

# Dialectal Variations in Tonal Register and Declination Pattern of Taiwan Mandarin

*Yi-Hsuan Huang and Janice Fon*

Graduate Institute of Linguistics  
National Taiwan University  
{r94142011; jfon}@ntu.edu.tw

## Abstract

This paper investigated how dialectal variations can influence the realization of tonal register and declination pattern in Taiwan Mandarin. Twelve speakers, six from the Northern dialect (standard) and six from the Central dialect (nonstandard), were recruited for a reading task. Target syllables of Tone 1 (T1) were embedded in a carrier sentence in three different sentential positions, initial, medial, and final. The dependent measure was the  $F_0$  maximum of the target syllables. Results showed that the Northern dialect had higher T1 register than the Central dialect, with the effect being more prominent in males than females. The magnitude of declination was also a function of gender and dialect. Central male speakers produced milder declination slopes than their Northern counterparts while Central female speakers tended to have steeper slopes instead by raising the initial starting pitch, indicating that in the Central dialect, female speakers were more aware of their vernacular speech status compared to male speakers and tended to hypercorrect their nonstandard accent by using a larger pitch range.

## 1. Introduction

The linguistic situation in Taiwan is anything but monolithic. Although the official language is Mandarin, nearly 80% of the population is ethnically Min, who speaks a variant of Southern Min [5, 6]. Therefore, Min acts as a powerful substrate language for Taiwan Mandarin.

Both Mandarin and Min are tone languages. Mandarin has four lexical tones, which are high level (Tone 1), mid dipping (Tone 2), low dipping/falling (Tone 3), and high-falling (Tone 4) [3, 7, 8], while Min has five long tones, which are high level (Tone 1), high falling (Tone 2), low falling (Tone 3), mid dipping (Tone 5), and mid level (Tone 7). Although the two languages have comparable tonal number and categories, the tonal range used in Min is somewhat lower than that in Mandarin [4, 9].

Due to the Mandarin-only language policy enforced by the government between 1945 and 1990, the relative statuses of the two languages have become unequal [10]. Mandarin is promoted as a high language and is used extensively in public domains and formal contexts while Min is demoted as a low language and is often limited to private domains and informal contexts. In addition, the degree of bilingual proficiency is also geographically imbalanced. As Taipei is the political and economic center of the country, more people became monolingual Mandarin speakers or unequal Mandarin-Min bilingual speakers who are dominant in Mandarin. On the other hand, in cities that are more down south, there are more people that are equal bilingual speakers of Mandarin and Min, or even unequal bilinguals that are dominant in Min.

Therefore, in this study, we would like to investigate whether there is any difference in the tonal range by Mandarin speakers of different dialects. Specifically, the Northern dialect, which is the standard variety, and the Central dialect, a nonstandard variety, were chosen. The Northern dialect is spoken in the Taipei Metropolitan area while the Central dialect is spoken in the Taichung Metropolitan area.

## 2. Aims of the study

There are three specific aims in this study. First of all, we would like to explore possible dialectal differences in tonal register. If the low tonal range of Min could be carried over to that of Mandarin, one would expect this effect to be stronger in the Central dialect than the Northern dialect, as there are more fluent Min speakers in the former area than the latter. Therefore, the tonal register of the Central dialect should be lower than that of the Northern dialect.

Secondly, if tonal register is indeed lower in nonstandard varieties, then one would suspect this difference to also influence the declination pattern, since declination exerts differential effects on high and low tonal targets, being more prominent on the former than the latter [11]. In other words, one would expect the topline declination of the Northern variety to be steeper than that of the Central variety, since the latter has a more restricted and lower tonal register.

Thirdly, we would like to explore whether gender would also influence tonal realization with regards to register and declination patterns in the two dialects. Sociolinguistic studies have demonstrated that women on average are more likely to conform to standard linguistic forms than men [12]. If so, we would expect women in the Central dialect to be closer to those in the Northern variety than their male counterparts.

