A SOCIOPHONETIC STUDY ON TONES OF CHONGQING MANDARIN IN GENDER AND AGE DIFFERENCE

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ABSTRACT

Based on the acoustic experimental data from 30 subjects, we reported sociophonetic variation in the citation tones in Chongqing Mandarin in this paper. The comprehensive analysis of both the pitch and duration illustrated the difference in the citation tones. Our results showed that pitch is greatly impacted by age but not by gender. The tone curve is located on the top of the tone register in the group of aged over 60 years, at the bottom in the group of aged 40-60 years; the tone curve is unstable in the group aged 40-60 years, who are the transition between the younger and older groups. Similar as the pitch, the duration is not affected by gender; while the duration of the T3 (Shangsheng) is gradually increased with the age decline. Our data may provide implications on sociophonetic perspective in tone studies.

Keywords: sociophonetic variation, tone, Chongqing Mandarin

1. INTRODUCTION

Sociophonetic studies have progressed rapidly. [4] The effects of the gender and age of a speaker on acoustic parameters have been well documented. [3] Despite the tremendous progress in Chinese tone research, socially driven phonetic variation, however, has received much less attention.

Chongqing dialect is a branch of Southwestern Mandarin. There are a total of four tones (including T1: Yinping, T2: Yangping, T3: Shangsheng and T4: Qusheng) in the modern Chongqing dialect.

Chao [2] used a 5-point pitch scale system to distinguish among these tones, in which '1' represents the lowest and '5' represents the highest level of a speaker's pitch range. The survey results regarding tone values of Chongqing dialect reported in *Phonology of Sichuan Dialect* [6] were widely accepted in the past; but some scholars have recently put forward different views on tone values as described in Table 1:

Table 1: The different tone value descriptions of citation tones of Chongqing dialect.

author	T1	T2	T3	T4
Hao, X. [6]	55	21	42	214
Zhai, S. [11]	55	21	42	214
Wu, C. [10]	44	21	42	214
Fu, J. [5]	34	21	41	213

As shown in Table 1, the tone value descriptions from the four articles are generally similar in T2, T3, and T4 but greatly different in T1. For example, Wu [10] describes the T1 as a high level tone 44, while Fu [5] argues that it is a high rising tone 34, which is different from the other three articles. However, there are no specific explanations regarding this discrepancy in Fu's research.

This paper presents the results of an exploratory study of the effect of gender and age on tone variation in Chongqing Mandarin.

2. METHODOLOGY

2.1. Subjects

Thirty subjects (aged 20-70 years old) from the urban of Chongqing, whose parents are both natives of Chongqing, participated in this study. There are 14 males and 16 females in three age groups: 1) 20-30 years of age; n=14; 2) 40-60 years of age; n=9; and 3) above 60; n=7. Subjects were enrolled through a social network approach and invited to participate in a 20-30 minutes recording session in a quiet place chosen by each subject.

2.2. Material and procedure

The reading material includes 48 (12 different syllables × 4 tones) monosyllables. These 12 syllables are designed to cover different syllable structures and different vowel types. We removed the first and the last syllables of each tone, and selected the remaining 10 syllables for analysis. Thus, there are a total of 2400 syllables used as test

material, i.e. 30 (subject) × 10 (syllable) × 4 (tone) × 2 (repetition).

Audio sounds were recorded directly into a laptop computer through a lapel microphone. The recording was digitized with a sampling rate of 11,025 Hz for acoustic analysis in Praat. [1]

2.3. Acoustic analysis

The acoustic analysis was carried out with Praat. To accommodate the pitch range differences among speakers (gender and age), f0 was normalized for each speaker across four tones. The f0 values obtained from each speaker were converted to their logarithms, using a formula commonly adopted for such purposes [7, 8, 9]:

$$(1)\quad T = \frac{\lg x - \lg(\min - St\min)}{\lg(\max + St\max) - \lg(\min - St\min)} \times 5$$

'*x*' is any given point of a pitch contour, 'min' represents the minimal data of all measure points, '*St*min' means the standard deviation of the minimal data, and 'max' means the maximal data of all, '*St*max' represents the standard deviation of the maximal data. The output (*T*) is a value from 0 to 5, which is similar to the 5-point pitch scale proposed by Chao [2].

