Retraction

Retraction: On the Monophthong Features of Cangzhou Dialect (Hebei Province) based on Acoustic Data Analysis in the Big Data Era (J. Phys.: Conf. Ser. 1992 042051)

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On the Monophthong Features of Cangzhou Dialect (Hebei Province) based on Acoustic Data Analysis in the Big Data Era

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Abstract. With reference to the acoustic data of seven first-level vowels in Mandarin Chinese, this paper examines the vowel characteristics of the 16 dialects in Cangzhou, Hebei, and summarizes the local and overall characteristics of the Monophthongs in the Cangzhou dialect based on a large amount of acoustic data. Through comparative analysis of the distribution of Monophthongs of various dialects in Cangzhou and their differences and similarities with Mandarin, we hope to enrich the dialect phonetic database and provide a reference basis for data support for the promotion of Mandarin Chinese.

Keywords: Cangzhou Dialect, Vowels, Acoustic Data

1. Introduction

Each dialect has its own phonetic characteristics and vowel pattern. "The vowel pattern is the systematic performance of vowels, and the content can include the positioning characteristics of vowels, the performance of internal variants, the overall distribution relationship, etc." (Shi Feng, 2002) [1]. Many scholars used experimental phonetics to analyze the vowel patterns of Chinese dialects based on acoustic data. For example, Shi Xiujuan (2006) investigated in a larger sample of 40 dialects including Harbin dialect, Qingdao dialect, Zhengzhou dialect [2], Yinchuan dialect, and Chengdu dialect to discuss the systematic performance of vowels. Bei Xianming and Shi Feng (2008) used Changsha, Pingxiang, and Liuyang dialects as examples to study the the vowel pattern under the influence of dialect [3]. Gu Lei et al. (2015) investigated the vowel pattern of Chengdu dialect; Liang Haimin (2016) [4-5], Qiu Chunan, and Liang Jie (2016) did a quantitative analysis of the vowel characteristics of Chaozhou dialect and Minxi Hakka dialect respectively [6]. With this trend, linguistics is undergoing the transformation from an empirical science to a data science.

Cangzhou is located in the southeast of Hebei Province, bordering the Bohai Sea in the east, Beijing and Tianjin in the north, and Shandong in the south. It has a total area of 14,000 square kilometers and a permanent population of 7.375 million with 2 districts, 4 cities, and 10 counties. According to the "Atlas of Chinese Language" and "Study on Official Mandarin Dialects of Mandarin Chinese", except for Wuqiao in the south, all the local dialects in Cangzhou belong to the HuangYueXiLaoPian, a branch of the dialect in Hebei and Shandong province [7]. Predecessors have mostly studied Cangzhou dialect from the perspective of vocabulary and syntax, and the research on
vowels in Cangzhou dialect is sporadic. In 1961, the "Overview of Hebei Dialects" compiled by the Beijing Normal University and the Institute of Languages and Literature of the Hebei Branch of the Chinese Academy of Sciences mentioned that the final vowel, [e], of Cangxian, Wuqiao, Suning, and Hejian dialect was combined with the initials of [zh], [ch], [sh], and [r], and then become into the retroflex vowel [er]. "Hebei Province Dialect" edited by Qilianshan and Li Shutong (1994) mentioned that in Botou, Nanpi, Huanghua, Haixing, Mengcun and other places, when the vowel [e] and consonants such as [g], [k], [h], and [r] are spelled together, the [e] in some syllables is often pronounced as [uo]. Lu Yucai (2003) found that "people in the Cangzhou dialect area are reading some round-lipped vowels with [o], [u], [ü], the original round-lip vowels are pronounced as non-round vowels". "The Cangzhou area generally follows the distribution law of 'west in front, east in back' on the issue of central ɑ inaccuracy." Here, "west" and "east" respectively refer to the western and eastern regions of Cangzhou. Li Xu (2008) studied the distribution of dialect features in central and southern Hebei including Suning, Cangzhou, Nanpi, Dongguang, and Wuqiao from the perspective of dialect geography [8].

