A Preliminary Study on the Age Variation of the Voicing Contrast in Wenzhou Wu Chinese

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ABSTRACT

Wu Chinese, spoken in the Southeastern part of China, still preserves an ancient feature of Middle Chinese, the phonological voicing contrast. The current study aims to investigate the age variation on the phonetic nature of voicing contrast in Wenzhou dialect of Wu using speech production data obtained from the electroglottography signal.

True voicing contrast could be found in fricatives and intervocalic obstruents but not in initial plosives or affricates in both old and young speakers' speech. For the young speakers, significant differences could be observed in phonation type of the vowels following all types of consonants: modal vowels after phonologically voiceless consonants and breathy vowels after phonologically voiced ones. However, the old speakers do not show a consistent contrast in phonation type of the following vowels. Therefore, there is apparent generational change related to the role of voice quality in the phonetic realisations of the voicing contrast.

Keywords: Wu Chinese, Voicing contrast, Age variation, Phonation type, Breathy voice

1. INTRODUCTION

Wu is a Chinese language spoken in Southeastern China and many overseas Chinese communities with about 70 million native speakers. A typical feature of Wu is that it still contrasts voiced and voiceless consonants in syllable-initial position phonologically, a feature lost in almost all of the other Chinese languages. The phonetic nature of the Wu voicing contrast has raised much discussion since 1920s [2] and there are different conclusions based on the fieldwork on various Wu dialects.

Recent phonetic research on northern Wu dialects (e.g. Suzhou and Shanghai dialects) indicates that the phonologically defined 'voiced' obstruents are not voiced phonetically (VOT > 0) in initial positions. The voicing contrast is distinguished by different phonation types of the following vowels: modal vowels after phonologically voiceless consonants and breathy vowels after phonologically voiced ones. In intervocalic positions, however, the voicing contrast is realised as true voicing of consonants, whereas the phonation type distinction of the following vowels no longer exists [4, 6, 10].

Regarding Wenzhou and other southern dialects, the conclusion is controversial as there are mixed findings. Some research agrees that the phonologically voiced obstruents in southern Wu consistently have negative VOT in both initial and intervocalic positions [3, 11, 15], different from northern Wu. However, other experimental studies support no dialectal difference on the phonetic realisations of Wu voicing contrast — it is also realised by the phonation type of the following vowels in southern Wu [1, 6, 13, 14].

In some experimental studies, some informants do still preserve the truly voiced consonants in initial positions, but this pattern is regarded as disappearing [9]. Because of the lack of standardisation and the frequent contact with Mandarin, the Wu phonological system including consonant, vowel and tone inventories is changing rapidly with apparent age variations [12].

Moreover, previous literature on the Wu voicing contrast focused only on plosives. It is important to investigate other consonants with phonological voicing contrast, like affricates and fricatives, even sonorants, to figure out the phonetic properties of the phonological voicing contrasts using all consonant types, as well as the potential age variation on this issue.

2. METHODS

2.1. Informants

The 8 informants were divided into two age groups — the old speakers (69-72 years old) and the young speakers (24-28 years old). There were 2 males and 2 females in each group.

All of the 8 native speakers were born and raised in Wenzhou downtown with no experience living in other places before adulthood. The parents and spouse (if applicable) of the informants were also all native speakers and Wenzhou Wu is basically the only language used in the family.

2.2. Experiment materials

Wenzhou dialect generally still retains a canonical eight-tone system of Wu: four tones of high register in syllables with the phonologically voiceless obstruent onsets and four tones of low register in syllables with the phonologically voiced obstruent onsets. As to the syllables with sonorant onsets, it potentially could be combined with tones in both registers, forming two types of syllables similar with the voicing contrast in the obstruent-onset syllables.

Table 1: Wenzhou Wu consonant inventory.

Labial	Alveolar	Alveolo-palatal	Velar	Glottal
p p^h b	t t^h d		k k^h g	
	ts ts^h dz	tɕ $tɕ^h$ dʑ		
f v	s z	ɕ		h ɦ
m	n	ɳ	ŋ	
ʋ		j[1]		
	l			

For the initial positions, to minimise the lexical gaps due to phonotactic constraints, the low vowel /a/ and the two level tones of the high and low registers were used to combine with the consonants in Table 1, forming the monosyllabic materials.

