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A psychological study of Cantonese tone confusion based on computer experimental data

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Abstract: - The paper is based on computer experimental data and aims at investigating the pronunciation of Cantonese tones by 40 participants in Guancheng. Accordingly, three methods, namely, the preparatory pronunciation, pronunciation experiment and perception experiment were applied to examine the tones. The methods correspond to three levels of psychological identification. As the result, confusions of Cantonese tones were summarized and the related reasons were analyzed. The psychological identification of different levels was found to show different trends in the confusion of the tone. Moreover, according to the preparatory experiment, as shallow level psychological identity, the similarity of the adjustment and modulation can be argued to be the internal reason of the confusion. As the medium level psychological identity, the pronunciation experiment suggested that the weakening of socialized pronunciation can lead to tone confusion. Finally, as the deep psychological identity, the experimental study of perception demonstrated the perceptual similarity as the direct psychological motivation of the confusion..

Keywords: Computer Experimental Data; Guancheng Cantonese; Tone; Confusion; Psychological Identification.

I. INTRODUCTION

Computers are widely used in the investigation and research of Chinese dialects, especially in experimental phonetics and psycholinguistics.[1-2] The computer software Praat can provide us with more accurate tone frequency data. Adopting a psychological identity perspective and base on Computer experimental data, the present study aims at investigating and summarizing the confusion of Cantonese tone in Guancheng at the three levels of linguistics field investigation, acoustic analysis and perception detection.

Commonly known as 'Cantonese' and 'vernacular,' Cantonese dialect is represented by Guangzhou Cantonese. The dialect is mainly used in numerous counties and cities in Guangdong and Guangxi, in Hong Kong, Macao as well as certain Chinese communities overseas. Moreover, Cantonese and Hakka dialects are primarily spoken in Dongguan city, which is generally represented by 'Guancheng Cantonese.' In recent years, while numerous researches have looked into confusions in Cantonese, the study of Cantonese in Guancheng have mainly focused on the presence of "Ru into" tone.

For example, while Wang[3] and Chen[4] demonstrated that 'Ru into' existed in Dongguan Cantonese, Yin Ping and 'Ru into' were shown to be in opposition by the former study; this is despite the adjustment value being quite close to the adjustment class. In other studies, Wang[5] and Li[6] suggested the nonexistence of an independent 'Ru into' tone. This is to say that, as argued by Wang Xule, Yangshang and 'Ru into' do not constitute the opposition, which is an indication of the evolution of 'Yangshang.' The issues are similarly discussed by Li. Noticeably, the academic community maintains that the Cantonese tone in Dongguan city may have evolved in the past 60 years. Furthermore, the rising value of Cantonese Yinping and Yangshang is demonstrated to be quite close in Guancheng, which can possibly lead to the confusion between Yinping, Yangshang and Ru into.

However, regardless of the confusion in Rusheng or other tones in Guangcheng Cantonese, research works on tone confusion has remained understudied. Moreover, the applied methods have merely relied on traditional approaches, which lack the acoustic analysis of the tone. The psychosocial attributes of the language are also overlooked.

II. PARTICIPANTS

According to the 1995 Dongguan City Annals, there are gates at the east, the south, the west, and the north parts of the county. Moreover, there are Twelve Fang, North Corner, Mizhou, Fengshan Township, Luozhi Township, Boxia Township, Jintai Township, Wanjiang Township outside the county. The participants of the study were selected from those inside the city. Moreover, due to the tone variation shown mainly at the youth level, while the subjects were predominantly selected from participants aged between 20 and 25, a number of older participants

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(over 50) were also selected as a reference. As can be seen in Table 1, the gender of the two age groups (total number of 40 participants) was balanced.