## 3. Methods

### 3.1. Participants

Twelve participants between ages 19 and 24 took part in this study. Half of them were from the Taipei Metropolitan area (the Northern dialect), and half of them were from the Taichung Metropolitan area (the Central dialect). Within each dialect group, there was an equal gender split. All of the subjects were Mandarin-Min bilinguals that were ethnically Min, but the Taipei speakers could not speak Min fluently.

### 3.2. Stimuli

Twenty-seven Tone 1 (T1) syllables representative of Mandarin phonotactics were chosen as stimuli, including 6 voiceless obstruent-initials (e.g., *han*<sup>1</sup> [xan] ‘charmingly naive’), 15 sonorant-initials (e.g., *la*<sup>1</sup> [la] ‘pull’), and 6 vowel-

initials (e.g., *wu*<sup>1</sup> [u] ‘black’). T1 syllables were chosen because they contain only high tonal targets and thus potential register and declination differences could be most clearly observed without being clouded by the presence of low tones. The relatively high pitch also guarantees modal voice and thus successful pitch extraction. Syllables were placed in three comparable carrier sentences, so that they occurred in sentence-initial, -medial, and -final positions (Table 1). Carrier sentences were designed so that syllables immediately before the target in medial and final positions ended mid, which would also be the starting point for the initial position according to the PENTA model [15]. In total, 27 (stimuli) × 3 (positions) = 81 sentences were recorded.

Table 1: Carrier sentences used in this study.

	Carrier Sentence
Initial	‘X’ <i>zhe</i> <sup>4</sup> <i>ge</i> <sup>0</sup> <i>zi</i> <sup>4</sup> <i>hen</i> <sup>3</sup> <i>nan</i> <sup>2</sup> <i>nian</i> <sup>4</sup> . ‘X’ this word is very hard to read.
Medial	<i>zhe</i> <sup>4</sup> <i>ge</i> <sup>0</sup> ‘X’ <i>zi</i> <sup>4</sup> <i>hen</i> <sup>3</sup> <i>nan</i> <sup>2</sup> <i>nian</i> <sup>4</sup> This word ‘X’ is very hard to read.
Final	<i>zhe</i> <sup>4</sup> <i>ge</i> <sup>0</sup> <i>zi</i> <sup>4</sup> <i>shi</i> <sup>4</sup> <i>nian</i> <sup>4</sup> ‘X’ This syllable indeed reads ‘X’

### 3.3. Equipment

Recordings were done using a SONY PCM-M1 Digital Audio Recorder with Maxell R-64 DA 60 min DAT tapes and a SHURE SM10A head-mounted microphone.

### 3.4. Procedure

The experiment was conducted in a quiet room. Speakers were asked to read aloud the semi-randomized stimuli using natural intonation at a normal rate. The whole process took about 15 minutes. The original recordings had a sampling rate of 48 kHz, which were subsequently downsampled to 16 bit 22050 kHz using Adobe Audition 1.5.

### 3.5. Analyses

The recordings were hand-labeled using Praat 4.6 [1]. A Praat script was written for automatic pitch extraction on the voiced portion of the syllable, which is considered the measurable domain for tones [2, 3, 13, 14]. For obstruent-initial syllables, the starting point of a tone was determined by the onset of the voice bar after the obstruent, which was voiceless in this study. For the rest, the starting point began from the onset of the syllable, as the whole syllable was voiced. The ending point was always the offset of the voice bar. Occasional syllable-initial or -final glottalized portions caused by voice fry were not included for pitch extraction. Extracted pitch tracks were later hand-checked and hand-corrected for doubling and halving through pitch period calculation, and were interpolated and smoothed using Praat functions afterwards. A second Praat script was written to extract  $F_0$  maximum for the target stimuli and the syllable *zhe*<sup>4</sup> ‘this’, which, being a high-falling tone, acted as a reference point for the sentence.