3. RESULT

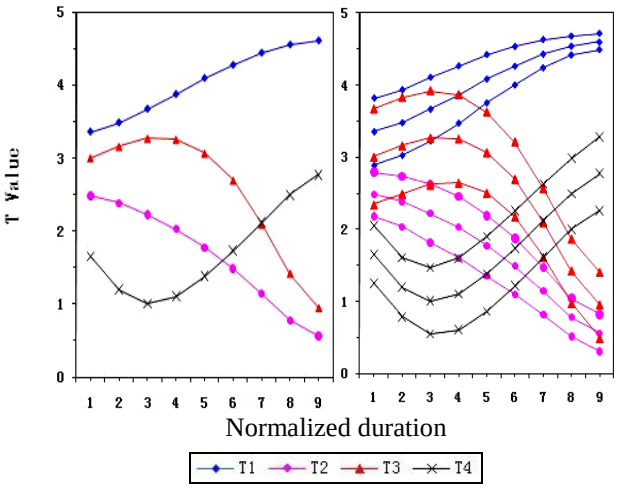
3.1. Statistical analysis of pitch

3.1.1. Tone pattern of Chongqing dialect

According to acoustic data and statistical analysis, we identified the values of four tones as T1: 35, T2: 31, T3: 341 and T4: 213. The left panel in Figure 1 showed the pattern of citation tones of Chongqing dialect. In the tone pattern, each tone is not occupied by a line, but a band of acoustic space. A tone curve should not be regarded as a line, but as a strip line or main line [7]. The right panel in Figure 1 showed the main distribution of citation tones of Chongqing dialect.

According to the standard deviation of every measurement point in each tone, we separated the stable and unstable parts of tone curve [9]. The tone feature is reflected in the stable part, while the unstable parts can mark the location of tone variations. In Chongqing dialect, the beginnings of T1, T2 and T3 are unstable parts, while the stable parts include the endings of T1, T2, T3 and the beginning of T4.

Figure 1: The pattern and the main distribution of citation tones of Chongqing dialect.

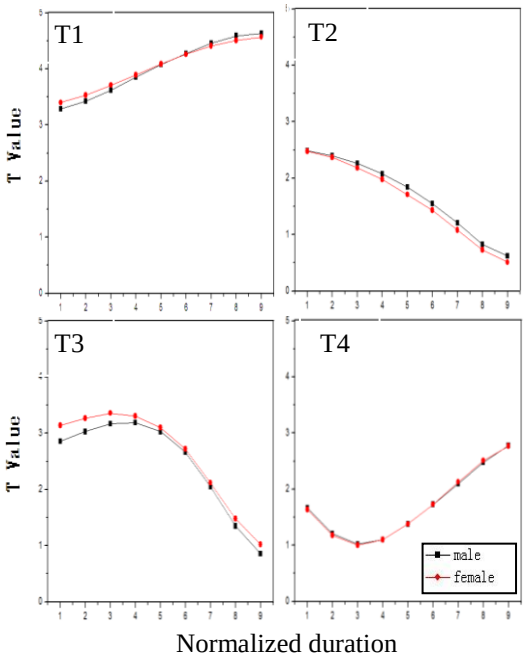


3.1.2. Statistical analysis on gender

Figure 2 displayed that the tone curves are only slightly different between male and female. Specifically, the female tone curve is slightly shifted above the male tone curve in T3. In contrast, the male tone curve sits above the female tone curve in T2. The tone curves of male and female almost completely overlap in T1 and T4.

The result of Independent-Sample T tests on nine points of each curve showed that the gender difference on all of nine points is not significant, $p > 0.05$.

Figure 2: The gender difference on citation tones of Chongqing dialect.



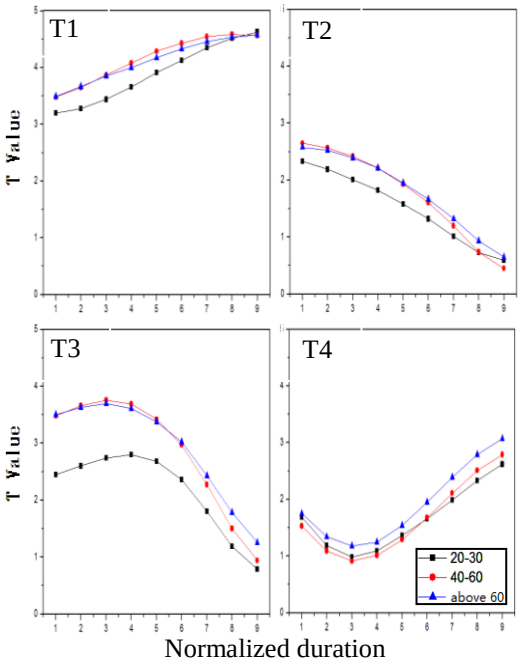
3.1.3. Statistical analysis on age

Thirty subjects are divided into three age groups: group 1 including the subjects aged 20-30 years, group 2 aged 40-60 years and group 3 aged above 60 years. As shown in Figure 3:

