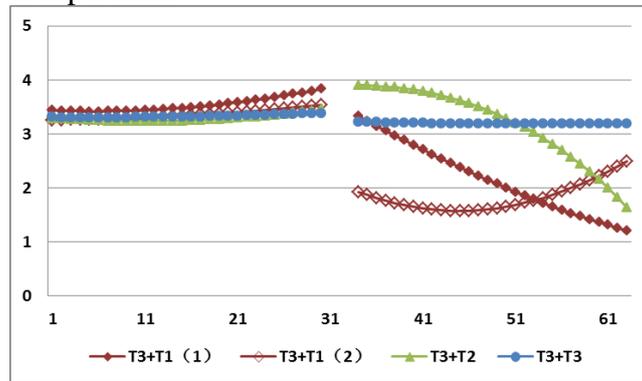


Figure 4. T value curve of "T3+X"

As can be seen from the Figure 4, in the "T3+X" combinations, there are four types of tone sandhi, wherein the T3+T1 combination has two types of tone sandhi. When T3 is used as the front word, the four curves are consistent, flat and balanced, and the starting point and the end point are in the fourth level. Compared with the result of citation tone, T3 is not affected by the combination and changes its mode and value, indicating that T3 is the non-transposition tone. Overall, T3+T1 is changed from the original value of 33+24 to 44+41/23, T3+T2 is changed from 33+51 to 44+42, and T3+T3 is changed from the original value of 33+33 to 44+33. It can be seen that T3 is relatively stable as the former words.

3.2 Discussion of result

Table.3. Basic forms of the bi-syllable tone of Dingxi Dialect

Former \ Latter	T1(24)	T2(51)	T3(33)
T1(24)	24+41/23	31+42	32+33
T2(51)	53+31/23	31+42	42+33
T3(33)	44+41/23	44+42	44+33

It can be seen from the Table 3 that in the process of tone sandhi of Dingxi dialect, each tone combination with T1 will produce two different transpositions, and the T1+T2 and T2+T2 combinations can be combined into one transposition form. Therefore, there are 11 basic transposition forms in the disyllabic phrases of Dingxi dialect. The bi-syllable tone of Dingxi dialect is relatively regular. From the horizontal and vertical comparison of the table, we can find that when each tone is used as the front word, except the T1, and the others maintain the original type of tone. When each tone is made as the latter words, the type and value of tone are the same in the combinations.

4. Conclusion

This paper mainly uses the combination of acoustic experiment and auditory perception to initially explore the bi-syllable tone of the Dingxi dialect. There are 11 basic transposition forms. In addition, it further reveals the basic tone sandhi rules of the disyllabic phrases of Dingxi dialect, and presents the language features in dynamic research.

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