## 4. Results

Subjects were asked to rate their Mandarin and Min fluency on a scale of 1 to 7. Since Mandarin was their native and most frequently used language, Min fluency was measured by

dividing Min fluency scores by Mandarin fluency scores. As shown in Figure 1, Taipei speakers in general had lower degrees of Min fluency than Taichung speakers, with female speakers being even less fluent than males. On the other hand, not much gender difference was found in Taichung speakers. Both males and females were fairly fluent in both languages.

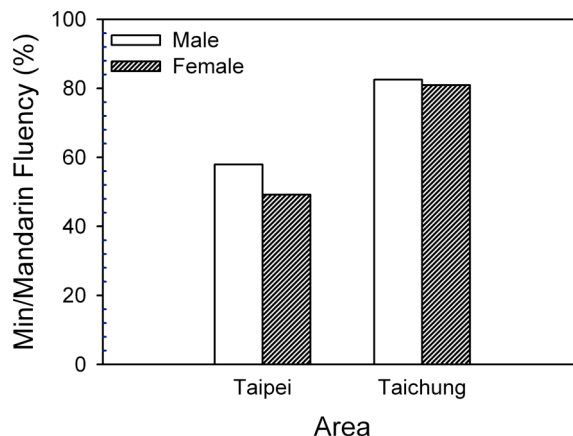


Figure 1: A bar graph of self-rated Min fluency relative to subjects’ Mandarin fluency

### 4.1. $F_0$ maximum of *zhe*<sup>4</sup> and the target syllable

Figure 2 shows scatter plots of the  $F_0$  maximum of *zhe*<sup>4</sup> and the target syllables for the two dialects in sentence-initial, -medial, and -final positions. The cluster in the upper right corner in each graph represents female data and the cluster in the lower left corner represents male data. As can be seen from the figure, Taichung male speakers used lower  $F_0$  maximum than Taipei speakers for both *zhe*<sup>4</sup> and target syllables, indicating an overall lowering in the tonal register. On the other hand, for female speakers, the distinction was not as clear. The overall pitch range for *zhe*<sup>4</sup> was fairly similar for the two dialect groups, with Taichung speakers being even slightly higher than Taipei ones. This was especially prominent in sentence-medial positions. However, for target syllables, Taipei speakers were still higher in pitch than those of Taichung.

A Gender (2) × Dialect (2) × Position (3) × Syllable (*zhe*<sup>4</sup> vs. target) four-way mixed ANOVA was performed to confirm the above observations. The between-factors were Gender and Dialect. Results showed that all of the main effects were significant [Gender:  $F(1, 318) = 18.94, p < .0001, \eta^2 = .96$ ; Dialect:  $F(1, 318) = 18.68, p < .0001, \eta^2 = .06$ ; Position:  $F(2, 636) = 172.60, p < .0001, \eta^2 = .35$ ; Syllable:  $F(1, 318) = 1498.8, p < .0001, \eta^2 = .83$ ]. Five of the two-way interactions were also significant [Position × Gender:  $F(2, 636) = 9.61, p < .0001, \eta^2 = .03$ ; Position × Dialect:  $F(2, 636) = 4.79, p < .01, \eta^2 = .02$ ; Syllable × Gender:  $F(1, 318) = 348.59, p < .0001, \eta^2 = .52$ ; Syllable × Dialect:  $F(1, 318) = 33.72, p < .0001, \eta^2 = .10$ ; Position × Syllable:  $F(1.97, 624.89) = 665.60, p < .0001, \eta^2 = .68$ ]. In addition, all of the three-way interactions involving Syllable were significant [Syllable × Gender × Dialect:  $F(1, 318) = 68.42, p < .0001, \eta^2 = .18$ ; Syllable × Gender × Position:  $F(1.97, 624.89) = 128.69, p < .0001, \eta^2 = .29$ ; Syllable × Dialect × Position:  $F(1.97, 624.89) = 15.45, p < .0001, \eta^2 = .05$ ]. Finally, the four-way

interaction was also significant [ $F(1.97, 624.89) = 29.90, p < .0001, \hat{\eta}^2 = .09$ ].