Table 1. Age and Sex of the Participants

age / sex	old	young
man	4	16
woman	4	16

The participants were selected based on the representative attributes proposed by Liang & Huang[7]. To be included as the subject of the study, the participants were required to have the following parameters set as (2):

a. [Inheriting the oral culture of Dongguan dialect]

b. [Using Dongguan dialect frequently]

c. [Should be approved by others/evaluators]

To achieve the aims of the study, a questionnaire was developed to detect the language attitude, language psychology and language use of the alternative participants. This was done to judge whether they met the attributes of (2) a and (2) b. The alternative participants were also asked to tell the story of "The North Wind and the Sun" in a natural and fluent Guancheng Cantonese. More than three Guancheng locals were also asked to decide whether the participants were qualified. In other words, to be included as a participant, the alternative speaker was required to simultaneously meet the above three representative attributes .

III. PREPARATORY PRONUNCIATION IN GUANCHENG CANTONESE

The purpose of the preparatory pronunciation was to re-determine the phonological tone system of Guancheng Cantonese. This was particularly for the characteristics of the tone, which reflects the shallow level psychological identification of the participants. Accordingly, two participants were selected from the two age groups as the representatives. Using the 'Dialect Survey Word Table' designed by the Institute of Linguistics of the Chinese Academy of Social Sciences, 3962 character-sounds were analyzed. The participants' tones were also normalized using experimental phonetics. The results obtained through the survey are shown in the last two columns of Table 2, i.e., old men, young women. Moreover, the absolute duration diagram of the pitch is displayed in Figure 1.

Table 2. Description of the Cantonese tone in Guancheng

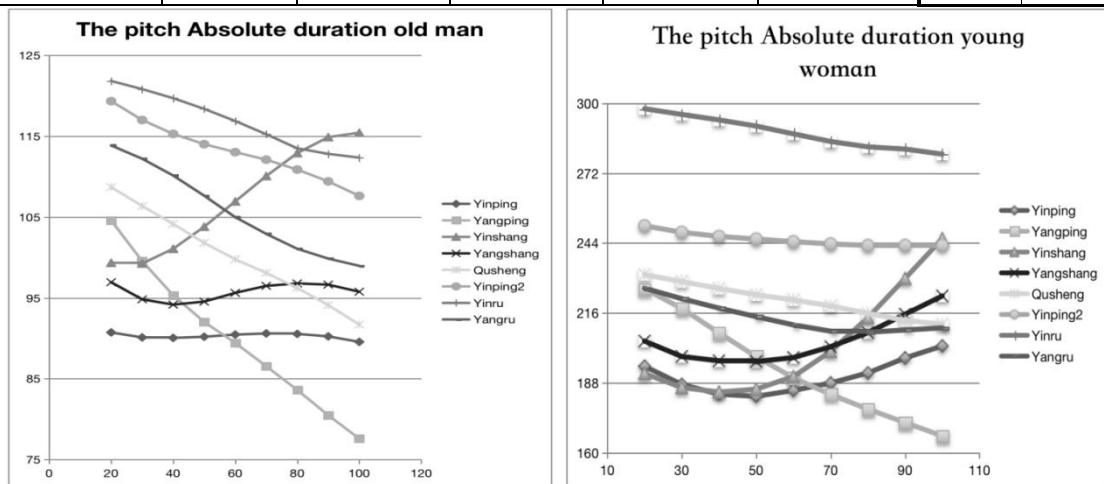| Tone name	Wang [3]	Chen[4]	Chen [8]	Wang[5]	Li[6]	old	young
Yinping	2132/232	213	213	213	132	22	223
Yinping 2						54	44
Yangping	11	21	11	21	21	31	31
Yinshang	24	35	35	35	35	35	24
Yangshang	23	13	13	13	24	23	23
Qusheng	332	32	32	33/32	332	42	32
Yinru	4	4	4	4	5	5	5
Yang ru	2	2	2	2	3	31	31
Ruinto	224	224	224				

Figure 1. The Pitch Absolute Duration Diagram in Guancheng

Based on the results obtained from the survey, the following conclusions can be drawn: (1) The 'Ru into' is completely disappeared in Guancheng Cantonese. After Wang[3], Chen[4] studied on the 'Ru into' of Dongguan

in the 1980s; however, no record of Cantonese has been observed in Dongguan since the 21st century; (2) while Guancheng Cantonese was observed to be slightly different among the old and the young groups, the Yinping, Yinshang and Yangshang were found to be quite close in all the age groups; and (3) with regards to Yinping, two values were observed in both the elderly layer and the youth layer, with the latter demonstrating more Yinping2 (the problem of Yinping will be discussed in another article).