- T1: The tone curves of three age groups are high-rising curves located on the top of the register. The T values of the ending points in each tone curve of three age groups are overlapped. The major difference in T value between the three groups is in the starting points. The starting point of group 1 is the lowest, with group 2 in the middle and group 3 the highest. Thus, the T values of the starting points in each tone curve are decreased with age decline. Therefore, we conclude that the rising trend of T1 is gradually increasing. Our results may help explain the different descriptions as to whether T1 is a high level tone or a high rising tone as depicted in Table 1. With the decline of age, the rising feature of T1 is more significant especially in group 1 (aged 20-30). Therefore our results agree to the description that T1 is a high rising tone, which is in accordance with the tone variation of contemporary Chongqing dialect.
- T2: The tone curves of the three age groups are low-falling curves located at the bottom of the register. Tone curves of group 2 and group 3 are close, both of which are shifted above of group 1. There are overlaps in some points between group 2 and group 1 as well as between group 2 and group 3. Group 2, as the transition, is always unstable.
- T3: The tone curves of the three age groups are high-falling curves with slightly convex beginnings. The tone curve of group 1 is at the bottom of register; curves of group 2 and 3 are on the top. With the decline of age, the register of T3 reduces gradually, which indicated the maximal limit of register declined gradually; the convex contour in the beginning of T3 becomes more significant. We assume that the "convex" feature is forming.
- T4: The tone curves of the three age groups are fall-rising. The tone curve of group 3 is beyond those of group 1 and 2 on the top of the register.

An ANOVA with age as a fixed factor showed that T1, T2, and T3 are significantly different between group 1 and group 2, as well as between group 1 and group 3 ($p < 0.05$); while T4 is not significantly different between the three groups ($p > 0.05$). The difference between group 2 and group 3 is not significant among four tones, ($p > 0.05$).

Figure 3: The age difference on citation tones of Chongqing dialect.



3.2. Statistical analysis of relative duration

In order to get the relative duration, we calculated dispersion index, a normalized measure of the dispersion of a probability distribution. We designated the duration of T3 as 1, whose dispersion index is minimal. We evaluated the duration difference in males and females. Based on the T test, the relative duration among T1, T2 and T3 is not significantly different between male and female ($p > 0.05$), while the relative duration between T1 and T4，T2 and T4, T3 and T4 are significantly different ($p < 0.05$). According to Figure 4, the duration of T4 is the longest in Chongqing dialect. The tone duration is relative to the tone curve. The duration of complicated contour tone is always longer than that of simple contour tone. T4 is a fall-rising tone and T3 is a high-falling tone with slightly convex beginning which becomes more significant. Therefore, the durations of T4 and T3 are longer than T2 and T1.

We next analyzed the duration difference in the three age groups. Figure 5 showed that the relative duration of T4 is the longest, followed by T3 in group 1 (aged 20-30) and group 2 (aged 40-60); the relative duration of T3 is the shortest in group

3 (above 60). The duration of T3 is increased with age decline.

Figure 4: The relative duration of citation tones of Chongqing dialect in different gender.

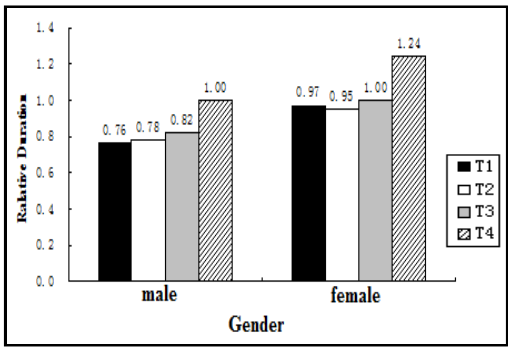
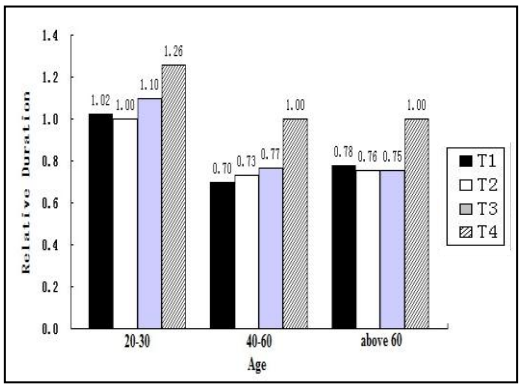


Figure 5: The relative duration of citation tones of Chongqing dialect in different age.



4. CONCLUSION

Based on the statistical analysis on tones of Chongqing dialect in male and female subjects with different age, we shows that age is an important factor for the variations in contour, register and duration. The tone curve of the group aged over 60 years is on the top of the tone register while the 20-30 years old group approaches the bottom, and 40-60 years old group shows unstable status as a transition. With the decrease of age, the 'rise' feature of T1 is more remarkable; the 'convex' shape at the beginning of T3 is forming, which is reinforced by the gradual increase in duration of T3.

5. ACKNOWLEDGEMENTS

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