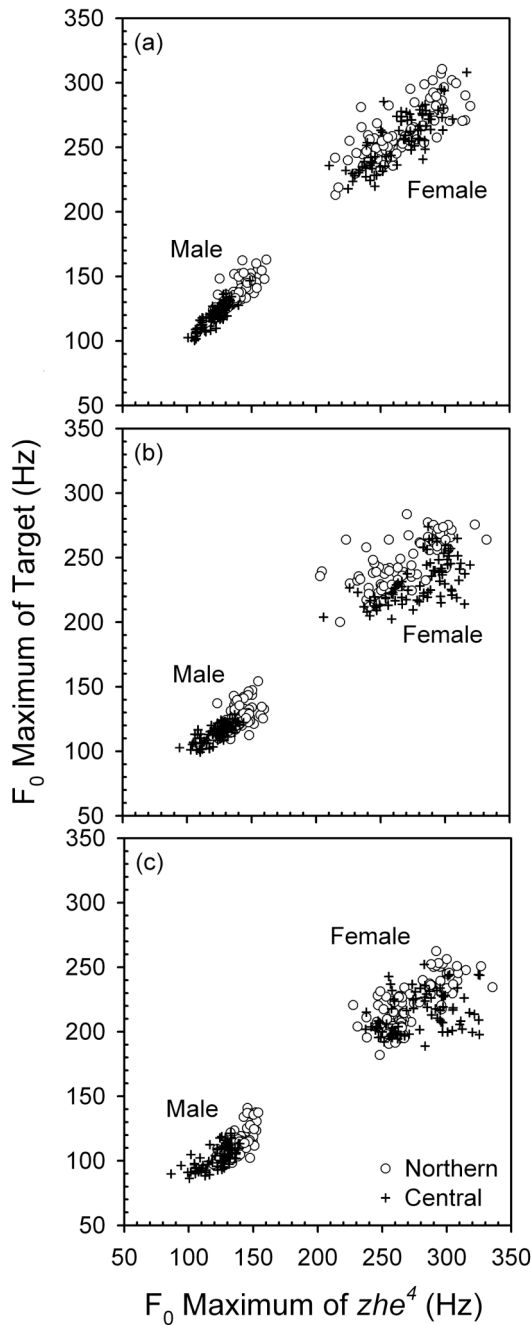


Figure 2: Scatter plots of  $F_0$  maxima of  $zhe^4$  and target syllables in sentence (a) -initial, (b) -medial, and (c) -final positions.

Post hoc independent *t*-tests regarding the Dialect effect indicated that the  $F_0$  maximum of Taipei male speakers was significantly higher than their Taichung counterparts across both syllable types and sentential positions ( $p < .0001$ ). However, this was not the case for female speakers. In the initial position, there was no difference between Taipei and Taichung speakers in  $zhe^4$  or the target syllables. In the medial

and final positions, target syllables of Taipei speakers were significantly higher than those of Taichung (Medial:  $p < .0001$ ; Final:  $p < .05$ ), while for  $zhe^4$ , Taichung speakers were in turn higher than Taipei speakers (Medial:  $p < .0001$ ; Final:  $p < .05$ ).

#### 4.2. Topline declination

Figure 3 shows the topline declination pattern of male and female speakers in the two dialect groups. For male speakers, the declination trend was steeper in the Northern dialect in sentence-medial and -final positions. Female speakers demonstrated an exactly opposite trend, with the Central dialect showing a steeper topline than the Northern variety, especially in sentence-medial positions.