In the context of the coordinated development strategy of Beijing-Tianjin-Hebei, the three provinces and municipalities of Beijing, Tianjin, and Hebei signed the "Agreement on the coordinated development strategy of the Beijing-Tianjin-Hebei spoken and written business". The study of Hebei dialect phonetics and the popularization of Mandarin should be highly valued. In this paper, based on the existing research results, we analyze the vowel characteristics of Cangzhou (Hebei Province) dialect based on acoustic data [9]. The data of the first formant and the second formant of vowels are collected to draw the diagram of vowel pattern, and the shape of dialect vowels are revealed through objective data and intuitive graphics. The research mainly focuses on the difference between Cangzhou dialect vowels and Mandarin vowels, and proposes targeted identification methods based on the differences supported by data.

2. Experimental Description

In this experiment, a total of seven monophthongs were designed, and each monophthong was designed with eight Chinese characters, excluding polyphonic characters and characters with official and local pronunciations.

Cangzhou dialect has the final vowel /ɛ/ to express response or exclamation, but it "only appears in the vocative expression from the semantic point of view, and only appears in the condition of the final vowel of head vowel is not i[i], u[u], ü[y] with no tail vowel from the semantic point of view, so it is not freely distributed, and belongs to the marginal unit of the phonology, which cannot be used as the fundamental figure" (Wang Hongjun, 1999). In addition, according to Li Xu (2008), when Hejian, Dongguang and other places pronounce [bo], the vowel after the initial is /ə/, and when [bao] is pronounced, the vowel after the initial is /ɔ/, some in Cangzhou native speakers pronounced the vowel of [gai] into a single sound /ɛ/ and so on. Considering that phonetic changes are not systematic, some conclusions need to be further confirmed, as well as the comparative analysis of dialects and Mandarin. The research content of this paper is the seven vowels of i[i], a[A], u[u], ü[y], i[I], -i[ɿ], e[ɤ]. Each word is read twice with a pause of at least 1 second between each pass, and collect the better pronounced one as the speech experiment sample.

This experiment was recorded by 16 speakers (10 males and 6 females) from 16 districts and counties in Cangzhou. The recording time per person is about 10 minutes. The recording software is Praat, a quiet room is used for recording, the sampling frequency is 22050 Hz, and the storage byte is 16 bits. When the recording is finished, it is saved as the sound file in wav format [10].

Speech acoustic parameters are a collection of speech acoustic features, and are a way to quantify spoken language resources. Use the MinispeechLab software of Nankai University's "Desktop Speech Studio" to extract the F1 and F2 values of the sample vowels, click the mouse to pick points in the energy map, take 2-3 points for each word, add them to the statistical group to get the normalized V value data. Normalization is to take the different distribution ranges of each person in the same dimension as unit 1, the maximum value is 100%, and the minimum value is 0%. Normalization
makes different speakers comparable. The V value is based on the average of the Bark value, and the formula is as follows:

\[ V_1 = \frac{B_1x - B_1\text{min}}{B_1\text{max} - B_1\text{min}} \times 100 \]

\[ V_2 = \frac{B_2x - B_2\text{min}}{B_2\text{max} - B_2\text{min}} \times 100 \]  

(1)

From this formula, we can obtain the coordinate value of each vowel in the relative graph. The V1 represents the height of the vowel, the maximum value is 100, which means the tongue is in the lowest position. The minimum value is 0, which means the tongue is in the highest position. Roughly speaking, the V1 of high vowels is between 0-30, the V1 of middle vowels is between 30-70, and the V1 of low vowels is between 70-100. The V2 represents the front and back of the tongue position. The maximum value is 100, which means the tongue position is the front, the minimum value is 0, which means the tongue position is the back [11]. Generally, in high vowels, V2 of it is between 0-20, it is a back vowel; V2 of it is between 20-80, it is a central vowel, and V2 of it is between 80-100, it is a front vowel. For low vowels, when V2 is between 0-40, it is a back vowel, when V2 is between 40-60, it is a central vowel, and when V2 is between 60-100, it is a front vowel. The V2 distribution range of the middle vowel is between the high and low vowels.

