DIALECTAL VARIATION OF VOICE QUALITY IN TAIWAN MIN: AN EGG AND ACOUSTICAL STUDY

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ABSTRACT

This study explored the voice quality of Taiwan Min checked tones 5 and 3 produced by speakers of varying ages from northern, central and southern Taiwan with Zhanzhou, Quanzhou and mixed accents. Comparison between spectral tilt (difference between H1*-H2* amplitudes) and closed quotients of the glottal wave form showed that checked tones with creaky / tense voice quality were distinguished from unchecked tones produced by middle aged speakers from central and southern Taiwan but not by young speakers.

Keywords: Taiwan Min, sociophonetics, checked tones, sound change, voice quality, EGG

1. INTRODUCTION

In many Sino-Tibetan languages, such as Green Mong, Khmar, Kuai, Jingho, Hani, Yi, and Wa, lexical tones are distinguished by both voice quality and tonal contour [1, 2, 3, 12, 13, 15, 17, 18]. For example, Yi has a tense and lax voice quality contrast as well as f0 tonal contrasts. White Hmong, a Hmong-Mien language, has modal, breathy, and creak phonation contrasts as well as tonal contrasts. Phonation and tonal contrasts exist in Jalapa languages as well. For example, Mazatec has modal, breathy, and creaky phonation contrasts and tonal contrasts. Also, Indo-European languages, such as Gujarati have phonation contrasts but do not have a tonal contrast.

Esposito [10] by means of Multidimensional Scaling Analysis (MDS) found that listeners' linguistic backgrounds affected the perceptual cues they used to distinguish phonation contrasts. A cross language Electroglottography (EGG) and acoustical study on phonation of Yi, Gujarati, white Hmong, and Mazatec found that spectral tilt, H1*-H2*, was effective in distinguishing the phonation types in all four languages [16], whereas EGG data, such as the mean close quotient (CQ_H), distinguished modal from breathy phonation in Gujarati, tense from lax phonation in Yi, and breathy, creaky, and modal phonation in White Hmong [16]. Languages make use of different acoustical parameters to distinguish phonation types. For example, Mazatec phonations can also be distinguished with H1*-H2* and Cepstral Peak Prominence (CPP) as well [11]. In addition to acoustic and EGG parameters, the time course in which the phonation contrast continues within the vowel also varied across languages. In Yi, the phonation contrast continues through the entire vowel. In Gujarati, the phonation contrast is present in the middle of the vowel, and in Mazatec the phonation contrast exists only in the beginning of the vowel [16].

This study followed this line of study on languages with both phonation and lexical tonal contrasts and investigated the voice quality of two checked tones, 5 and 3, of Taiwan Min. CVC syllables with final unreleased voiceless stops, "checked" tone syllables, are shorter in duration than open syllables, or syllables with nasal codas [7].

A previous fiber optical study on Taiwan Min checked tones 5 and 3 found glottalization accompanying oral closure during articulation of final stops [14]. An inverse filtered oral airflow study found low airflow and a long closed phase in the glottal waveform of checked tones produced by some speakers [19]. As the vocal folds closed off during checked syllables, the airflow decreased and the closed phase of glottal wave forms increased. Acoustical studies using spectral tilt, amplitude of first harmonic minus amplitude of the highest peak of second formant (H1-A2), did not find creaky voice quality for checked tones [20]. It was proposed that H1-A2 may not be an effective parameter in documenting voice quality of Taiwan Min checked tones. Laryngoscopic study found that all speakers showed glottal fold adduction. Younger speakers showed less or no adduction of ventricular fold or aryepiglottic folds [8]. In sum, fiber optical, laryngoscopic and inverse filtered oral airflow studies all found glottalization for Taiwan Min checked tones, however, the effective acoustical parameters for documenting Taiwan Min checked tones are yet to be determined.