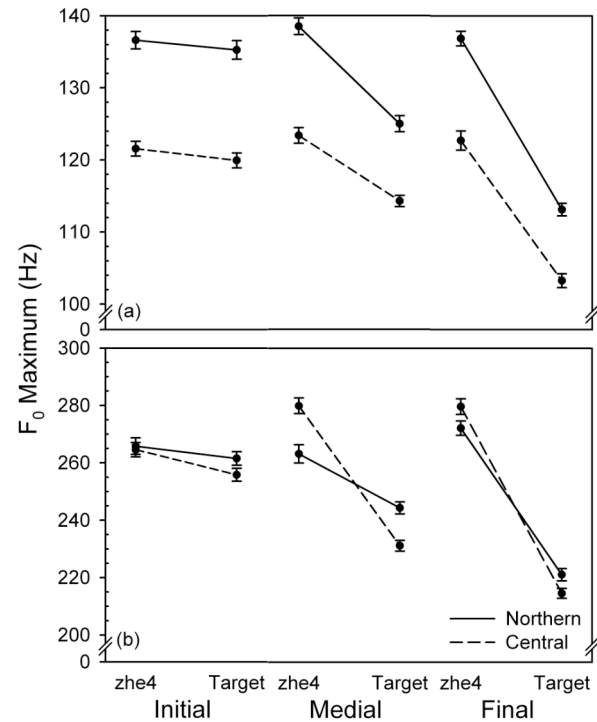


Figure 3: Mean  $F_0$  maxima of  $zhe^4$  and target syllables of (a) male and (b) female speakers.

In order to confirm what was observed above, a Gender (2)  $\times$  Dialect (2)  $\times$  Position (3) three-way mixed ANOVA was conducted on degree of declination, defined by  $F_0$  maximum difference between the reference  $zhe^4$  and the target syllable. Results showed that all of the main effects were significant [Gender:  $F(1, 318) = 348.91, p < .0001, \hat{\eta}^2 = .52$ ; Dialect:  $F(1, 318) = 33.59, p < .0001, \hat{\eta}^2 = .10$ ; Position:  $F(1.97, 625.11) = 665.13, p < .0001, \hat{\eta}^2 = .68$ ]. All of the two-way interactions were also significant [Position  $\times$  Gender:  $F(1.97, 625.11) = 128.56, p < .0001, \hat{\eta}^2 = .29$ ; Position  $\times$  Dialect:  $F(1.97, 625.11) = 15.52, p < .0001, \hat{\eta}^2 = .05$ ; Gender  $\times$  Dialect:  $F(1, 318) = 68.61, p < .0001, \hat{\eta}^2 = .18$ ]. The three-way interaction was significant as well [ $F(1.97, 625.11) = 19.92, p < .0001, \hat{\eta}^2 = .09$ ].

Post hoc independent *t*-tests regarding the Dialect effect showed that  $F_0$  drop was much larger in Taipei male speakers than those of Taichung in medial and final positions, the difference being greater in the latter than the former position (Medial:  $p < .0001$ ; Final:  $p = .001$ ). For female speakers, the

difference was also significant in medial and final positions ( $p < .0001$ ), but the trend was the opposite of male speakers. Taichung females tended to have a larger  $F_0$  drop than Taipei females, with the difference being greater in the sentence-medial than the final position. In the initial position, however, both genders show no dialectal differences.

## 5. Discussion

Results in this study showed that variation did exist between the two dialects of Taiwan Mandarin for T1. In general, the Central dialect tended to have a lower tonal register than the Northern dialect. This is consistent with our predictions. Since Taichung speakers were more fluent in Min, their Mandarin tonal register would more likely be influenced and become lower in pitch. However, such an effect was more prominent in male than in female speakers. In female speakers, only sentence-medial and -final positions showed such an effect, while in male speakers, all three positions showed the same trend. The gender differences could not have been due to differential levels of Min proficiency, as speakers from the Central dialect had approximately the same level of Min fluency, regardless of gender. In other words, what was underlying the difference between male and female speakers was more likely to be a pure gender issue. Female speakers were more sensitive to the differences between standard and nonstandard forms and were more likely to conform themselves to the social norm. As a consequence, they were less inclined to show obvious regional traits.