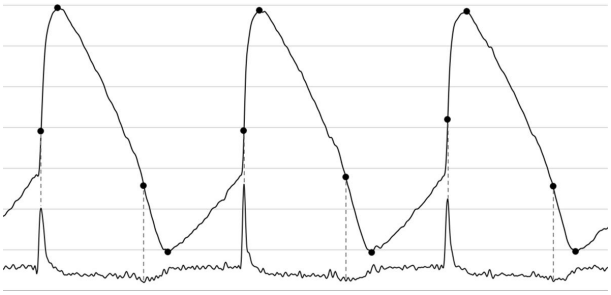
As for the intervocalic consonants in the multisyllabic materials, the vowels preceding and following the consonants within a word pair were controlled to be same respectively as in the instance of '/ba ɕi ba/' ('very white') and '/pa ɕi pa/' ('very sticky'). Only the multisyllables without tone sandhi were adopted. Three repetitions were recorded for each token.

2.3. Electroglottography (EGG) signal

The electroglottography (EGG) provides us a relatively straightforward method to trace the movement of vocal folds, which determines various phonation types. In the current study, the Glottal Enterprises EG2-PCX EGG was used. The electrical resistance of the larynx would change with the area of the glottis, so that the electric current passing through the two EGG electrodes reflected by the amplitude of EGG signal is negatively correlated with how open the vocal folds are. The open and closed phases of vocal fold movement are usually determined by the peak and valley values of the derived curve of EGG signal (DEGG) [5], as shown in Fig. 1.

Nevertheless, since the valley values of DEGG curves are likely to be extracted wrongly owing to the influence of noise, the opening point, i.e., the onset point of open phase could be settled by a certain threshold in the EGG curve (Herbst & Ternström [7] proposes 25% as an empirically appropriate reference). In the current study, the interval between the peak value of DEGG curve and the point when EGG signal exceeds the 25% threshold would be designated as the closed phase of vocal fold movement. The closed quotient (CQ) then could be calculated accordingly: the ratio of the closed phase to a whole cycle.

Figure 1: The schematic diagram of synchronous EGG (upper) and DEGG (lower) curves.



2.4. Data processing

All tokens were time normalised as having 10 time points of CQ values. For the tokens with obstruent onset, the data were extracted from the vowel, while for the tokens without onset or including sonorant onset (which were entirely voiced and thus had valid glottal pulses consistently across the syllable), the whole syllable was analysed.

Besides, the Smoothing Spline ANOVA model was used in the study to test the statistical difference between the curves. The result could be interpreted as statistically significant ($p<.05$) if the different shaded areas do not overlap at all.

3. RESULTS

Since there was no significant gender distinctions found in the CQ curves, the data below were collapsed across both male and female speakers.

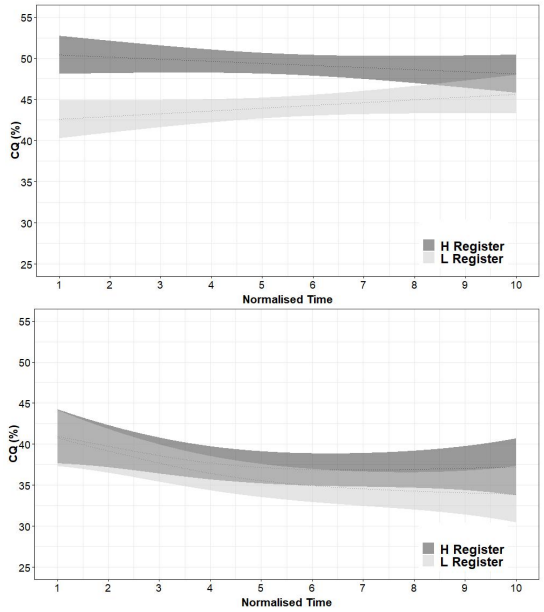
3.1. Initial plosives

According to Fig. 2 below, it is clear that the two types of syllables were indeed significantly differentiated by the phonation type in the young speakers but not in the old speakers.

Referring to the young speakers' data, the CQ of the tokens with tones of high register (phonologically voiceless onset) was mainly around 50%, which implied a typical modal voice quality. Whereas, the CQ of the tokens with tones of low register (phonologically voiced onset) was

noticeably lower than 50%, i.e., the open phase of the glottis was significantly longer, which supported it as breathy voiced sound with the glottis not fully closed all along.