Recent field work studies based on auditory impressionistic data observed ongoing sound change for Taiwan Min checked tone 5. The high onsets of checked tone 5 drop to mid onset as checked tone 3 [4, 6]. To explore how tense / creaky voice qualities were affected by the sound change in f0 contours, the voice quality of checked tones produced by young and middle aged speakers in Northern Zhangzhou, Northern Quanzhou, Central Zhangzhou, Central Quanzhou, and Southern Mixed dialect regions of Taiwan are documented.

2. METHOD

2.1. Subjects

Following the isoglosses defined by Ang [5], this study recruited native speakers from northern and central Taiwan with Zhangzhou (漳州) and Quanzhou (泉州) accents and southern Taiwan with a mixed accent. All speakers were able to speak Mandarin. EGG data were recorded from four of 10 speakers, as shown in Table 1.

Table 1: Speakers' backgrounds.

	40-60 years old	20-30 years old
N. Zhangzhou	1Female (1 EGG)	1Male (1 EGG)
N. Quanzhou	2Females (1 EGG)	
C. Zhangzhou	2Females	
C. Quanzhou	1Male	1Female
S. Mixed	1Female	1Male (1 EGG)

2.2. Instruments

Glottal Enterprise EGG system EG2-PCX and TEV TM-728II microphones were used to simultaneously pick up acoustic and EGG data. The EGG and acoustic signals were recorded with Audacity onto a laptop and then separated into different channels, inverted and analyzed with EggWorks [9]. The acoustic signals were tagged by Praat to mark vowel boundaries, and then analyzed with VoiceSauce [21].

2.3. Corpus

A randomized reading list included 390 monosyllabic tokens that were read in citation form included the target checked tones, 5 and 3,controlled unchecked tones, 53 and 31 and filler items with rising and level tones.

2.4. Procedure

During the recording, two electrodes were placed on four speaker's necks while a microphone was placed within 15 cm in front of all speakers' mouths. The EGG system was not available for remaining subjects. Speakers first read the number of the order for each token and then paused before reading each target token on the reading list. Speakers took a break and drank water after every 100 tokens. The recording lasted for about 40 minutes.

2.5. Data analysis

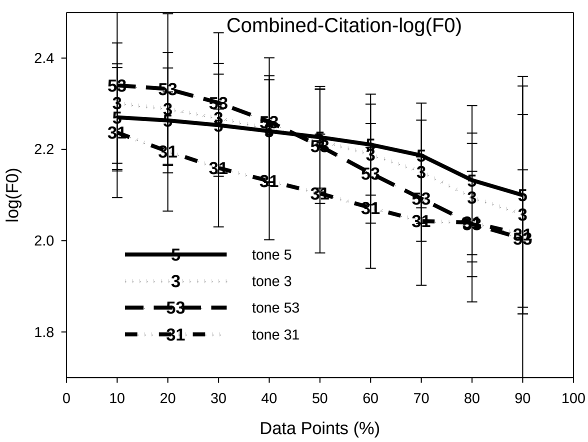
The closed quotients of the glottal wave form were calculated with a hybrid method (CQ_H) [9]. Following previous studies [10, 11], H1*-H2* amplitude was calculated with VoiceSauce [21]. Corrected H1*-H2* values were used, because the vowel quality was not controlled. A negative H1*-H2* value indicate creaky voice quality. The closed quotient, f0, and H1*-H2* values at every 10% in time during the vowel were extracted and analyzed with one-way ANOVA (checked vs. unchecked tones).

3. RESULTS

3.1. F0

As shown in Figure 1, the f0 contours of tones 5, 3, 53, and 3 fell through out the entire vowels. The f0 onset of unchecked tone 53 was the highest, followed by tone 3, then tone 5, and finally tone 31.