With regard to the declination pattern, dialectal differences were also found. For both genders, only sentence-medial and -final positions showed reliable differences. However, the direction of the effect was exactly opposite for the two genders. Male Taichung speakers had a milder declination topline than their Taipei counterparts, while female Taichung speakers had a steeper declination topline instead. The pattern of male speakers was in line with our predictions. Since tonal register was lower in the Taichung dialect, and since higher tonal ranges were more elastic than lower ones [11], the declination range would naturally be more restricted and thus the slope of the topline would be shallower. However, in female speakers, the Central dialect showed steeper slopes than the Northern dialect. If this reverse pattern could also be attributed to differential gender sensitivity to the linguistic norm, then female Taichung speakers were actually counteracting regional characteristics by over-correction. Interestingly, this was done not by raising the overall pitch range of the sentence, using the same mechanism employed by their Taipei counterparts, but was instead achieved by only raising the initial starting point, that of  $zhe^4$ , demonstrating a partial-raising of the tonal range.

## 6. Conclusion

This study showed that dialectal differences existed in the tonal range and declination pattern of Taiwan Mandarin, with the nonstandard dialect demonstrating a phonetically lower high tone, and the declination slope shallower than the standard variety. It was assumed that such a difference could be attributed to differential influences from the substrate language Min. Fulfilling sociolinguistic predictions, female speakers showed a lesser degree of such dialectal differences and were more likely to counteract regional characteristics by over-corrections. In order to further confirm this trend, one plans to extend the scope of the study to include the Southern

dialect. If such dialectal differences were indeed due to influences from Min, then one should be able to see the same pattern in the Southern dialect, perhaps even more so, as Min is even more commonly used in the area.

## 7. References

- [1] Boersma, P.; Weenink, D., 2007. Praat: doing phonetics by computer (Version 4.6.02) [Computer Program]. <<http://www.praat.org/>>
- [2] Chao, Y. R., 1956. Tone, intonation, singsong, chanting, recitative, tonal composition, and atonal composition in Chinese. In *For Roman Jakobson* M. Halle, (ed.). The Hague: Mouton, 52-59.
- [3] Chao, Y. R., 1968. *A Grammar of Spoken Chinese*. University of California Press: Berkeley.
- [4] Chen, S. H., 2005. The effects of tones on speaking frequency and intensity ranges in Mandarin and Min dialects. *Journal of the Acoustical Society of America* 117(5), 3225-3230.
- [5] Chen, Y.-D., 1989. *Taiwan de Kejiaren [Hakka on Taiwan]*. Taiyuan Press: Taipei.
- [6] Cheng, R. L., 1985. A comparison of Taiwanese, Taiwan Mandarin, and Peking Mandarin. *Language* 61(2), 352-377.
- [7] Fon, J.; Chiang, W.-Y., 1999. What does Chao have to say about tones? -A case study of Taiwan Mandarin. *Journal of Chinese Linguistics* 27(1), 15-37.
- [8] Fon, J.; Chiang, W.-Y.; Cheung, H., 2004. Production and perception of two dipping tones (T2 and T3) in Taiwan Mandarin. *Journal of Chinese Linguistics* 32(2), 249-280.
- [9] Hsu, S.-y., 2006. *The tonal variation of Mandarin Tone 2 in Taiwan: A phonetic study on Taiwanese-Taiwan Mandarin bilinguals and Taiwan Mandarin monolinguals*. National Chengchi University.
- [10] Huang, S., 1993. *Yuyan, shehui yu zuqun yishi--Taiwan yuyan shehuixue de yanjiu [Language, society, and ethnic identity--Studies in language sociology in Taiwan]*. Crane: Taipei.
- [11] Ladd, D. R., 1988. Declination 'reset' and the hierarchical organization of utterances. *The Journal of the Acoustical Society of America* 84(2), 530-544.
- [12] Trudgill, P., 2000. *Sociolinguistics: an introduction to language and society*. Penguin Books: New York.
- [13] Wang, W., S-Y., 1967. Phonological features of tone. *International Journal of American Linguistics* 33(2), 93-105.
- [14] Xu, Y., 1998. Consistency of tone-syllable alignment across different syllable structures and speaking rates. *Phonetica: International Journal of Speech Science* 55(4), 179-203.
- [15] Xu, Y., 2005. Speech melody as articulatorily implemented communicative functions. *Speech Communication* 46(3-4), 220-251.