3. Experimental Results and Analysis

In order to find the regulation from different samples, we normalized the extracted data. The vowel patterns and data of the 16 districts and counties of Cangzhou are shown in Figure 1 and Table 1:

![Figure 1. The vowel pattern of Cangzhou dialect](image-url)
Table 1. Table of vowel V value in Cangzhou dialect

| Region            | i[i] | o[A] | u[u] | ü[y] | -i[ɿ] | -i[ʅ] | e[y] |
|-------------------|------|------|------|------|--------|--------|------|
| Renqiu            | 0-100| 100-59| 16-0 | 0-80 | 8-57   | 18-72  | 43-42|
| Hejian            | 0-100| 100-41| 12-0 | 3-90 | 23-70  | 25-68  | 57-43|
| Suning            | 0-100| 100-45| 14-0 | 2-90 | 31-62  | 23-70  | 50-42|
| Xian County       | 0-100| 100-36| 19-0 | 2-89 | 18-55  | 22-72  | 39-45|
| Central region    | Botou| 0-100| 100-57| 16-0 | 8-86   | 30-40  | 14-76|
| Cang County       | 0-100| 100-39| 11-0 | 3-81 | 29-50  | 16-70  | 44-38|
| Nanpi             | 0-100| 100-38| 13-0 | 0-90 | 9-52   | 22-78  | 47-47|
| Dongguang         | 4-100| 100-29| 12-0 | 8-88 | 12-40  | 20-70  | 40-30|
| Southwest Region  | Wuqiao| 0-100| 100-34| 13-0 | 11-85  | 14-54  | 40-57|
| Qing County       | 0-100| 100-48| 16-0 | 1-97 | 35-60  | 23-72  | 36-34|
| Canal District    | 0-100| 100-16| 24-0 | 1-74 | 28-55  | 29-64  | 73-39|
| Xinhua District   | 4-100| 100-10| 29-0 | 0-93 | 27-55  | 17-78  | 47-37|
| Huang Hua         | 2-100| 100-55| 25-0 | 0-87 | 19-49  | 14-75  | 49-44|
| Meng Village      | 13-100| 100-51| 22-0 | 0-85 | 24-57  | 18-68  | 62-47|
| Haixing           | 0-100| 100-29| 27-0 | 9-78 | 23-56  | 31-62  | 74-42|
| Yanshan           | 7-100| 100-5 | 22-0 | 0-69 | 27-50  | 34-79  | 67-35|

Note: For the numbers in the table, the data before "-" represents the vowel V1, and the data after "-" represents the vowel V2.

The data in Figure 1 and Table 1 show that the positions of the seven vowel phonemes are clearly and orderly arranged. The vowels [i], [u], and [u] are the three vertex vowels, [i] is at the left and top of the pattern, and the tongue is higher and forward; [u] is at the uppermost position on the right of the pattern, and the tongue position is lower than [i], and it is also higher at the back. The tongue position of the eastern area is lower than that of other areas as a whole, especially in Cangzhou. [ɑ] is the lowest position in the middle and back of the pattern map[7]. Compared with other vowels, the distribution range of vertex vowels is smaller, and they all spread out in one dimension. The non-vertex vowels, ü, -i[ɿ], -i[ʅ], and e are located inside the vowel pattern frame, and the V value data has a large distribution range. In the graph, [ü] is very close to [i], due to the rounded lips, the tongue is a little behind. From the perspective of high and low dimensions, Cangzhou dialect vowels i, ü, -i[ɿ], -i[ʅ], u are basically high vowels, e belongs to middle vowels, and [ɑ] belongs to low vowels. From the front and back dimensions, [i] and [ü] belong to the front vowel; -i[ɿ], -i[ʅ], e belongs to the central vowel; u belong to the back vowel. The vowel [ɑ] has a narrow distribution range, and the pronunciation of different districts and counties is quite different, and it belongs to the central vowel. From the data in Table 1, we can see that the pronunciation of the vowel [ɑ] in Cangzhou and Yanshan County is very bake in position, and the actual pronunciation is o[ɑ] instead of o[A].
The standard deviation ST reflects the degree of concentration and dispersion of a set of data. In general, the smaller the standard deviation, the more concentrated and stable the data, and vice versa. The standard deviation data of the seven first-level vowels in Cangzhou dialect are shown in Table 2:

Table 2. Table of ST values of vowels in Cangzhou dialect

|       | i[i] | ɑ[A] | u[u] | ü[y] | -i[ɿ] | -i[ʅ] | e[ɤ] |
|-------|------|------|------|------|-------|-------|------|
| V1    | 3.6  | 0    | 4.3  | 3.6  | 8.2   | 7.4   | 14   |
| V2    | 0    | 15.5 | 0    | 7.2  | 7.2   | 6.1   | 4.9  |