Figure 2: The CQ of the plosive-onset syllables (Upper: young speakers; Lower: old speakers).



3.2. Initial affricates

Similar with the plosive-onset syllables, based on the young speakers' data in Fig. 3, the phonation types of the syllables were respectively modal voice and breathy voice. In other words, the voicing of initial affricates was realised by the breathiness of the following vowels as well.

Figure 3: The CQ of the affricate-onset syllables (Upper: young speakers; Lower: old speakers).

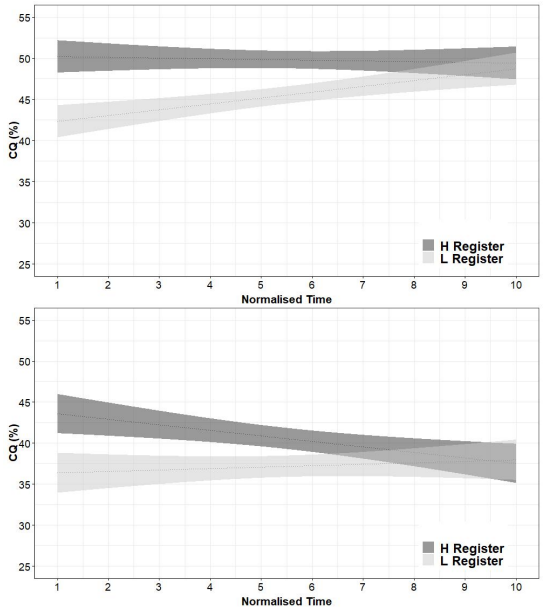


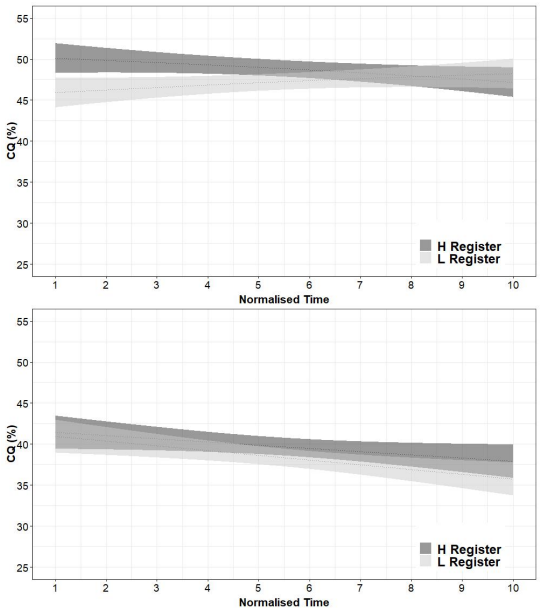
Fig. 3 also shows that the two types of affricate-onset syllables produced by the old speakers also showed significant differences in phonation type.

Meanwhile, as there was only 1 token found with negative VOT in all of the eight informants' initial phonologically voiced plosives and affricates (768 relevant tokens in total), it can be concluded that the breathiness of the following vowels, rather than the true voicing, has become the main phonetic nature to realise the phonological voicing contrast of initial plosives and affricates.

3.3. Initial fricatives

Different from the plosives and affricates discussed above, the phonologically voiced fricatives of Wenzhou Wu are basically truly voiced, i.e., showing a clear voice bar during the fricatives, which is not observed in northern dialects according to the literature. Among the initial phonologically voiced fricatives we recorded, 79.2% of them were truly voiced.

Figure 4: The CQ of the fricative-onset syllables (Upper: young speakers; Lower: old speakers).