Similar tuning and close tuning are considered to be significant links in the evolution of a tone merger [9]. With regards to the characteristics of the old men and the young women, the following confusion trends were also observed: Yin Ping and Yang Shang, Yin Shang and Yang,Shang, Yin Ping and Yin,Shang, Yang Ping and Qu Sheng.

In order to further evaluate the confusion trends in the Cantonese tone of Guancheng as well as to assess the psychological identity of the participants, the pronunciation and perception experiments were carried out on the Cantonese society in Guancheng.

IV.   PRONUNCIATION EXPERIMENT IN GUANCHENG CANTONESE

Through conducting acoustic analysis, middle-level psychology of Cantonese tone confusion was observed in Guancheng by the pronunciation experiment. The tone confusion can also be investigated at the pronunciation level through the coincidence of the base frequency curves of the two-tone types within one standard deviation. In other words, a complete overlap in the points of the two tones is preliminarily an indication of confusion in pronouncing the two tones.

A.   Materials

For the purpose of the pronunciation experiment, the participants were required to read the 'Guancheng Cantonese Character table' in Guancheng Cantonese, with the target words and the filled words being in a scrambled order. To represent the farthest vocal parts of the three opposing points in the mouth, the selected target words included the unit sounds [a] [i] [u] as the finals. This is because such vowels are articulated by the farthest opposite point in the tongue map ([o] replaces [u] because there is no complete set of [u] rhyme tone in Guancheng Cantonese, and [o] is closest to [u]).

At the same time, to facilitate the annotation, the target words were selected from commonly used words. This also helped to avoid rare and polyphonic characters. Moreover, the voice was mainly stop sounds. All target words appeared twice in the experimental word table, the pronunciation order of which was scrambled to avoid the participants guessing the purpose of the experiment. The 'Feifeng Language Field survey and Analysis system' developed by the E-Institute of comparative Linguistics in Shanghai universities and the Linguistic Institute of Shanghai Normal University was used as the survey recording software. Moreover, to key in the international phonetic symbols 'Lingfeng multi-language input method' was utilized. More details are provided in Table 3.

Table 3. Cantonese Experimental Characters in Guancheng

vowel tone	target word			Fill the word		
	a	i	u	a	i	u
Yinping	Ba [pa232]	Zhi [ʧi232]	Duo [tu232]	Shou [sau232]	Shi [si232]	Fu [fu232]
Yinping2	Ga [ka55]	Shi [sʅ55]	Ge [kɔ55]	Xia [ha55]	Zhi [tsi55]	Bei [pu55]
Yangping	Pa [pʰa11]	Chi [ʧʰi11]	Chu [ʧu11]	Chou [sau11]	Shi [si11]	Fu [fu11]
Yinshang	Ba [pa24]	Chi [ʧʰi24]	Zu [ʧu24]	Chou [tsʰau24]	Shi [si24]	Fu [fu24]
Yangshang	Ca [tsʰa23]	Zhu [tsʰy23]	Tuo [tʰu23]	Shou [sau23]	Shi [si23]	Fu [fu23]
Qusheng	Ba [pa332]	Zhi [ʧi332]	Cuo [ʧʰu332]	Chou [tsʰau332]	Shi [si332]	Fu [fu332]

B.   Experimental Methods

In a study on Cantonese rhythm, Wee et al[10] observed that while the second syllable of three consecutive syllables may be read lightly, the last syllable sometimes melts. Therefore, to form a rhythmic sentence without an internal grammatical structure as well as to extract the fundamental frequency of the first syllable, each Cantonese

entry was required to be read for three times, namely AAA. If the pitch curve of the first syllable was disordered, the pitch value of the second syllable was extracted as appropriate.