The data in Table 2 shows that the standard deviation of the V1 of the vowel [i] among the districts and counties of Cangzhou is 3.6, and the standard deviation of the V2 value is 0, indicating that when the people of Cangzhou pronounce the vowel [i], the tongue position is very high, and the little difference is only in the height of the tongue position. Generally speaking, the vowel [i] is distributed in a concentrated manner. The standard deviation of the V1 of the vowel [ɑ] is 0, and the standard deviation of the V2 is 15.5, indicating that when the Cangzhou native speakers pronounce the vowel [ɑ], the tongue position is the lowest, and the huge difference is only between the front and back position of the tongue. In some areas, the pronunciation of the vowel [ɑ] is in the very back position of their tongue. When learning Mandarin, the tongue should be deliberately forward. The standard deviation of the V1 of the vowel [u] is 4.3. The standard deviation of the V2 is 0, which means that when Cangzhou natives pronounce the vowel [u], the tongue is very back in position, and there is only a certain difference in the height of the tongue, which is similar to the distribution of the vowel [i], showing a shpe of vertical strip. The V1 and V2 of the vertex vowels ū, -i[ɿ], -i[ʅ], and e are all discrete to different degrees, and take the average value as the origin point and spreading, it shows that these vowels are not as concentrated as the vertex vowels in the height or front and back of the tongue position, and there are varying degrees of difference in the height or front and back of the tongue position, and there are varying degrees of difference between different districts [12-13].

In short, in the Cangzhou dialect the vowel [i] shows the highest unity. The vowel [ɑ] is unstable in the front and back of the pronunciation among the other districts and counties. The vowels ū, -i[ɿ], -i[ʅ], and e in V1 and V2 is relatively discrete in the two dimensions, especially the V1 of the vowel [e]. The tongue position of the vowel [e] in most districts and counties in the east and the southwest of Wuqiao County is lower, and the tongue position in other areas is higher. The pronunciation central vowel is unstable, which is the commonality.

Cangzhou dialect and Beijing dialect are both northern dialects. Comparing the vowel pattern of Beijing dialect (see Liang Lei, 2011), we can find that the pronunciation of some vowels in Cangzhou dialect and Beijing dialect is very similar, such as the overall distribution relationship. The three vowels of [ɑ], [i], and [u] are located at the vertex, and the central vowel [e] is vacillant. However, because Beijing dialect belongs to the Mandarin dialect area and Cangzhou dialect belongs to the Hebei-Beijing Mandarin dialect area, there are also differences between the two. The major differences are as follows: First, the position of the vowel [u] in the Cangzhou dialect is higher. The data shows that the pronunciation of Hejian, Suning, Nanpi, Qingxian and Xinhua districts is: V 2 more than 90, which is close to the vowel [i]. Especially when [u] and initial [q] are spelled together, the lips of individual speakers are not rounded, and [u] is close to [i]. Secondly, the distribution of vertex vowels -i[ɿ] and -i[ʅ] in the pattern is crossed. In Mandarin, the vowel -i[ɿ] only spells [z], [c], and [s]. When pronounced, the underside of the tongue can touch the back of the lower teeth, and the upper side of the tongue is opposite to the back of the upper incisors, leaving a narrow passage (no friction occurs when the air flows through), and the lips are flat. The vowel -i[ʅ] is only spelled with [zh], [ch], and [sh]. When pronounced, the tip of the tongue is lifted close to the front hard palate, forming a narrow passage (no friction occurs when the air flows through), and the lips are flat and can protrude forward for a bit. Some people in the Cangzhou dialect area confuse the two. The vowels -i[ɿ] and -i[ʅ] in Hejian, Suning, Yunhe District, Haixing and other places have similar V1 and V2. Finally, the tongue position of the low vowel [ɑ] in the Cangzhou dialect is inaccurate. The V2 are less than 40
for the vowel [ɑ] in most districts and counties in the southwest and east, especially in Cangzhou and Yanshan in the east, it is pronounced very backward, and sounds blunt. The pronunciation of the northwest and central regions is in the center.