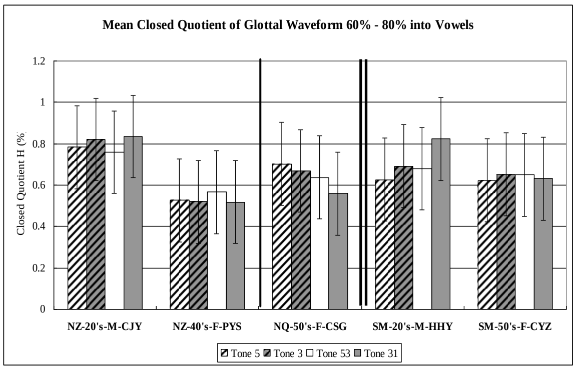
Figure 1: F0 contours.



3.2. EGG

As shown in Figure 2, there was a significant effect of checked tones vs. unchecked tones on closed quotients produced by middle aged female speaker, CSG, from Northern Quanzhou region (F(1, 302) = -3.74, p<.01), but not any other speakers. The closed quotient may not be an effective parameter in documenting voice quality. Other EGG parameters should be used.

Figure 2: Close quotients of glottal wave form.



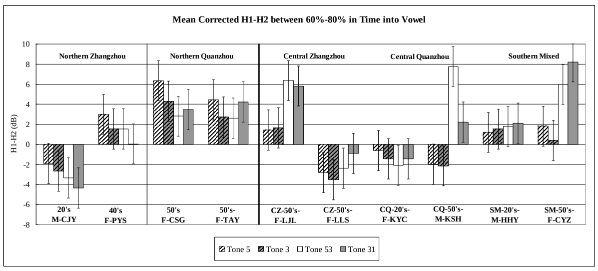
3.3. Spectral tilt: H1*-H2* corrected

There were significant effects of tones on spectral tilt, H1*-H2*, produced by a young speaker, CJY, from Northern Zhangzhou region ($F(1, 327)= -3.08$, $p< .01$), a middle aged female speaker, CSG, from Northern Quanzhou region ($F(1, 310)= -4.6$, $p< .01$), two female middle aged speakers, LJL and LLS, from Central Zhangzhou region (LJL: $F(1, 298)=7.9$, $p< .01$; LLS: $F(1, 298)=4.98$, $p< .01$), a middle aged male speaker, KSH, from Central Quanzhou region ($F(1, 312)=16.99$, $p< .01$), and a middle aged female speaker, CYZ, from Southern Mixed region ($F(1, 327)=11.854$, $p< .01$).

In other words, excluding one young speaker, CJY, significant effects of tone on H1*-H2* were only observed on spectral tilt data from middle aged speakers.

As shown in Figure 3, in the two northern speakers' CSG and CJY, data, the H1*-H2* values of checked tones were higher than unchecked tones.

Figure 3: Spectral tilt.



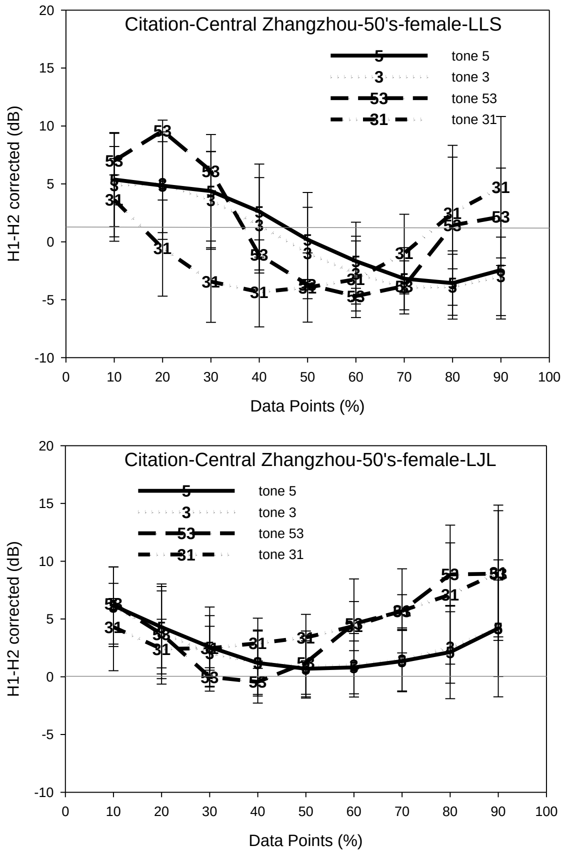
For these two northern speakers, the voice quality of checked tones was NOT more tense / creaky than unchecked tones as suggested by fiber optical or laryngoscopic studies. However, in central and southern middle aged speakers' productions, the H1*-H2* of checked tones were smaller in values than uncheck tones. Checked tones were tenser/ creakier than unchecked tones in central and southern speakers' data.