The Praat script of Xu [11] was also used to extract the base frequency data. The end and the beginning of the intercept boundary were calculated from the starting point of the rhyme belly (vowel) according to the starting point of Zhu[12] (vowel). On the word graph, the second pulse of the vowel is the starting point. The end point of the tone was determined based on two criteria, namely, (1) a significant decrease of the amplitude in the sound graph, and (2) the clarity of the second resonance peak in the broadband diagram. Therefore, if the structure of the resonance peak was blurred, it was considered to be the end point of the tone. Moreover, when the baseline was evenly divided into nine parts, a base frequency value was extracted every 10%. Then, the average value of the 10 points of the base frequency of the same tone was normalized. Furthermore, in order to obtain linguistically meaningful information, homing was applied to filter out personal characteristics and subtract differences in the pronunciation style in the recordings. Consistencies in interpersonal differences and commonalities in interlanguage variation can be determined through normalization, which, in turn, enables the study of interpersonal and interlanguage comparison [12].

Accordingly, the mean of each time point was obtained. The standard deviation of the mean of each base frequency was also calculated. According to the base frequency mean, a positive and a negative standard deviation were added to each base frequency curve to determine whether the base frequency curve of each sound class coincides within one standard deviation.

C. Results

After normalizing the participants, a complete coincidence within the standard deviation was first calculated and then divided into four groups of statistics. This was done based on the overlap in the standard deviation of the base frequency value. The confusions in pronunciation are summarized in Table 4. What also needs to be noted is that the pronunciations of two young men lacked Yinping.

Table 4 Articulation Confusion (number/ scale)

	Yinping-Yangshang	Yinshang-Yangshang	Yinping-Yang ping	Yinping-Yinshang	Yanping-Yangshang	Yinping-Qusheng	Yangping-Qusheng	Yangshang-Qusheng	Yinshang-Qusheng
Old man	3/75%	3/75%					2/50%		
Old woman	2/50%	3/75%					1/25%	1/25%	
Young man	9/56.25%	10/62.5%	1/6.25%		1/6.25%	3/18.75%	4/25%	2/12.5%	2/12.5%
Young woman	15/93.75%	11/68.75%	1/6.25%	4/25%		1/6.25%	1/6.25%	3/18.75%	1/6.25%

Based on the results obtained from pronunciation confusion data, the following conclusions can be drawn: (1) the complexity of intonation confusion in the youth layer was found to be higher than that of the elderly layer. Moreover, while confusion of the tone pronunciation by the old layer may be shown in Yinping-Yangshang, Yinshang-Yangshang, Yangping-Qusheng, Yangshang-Qusheng, the youth layer demonstrated confusions in Yinping-Yangshang, Yinshang-Yangshang, Yinping-Yangping, Yinping-Yinshang, Yangping-Yangshang, Yinping-Qusheng, Yangping-Qusheng, Yangshang-Qusheng and Yinshang-Qusheng; (2) Considering the pronunciation experiment, the confusion index of Yinping-Yangshang was observed to have an absolute advantage among old men, old women and young men. This is while YinPing-Yangshang was found to occupy the main position among young women, which was followed by Yangping-Qusheng and Yangshang-Qusheng.