The above is a data analysis of the vowel characteristics of Hebei Cangzhou dialect. Although the frequency of the same vowel formant produced by different people is different, the relative position of each vowel produced by each person on the acoustic map is basically stable [14]. On the surface, the vowel patterns of the Cangzhou dialect of different speakers seem overlapped and chaotic, but in details, there are still regulations to follow. In view of the above main differences, this paper proposes the following methods to distinguish:

3.1. About the Front-High Rounded Vowel [ü]
When speaking Mandarin [ü], the mouth opening is small, the tongue position is high, the lips are rounded, and slightly protruding forward, leaving an oblate small hole in the middle, the tip of the tongue is against the back of the lower teeth, and the front of the tongue is raised. The uvula rises, the nasal passage is closed, and the vocal cords vibrate. In Mandarin, the tongue position of [ü] is similar to [i], but is slightly lower and backward than [i]. To distinguish between [ü] and [i], it is necessary to improve the flexibility of the lip extension. There are 6 pairs of syllables compared between the two, and there are no contrasting syllables for [bi], [pi], [mi], [di], and [ti].

3.2. About the Apex Vowels -i[ɿ] and -i[ʅ]
In Mandarin, -i[ɿ] only has a splicing relationship with the initials [z], [c], and [s], and -i[ʅ] only has a splicing relationship with the initials [zh], [ch], [sh], and [r]. Generally, [zi], [ci], [si], [zhi], [chi], [shi], and [ri] are recognized as a whole syllable in the teaching process, and the vowels of the tongue are not analyzed and taught separately. Therefore, the confusion between -i[ɿ] and -i[ʅ] is, in the final analysis, caused by the confusion of the [z] and the [zh] group. To distinguish between group [z] and [zh], first find out the pronunciation part and understand the pronunciation method. Second, the principle of "remember the less" can be adopted. In Mandarin, the number of characters with flat tongue as the initials is less than the number of characters with stilted tongue as initials. In addition, analogy can be made by using the radicals of pictophonetic characters and the spelling rule of Mandarin.

3.3. About the Central-Low Unrounded Lip Vowel [ɑ]
The vowel [ɑ] in Cangzhou dialect is pronounced with back tongue position, and it belongs to or is close to the back-low rounded vowel, [o][ɑ]. In Mandarin discrimination, attentions should be paid to the position of the tip of the tongue during pronunciation. When the tip of the tongue is retracted, the tongue will be shifted behind when leaving the back of the lower teeth. The correct pronunciation should be that the mouth is open, the tongue is lowered, the tongue is naturally flat, and the tip of the tongue touches the lower gums, the middle part of the tongue is slightly raised behind, and the lips are naturally expanded. During the pronunciation, the vocal cords vibrate, the back vocal cavity are opened, and the soft palate rises and lifts, the nasal passage closes.

4. Conclusions and Reflections
The data obtained from acoustic experiments can record and describe speech more objectively and accurately, revealing many speech phenomena that could not be observed in the past. At the same time, it does not affect our extraction of common features of speakers and linguistic analysis, which opens up a new perspective of dialect research and enriches dialect phonetic database.

The basic vowel patterns of Cangzhou dialect and Beijing dialect based on data analysis are very similar: from the perspective of high and low dimensions, vowels of i, ü, -i[ɿ], -i[ʅ], u in Cangzhou dialect are basically high vowels, [e] belongs to the middle vowel, [o] belongs to the low vowel. From the perspective of front and back dimensions, [i] and [ü] belong to the front vowels; -i[ɿ], -i[ʅ], and e belong to the central vowel, and u belong to the back vowel etc. At the same time, there are
differences between the two, which are obvious in the vowels ü, -i[ɿ], -i[ʅ], and ɑ. Based on these differences, this paper discusses corrective strategies, hoping to help people of dialects speakers speak Mandarin well.

No more regular differences in vowel patterns in different regions of Cangzhou have been seen. The data in northwest, central and southwest regions are relatively unified, while the dialect eastern region is quite different from standard Mandarin. The vowels [u] and [e] require a lower tongue position, and [ɑ] has a rear tongue position.

There are still some shortcomings in this experiment, such as few sample data, much synchronic analysis of vowels in Cangzhou dialect and less diachronic discussion, and insufficient research on the relationship between Cangzhou dialect and peripheral dialects. In future research, more in-depth experiments are needed to address these shortcomings in order to achieve further improvement.

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