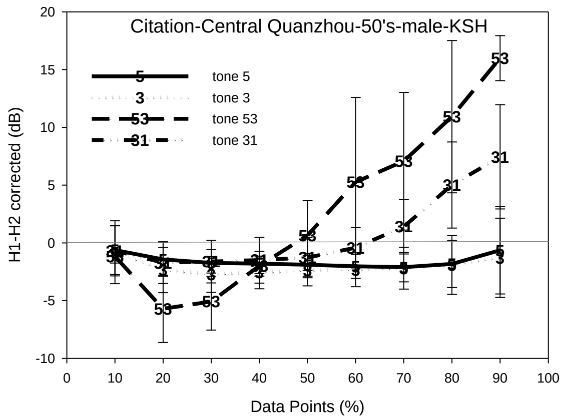
Even among and central and southern middle aged speakers, only in KSH's spectral tilt data was there a creaky versus modal versus breathy voice quality distinction. KSH produced checked tones with negative H1*-H2* values, indicating a creaky voice quality. He produced unchecked tones with positive H1*-H2* values, indicating a modal / breathy voice quality.

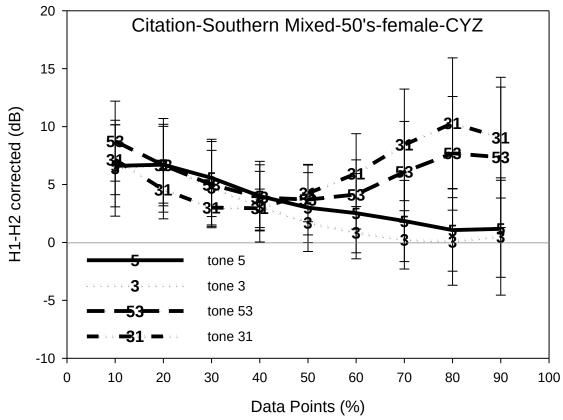
3.4. Timecourse

Among the central and southern speakers who produced checked tones with a tenser / creakier voice quality, the voice quality contrast between checked and unchecked tones was either in the middle or final portion of the vowels. As shown in Figure 4, the spectral tilt distinction between checked tones, 5 and 3, and unchecked tones, 53 and 31, started after 40% in time into the vowels produced by LLS, after 50% in time for KSH and CYZ, and after 60% in time for LJL. The acoustic cues for distinguishing checked tones from voice quality distinction occur in the final half of the vowels.

Figure 4: Times course of spectral tilts.







4. DISCUSSION

The closed quotient data used here is not effective in distinguishing the voice quality of checked tones from unchecked tones. Further study on other EGG parameters, such as the beginning of contact phase, the end of contact phase, and the differences between minimum or maximum amplitude values in each cycle of EGG should be conducted.

Younger speakers do not maintain a voice quality distinction between checked and unchecked tones. This could be attributed to the influence of Mandarin, Taiwan's office language. Mandarin does not have checked syllables and so there is no need for such a distinction. Middle aged speakers whose native language is Taiwan Min still maintain the quality distinction. More data from different regions, ages and both genders should be collected to reveal the progress of checked tone voice quality changes in Taiwan.

5. ACKNOWLEDGEMENTS

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