Accordingly, the results obtained from the preparatory pronunciation revealed that confusions in Guancheng Cantonese may occur in Yinping-Yangshang, Yinshang-Yangshang, Yinping-Yinshang and Yangping-Qusheng. The results of the pronunciation experiment were basically consistent with those obtained from the preliminary pronunciation survey, which is an indication of confusion in Yinping-Yangshang and Yinshang-Yangshang; however, the confusion of Yinping and Yinshang was only observed in 25% of young female participants. Moreover, despite the Yangping-Qusheng tone being falling tone, the confusion index was far lower than that of Yinping-Yangshang and Yinshang-Yangshang. Furthermore, although such standard deviations as Yinpng-Yangping, Yinping-Yinshang, Yang ping-Yangshang, Yinping-Qusheng, Yangshang-Qusheng, Yinshang-Qusheng completely coincided in different ages, any possibility of confusion was rejected as its tone was completely different. Therefore, the confusion of Yinping-Yangshang, Yinshang-Yangshang, and Yangping-Qusheng was further counted at the social level (Table 5, 6, 7).

Numerous examples of confusion can be found in Cantonese on Yinping-Yangshang, Yinshang-Yangshang, and Yangping-Qusheng such as Guangxi Lianzhou Cantonese, the Yinshang and Yangshang are mixed into one tone,value 24; Yinqu combine to Yangping, value 33; Qinzhou Cantonese mix in Yinshang and Yangqu, Yangqu and Yangping [13]. Guangzhou Conghua Shenggang Yangshang and Yinqu are mixed to value 23 [14]. As can be seen in Table 7, the tone pattern of Yangping and Qusheng are very similar and basically in a parallel state;

however, the Yinping and the Yangshang, the Yinshang and Yangshang appear diffrent degrees of intersection or tangency, i.e., from the psychological identity of the middle level, they are likely to mix.

Table 5 Coincidence of the Standard Deviation between Yinping and Yangshang

	Complete overlap	Part overlap	complete separation
Old man	3	0	1
Old woman	2	2	0
Young man	9	4	3
Young woman	15	0	1

Table 6 Coincidence of the Standard Deviation between Yinshang and Yangshang

Old man	Complete overlap	Part overlap	complete separation
Old woman	3	1	0
Young man	3	1	0
Young woman	10	6	0
Old man	11	4	1

Table 7 Coincidence of the Standard Deviation between Yangping-Qusheng

Old man	Complete overlap	Part overlap	complete separation
Old woman	2	0	2
Young man	1	1	2
Young woman	4	3	9
Old man	1	3	12

V. PERCEPTION EXPERIMENT IN DUANCHENG CANTONESE

The perception experiment enabled us to deeply observe the psychological identity of the participants. Moreover, to further determine the confusion trend in the Cantonese tone in Guancheng, the experiment examined the existence of group agreement in the psychological identity of the Cantonese tone system.

A. Materials

The word table of the perception experiment consisted of 40 syllables including / p ^{h} ɐi /, / si /, / tsʰ ɔ /, / i ɐ n23 /, / i n23 / five syllables, forming 40 words (considering the balance of rhyme combination). The syllables examined in the experiment are provided in Table 8.

Table 8 Stimulus Syllables of the Perception Experiment

	[a]	[i]	[ɔ]	[ɐi]	[i]	[ɔ]	[i ɐ n]	[in]
Yinping	Ba[pa232]	Zhi [tsi232]	Duo [tɔ232]	Pi[pʰɐi232]	Shi [si232]	Chu [tsʰɔ232]	En [iɐn232]	Yan [in232]
Yangping	Pa[pʰa11]	Chi [tsʰi11]	Chu [tsʰɔ11]	Pi[pʰɐi11]	Shi [si11]	Chu [tsʰɔ11]	Ren [iɐn11]	Yan [in11]
Yinshang	Ba[pa24]	Chi [tsʰi24]	Zu[tsɔ24]	Bi[pʰɐi24]	Shi[si24]	Chu [tsʰɔ24]	Ren [iɐn24]	Yan [in24]
Yangshang	Ca[tsʰa23]	Zhu [tsʰy23]	Tuo [tʰɔ23]	Bei[pʰɐi23]	Shi[si23]	Zuo [tsʰɔ23]	Yin [iɐn23]	Ran [in23]
Qusheng	Ba[pa332]	Zhi [tsi332]	Cuo [tsʰɔ332]	Pi[pʰɐi332]	Shi [si332]	Cuo [tsʰɔ332]	Yin [iɐn332]	Yan [in332]