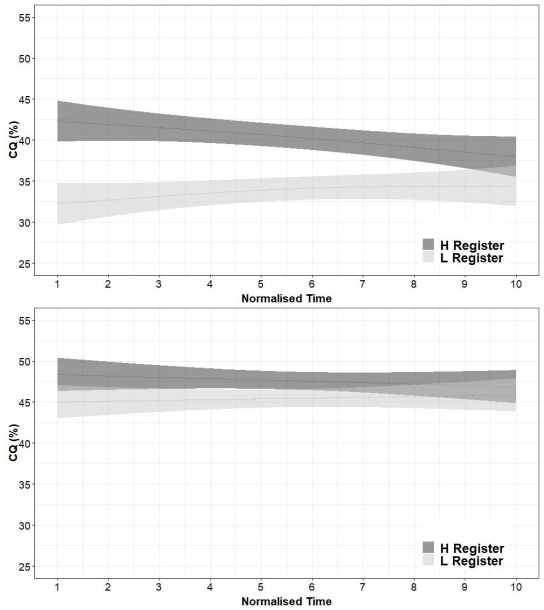
Nonetheless, as Fig. 4 indicates, the two types of syllables still contrast in breathy voice / modal voice in the young speakers, even though the difference was not as large as in syllables with plosive or affricate onsets. The old speakers however did not contrast in phonation type.

The two types of fricative-onset syllables contrasted in both the voicing of initial consonants and the phonation type for young speakers, demonstrating redundant cues to some extent.

3.4. Initial sonorants

The initial sonorant consonants in the two types of syllables were naturally both truly voiced. Hence the sonorant consonant per se could potentially be breathy voiced. In Fig. 5, it could be noticed that the breathiness of the syllables with tones of low register was not limited to the vowel part but across the whole syllable in the young speakers' speech. The old speakers did not contrast the phonation types in sonorant-onset syllables.

Figure 5: The CQ of the sonorant-onset syllables (Upper: young speakers; Lower: old speakers).

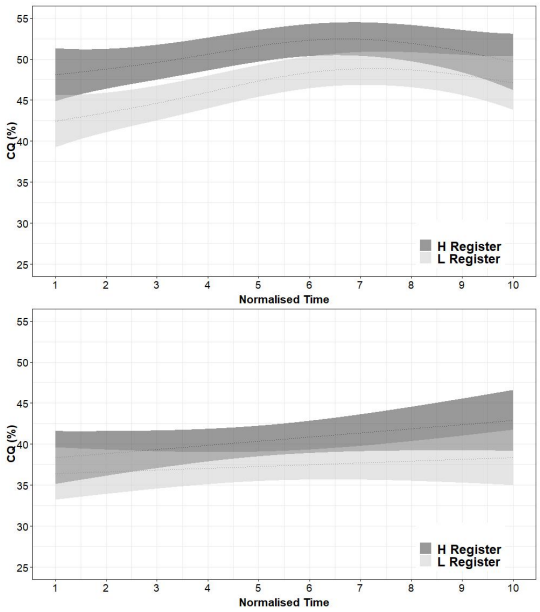


3.5. Intervocalic consonants

Consistent with the conclusions drawn by previous studies on Wu, the phonologically voiced consonants of Wenzhou Wu in intervocalic position are mostly truly voiced as well. Among intervocalic phonologically voiced obstruents, 93.8% of plosives and affricates as well as all of the fricatives had true voicing.

Despite the fact that the voicing contrast of intervocalic obstruents could be realised by true voicing, it could be observed in Fig. 6 that the breathiness contrast was still present in young speakers, although the difference was not as prominent. The old speakers again did not show such contrast here.

Figure 6: The CQ of non-initial syllables (Upper: young speakers; Lower: old speakers).



4. CONCLUSION

Based on the above results, it could be concluded that the phonetic realisation of the voicing contrast of Wenzhou Wu shows two different variants depending on age groups, which may suggest a potential diachronic sound change in progress.

With respect to the young speakers, significant differences could be noticed in breathiness of the vowels following all types of consonants including sonorants in both initial and intervocalic positions: modal vowels after phonologically voiceless consonants and breathy vowels after phonologically voiced ones, whereas the phonation type difference does not play a significant role in old speakers' voicing contrast.

The true voicing contrast could be found in fricatives and intervocalic obstruents but not in initial plosives or affricates consistently without age variation. It seems that the true voicing contrast has also been partly dropped by the old speakers nowadays. Therefore, in the phonetic realisations of Wu voicing contrast, the voice quality differences seem to be increasingly important.

As there may be on-going changes on the phonetic realisations of voicing contrast in Wu, whether the age variations or diachronic changes also exist in the perceptual cues that distinguish the two types of syllables remains unexplored and requires our further research.

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[1] Some studies indicate that there is frication and transcribe this phoneme as a fricative /j/ nearly contrasted with /ɕ/.