Table 9 Minimum Opposing Pairs

First word / Last word	Yinping	Yangping	Yinshang	Yangshang	Qusheng
Yinping	Shi-Shi Chu-Chu	AA	Chu-Chu Ren-Ren	Shi-Shi Ren-Yin	Chu-Cuo Ren-Yin
Yangping	Ba-Ba Yan-Yan	Chi-Chi Shi-Shi	AA	Shi-Shi Yan-Ran	Ba-Ba Shi-Shi
Yinshang	Shi-Shi Ran-Yan	Zuo-Chu Bei-Pi	Zuo-Chu Yin-Ren	AA	Shi-Shi Yin-Yin
Yangshang	Ba-Ba Shi-Shi	Pi-Pi Shi-Shi	Cuo-Chu Yin-Ren	Pi-Bei Cuo-Zuo	AA
Qusheng	Shi-Shi Chu-Chu	AA	Chu-Chu Ren-Ren	Shi-Shi Ren-Yin	Chu-Cuo Ren-Yin

Minimum opposition to two					
AA vowel	Yinping-Yinping	Yangping-Yangping	Yinshang-Yinshang	Yangshang-Yangshang	Qusheng-Qusheng
[a]	Ba-Ba	Pa-Pa	Ba-Ba	Ca-Ca	Ba-Ba
[i]	Zhi-Zhi	Chi-Chi	Chi-Chi	Zhu-Zhu	Zhi-Zhi
[ɔ]	Duo-Duo	Chu-Chu	Zu-Zu	Tuo-Tuo	Cuo-Cuo

As can be seen in the table, the 40 distinguishing syllables form 50 minimum opposing pairs in AA and AB (30 AA and 20 AB). Moreover, as is shown in Table 9, appearing in the AB and BA order, the AB combination covers all the tone coordination conditions.

B. Experimental Procedures

For the perception experiment, a human voice synthesized by the base frequency was used as the audio file. First, the standard deviation of the base frequency in the pronunciation experiment read the 40 syllables. Subsequently, the duration and sound intensity (standard-1dB) of the syllables were processed using Adobe Audition (standard 400ms). Next, the original base frequency value of each standby syllable was removed using Praat. In order to synthesize the stimulus sound, the normalized average value of the base frequency of each tone was also added at the corresponding time point. Then, the resultant stimulus sound was played in the form of AB or AB and BA to the speaker to be evaluated. The time interval between the stimulus sounds was set to 500m. Finally, using Windows Media Player, the 50 pairs of recordings were randomly played (each recording was played three times). The speaker was then asked to judge whether the two words in each set of recordings were the same. The obtained results are shown in Table 10.

The perception experiment required the speaker to determine whether the two sounds in each group were identical. Through the judgment of the accuracy of the speaker, to judge the difficulty of the speaker to distinguish these tones based on the perception of the confusion of the participants (The yellow mark is a lie test).

Table 10 The Perceptual Experiment Judgment Table

Order	Assemble	Whether homophone	Order	Assemble	Whether homophone	Order	Assemble	Whether homophone
1	Ba-Zhi		21	Chu-Chu		41	Pa-Pa	
2	Zhi-Cuo		22	Zhi-Shi		42	Shi-Shi	
3	Cuo-Cuo		23	Shi-Shi		43	Shi-Shi	
4	Zuo-Chu		24	Ran-Yan		44	Ca-Ca	
5	Pi-Pi		25	Bei-Pi		45	Yin-Ren	
6	Yin-Yin		26	Chu-Cuo		46	Ren-Ren	
7	Zhi-Zhi		27	Chu-Zuo		47	Shi-Shi	
8	Zuo-Chu		28	Yan-Yan		48	Ba-Ba	
9	Chi-Chi		29	Ren-Yin		49	Ba-Ba	
10	Ren-Yin		30	Shi-Shi		50	Ba-Chi	
11	Zhi-Zhi		31	Ba-Ba		51	Ba-Ba	
12	Chu-Chu		32	Shi-Shi		52	Pi-Bei	
13	Yin-Ren		33	Cuo-Zuo		53	Chi-Chi	
14	Zhu-Zhu		34	Pi-Pi		54	Pi-Bei	
15	Shi-Shi		35	Chi-Chi		55	Chu-Chu	
16	Chu-Cuo		36	En-Ren		56	Shi-Shi	
17	Zhi-Zhi		37	Zu-Zu		57	Ba-Ba	
18	Yan-Ran		38	Tuo-Tuo		58	Shi-Shi	
19	Shi-Shi		39	Ba-Ba		59	Cuo-Chu	
20	Duo-Duo		40	Chu-Chu		60	Chu-Pi	

C. Results

The participants were also divided into four groups of, namely, young men, young women, old men and old women. Excluding the lie tests, the perceptual error rate of the five pairs of tuning tones was calculated. The obtained data are provided in Table 11.

Based on the obtained results from the perception data, the following conclusions can be drawn: (1) the highest perception confusion index was found to be for Yangshang-Yinping, which was followed by Yinshang-Yangshang, Yangshang-Yinshang, and Yinshang-Yinping; (2) The order of pronunciation was found to be different, with the perceptual results being not exactly the same. Accordingly, the order of pronunciation can be argued to play a role in perceptual discrimination. Moreover, the tone confusion is likely to develop from the error of perceptual discrimination.

Table 11 Statistics of Perceived Error Rate (number)

First word \ Last word	Yinping		Yangping		Yinshang		Yangshang		Qusheng	
Yinping	Young man	1	Young man	10	Young man	8	Young man	10	Young man	3
	Young woman	1	Young woman	6	Young woman	7	Young woman	5	Young woman	1
	Old man	1	Old man	1	Old man	0	Old man	1	Old man	0
	Old woman	0	Old woman	2	Old woman	0	Old woman	3	Old woman	3
Total		**3**		**19**		**15**		**19**		7
Yangping	Young man	7	Young man	2	Young man	3	Young man	5	Young man	1
	Young woman	5	Young woman	3	Young woman	5	Young woman	4	Young woman	3
	Old man	0	Old man	1	Old man	0	Old man	0	Old man	0
	Old woman	2	Old woman	0	Old woman	1	Old woman	1	Old woman	1
Total		**14**		**6**		**9**		**10**		5
Yinshang	Young man	11	Young man	4	Young man	2	Young man	23	Young man	8
	Young woman	6	Young woman	3	Young woman	1	Young woman	22	Young woman	7
	Old man	1	Old man	0	Old man	1	Old man	5	Old man	1
	Old woman	5	Old woman	0	Old woman	0	Old woman	7	Old woman	2
Total		**23**		**7**		**4**		**57**		18
Yangshang	Young man	24	Young man	2	Young man	17	Young man	9	Young man	7
	Young woman	23	Young woman	2	Young woman	14	Young woman	6	Young woman	5
	Old man	4	Old man	0	Old man	4	Old man	0	Old man	3
	Old woman	8	Old woman	0	Old woman	7	Old woman	0	Old woman	5
Total		**69**		**4**		**42**		**15**		20
Qusheng	Young man	6	Young man	9	Young man	4	Young man	9	Young man	2
	Young woman	3	Young woman	4	Young woman	3	Young woman	6	Young woman	2
	Old man	0	Old man	1	Old man	0	Old man	1	Old man	0
	Old woman	1	Old woman	3	Old woman	0	Old woman	1	Old woman	0
Total		**10**		**17**		**7**		**17**		4

VI.   PSYCHOLOGICAL IDENTITY MECHANISM IN CUANCHENG CANTONESE

Studies on Cantonese tone have so far focused on traditional dialect surveys. This is to say that, such studies have less benefited from experimental means, and accordingly, have rarely examined the variation of tone through perceptual experiments. As shown in Table 12, the obtained results of the survey on traditional dialects suggest the more complexity of tone confusion. This is while the pronunciation experiment was observed to reduce the complexity of the confusion trend. Moreover, the perception experiment was found to further determine the scope and trend of confusion. The findings are provided in Table 12.

Table 12 The Interfusion of Cantonese Tone in Guancheng

	Preparatory pronunciation	Pronunciation experiment	Perception experiment
Confusion situation	Yinping-Yangshang	Yinping-Yangshang	Yangshang-Yinping
	Yinshang-Yangshang	Yingshang-Yangshang	Yinshang-Yangshang Yangshang-Yinshang
	Yinping-Yinshang		
	Yangping-Qusheng	Yangping-Qusheng	

Based on the obtained results, different levels of psychological identity were found to show different tone trends with different values and significance. Additionally, according to the preparatory pronunciation of superficial psychological identification, the similarity of adjustment and modulation can be argued to be the internal reason of confusion. Furthermore, the pronunciation experiment of intermediate psychological identification maintained the weakening of socialized pronunciation as the possible reason for tone confusion. Also, according to the perception experiment as the deep psychological identity and the direct psychological cause of confusion, the perceptual similarity can be determined more accurately.

Tonal confusion was also found to be the result of language simplification, which was performed based on the psychological identity of the social groups. "Yangshang come into Yangqu" is the main form of the evolution of Chinese dialect tone. Moreover, the Yangshang of Cantonese in Guancheng was observed to have confusion trend in pronunciation. Evolution of a language can be argued to be the result of such internal and external factors as the structure of the language and the social culture, respectively. With regards to the former, the Yangshang of Guancheng Cantonese demonstrated a trend in confusing Yinping tone or Yinshang. The question that arises is whether it belongs to the Yinping or Yinshang.

Based on the 'preparatory pronunciation' in the present study, either of the elderly layer or the youth layer may have different proportions of Yinping 2; however, the number of Yinping2 was observed to be more in youth layer than the elderly one. Two young men participated in the 'pronunciation experiment.' Based on the obtained results, while averagely all Yinping read high profile, the participants recognized the existence of Yin Ping in the 'perception experiment' at the same time, which was not the case in previous studies. Accordingly, while the high level Yinping 2 can be discussed to be influenced by external factors, it can also be due to the evolution of the language in recent years.

Moreover, Guangzhou Cantonese and Hong Kong Cantonese were found to have two Yinping, they are high level and high falling . While Yinping in Hong Kong Cantonese was used to read high level 55 tones, Guangzhou Cantonese was used to read high drop 53 tones. According to Gan[14], in Cantonese, the values of Yinping are 55 and 53 variants in Guangzhou (Haizhu, Huangpu), Foshan (Haizhu, Lanshi), Nanhai (Guicheng), Shunde (Chencun), Sanshui (southwest) and other places. Furthermore, Cantonese dialect is represented by Guangzhou dialect and, Dongguan has always been involved in trade activities with Hong Kong, so the Yinping of Dongguan also presents a high pattern.

Therefore, the evolution of Cantonese tone in Guancheng can be discussed to be the result of the interaction between language structure and external social factors. The confusion of Yangshang and Yinping begin with confusions in tonal perception, it progresses to the level of pronunciation. Finally, confusions in pronunciation and perception provide conditions for the implantation of the high Yinping 2 in the neighboring Cantonese dialect. Accordingly, while the evolution of the Yangnshang to Yinping (low), and Yinping (low) to Yinping2 (high) can proceed, the stable space for the increase of Yinshang can be retained as well. It can be seen that the computer experimental data strongly indicate the psychological process of tone confusions.

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