INVESTIGATING THE EFFECT OF MIN ON DIALECTAL VARIATIONS OF MANDARIN TONAL REALIZATION

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ABSTRACT

This paper investigated the effect of Min on dialectal variations of Mandarin tonal realization. Experiment 1 recruited 12 females, 7 from China and 5 from Taiwan. Results showed that tones in Taiwan had lower pitch register than those in China. Experiment 2 tested 20 subjects, half from Taipei and half from Taichung. Results showed that Taichung had lower pitch register than Taipei. It is surmised that Min plays a major role in forming these dialectal variants.

Keywords: Mandarin tones, Taiwan Mandarin, Mainland Mandarin, dialectal variation

1. INTRODUCTION

Mandarin is the official language of China and Taiwan. Owing to political separation for more than sixty years, the two variants have become linguistically distinct [5]. As more than 80% of the population in Taiwan speak at least some Southern Min natively [13], while only 4% of those in China do , many assume that Southern Min (Min hereafter) is the main source causing the variations. However, experimentally controlled studies have been scarce, and such a premise has thus not been scientifically examined. This study thus plans to investigate whether Min could account for the phonetic variations between Mandarin in Taiwan and China.

Mandarin and Min are both tonal languages. Mandarin has four lexical tones, high-level (Tone 1), mid-rising (Tone 2), mid-dipping/-falling (Tone 3), and high-falling (Tone 4) [3, 12], while Min has five long tones, high-level (Tone 1), high-falling (Tone 2), low-falling (Tone 3), mid-dipping (Tone 5), and mid-level (Tone 7). Although the two share several tonal categories, tones in Min have lower tonal register than those in Mandarin [4]. Fon, et al. [6] also found that tones in Taiwan Mandarin have lower pitch register and narrower pitch range.

Though Taiwan is predominantly a Mandarin-Min bilingual society, the bilingual status is imbalanced across regions. More non-Min speakers are found In Taipei, the northern metropolis of Taiwan, than other areas of Taiwan [13]. Also, non-Taipei residents speak Min more frequently than people in Taipei [1]. Thus, if Min indeed influences Mandarin tonal realization, then dialectal variations should be found both between Taiwan and China (Experiment 1), and within different regions in Taiwan (Experiment 2). Specifically, we predict that tones in Taiwan should be lower in register than those in China, and tones in central Taiwan (Taichung) should be lower than those in northern Taiwan (Taipei) due to influence of Min.

2. METHODS

2.1. Participants

Experiment 1 recruited 12 females, aged from 19 to 24. Seven were from Beijing, China and five were from Taipei, Taiwan. All subjects spoke Mandarin as their L1. The Taipei speakers were ethnically Min but their Min proficiency varied. Experiment 2 recruited 20 native speakers of Taiwan Mandarin, balanced in gender. They aged from 19 to 24, half were from Taipei and half were from Taichung. All were Mandarin-Min bilinguals but Taichung subjects generally spoke Min more fluently.

2.2. Stimuli

Stimuli included 27 (near-)minimal quadruplets and 3 (near-)minimal triplets of mono-syllabic words that only differed in tones. Three Tone 1 syllables were not possible due to accidental gaps. The 117 syllables covered all possible phonotactic structures in Mandarin, and were used for both Experiments 1 and 2.

2.3. Equipment

Stimuli were recorded by a SONY PCM-M1 Digital Audio Recorder with Maxwell R-64 60 min DAT tapes and a SHURE SM10A head-mounted microphone.

2.4. Procedure

The recording was conducted in a quiet room. Subjects were presented with stimulus written in Chinese characters printed on index cards. They were asked to read aloud the stimuli as natural as possible at a normal speaking rate. The total process took about 10 minutes. The original sounds were recorded with the sampling rate of 48 kHz and were later down-sampled to 22,050 Hz using Adobe Audition 1.5.

2.5. Measurements

The sound files were sliced and the voiced portion of the syllable measurable domain of tones [3] were hand-labeled using Praat 4.0 [2].

A Praat script was written for pitch extraction, which was then checked and corrected manually to avoid pitch doubling or halving. A second script was written to extract ten pitch points of equal time intervals between the onset and the offset of the voiced portion. A third script was written to extract the reference points for the stimuli of each tone. For Tone 1, the F_0 maximum of each syllable was extracted. For dipping tones such as Tone 2 and Tone 3, the initial F_0 maximum, the medial F_0 minimum, and the final F_0 maximum were extracted as reference points. For tonal contours which were realized as falling shapes, such as Tone 4 and partial Tone 3, the initial F_0 maximum and the final F_0 minimum were measured.

3. RESULTS

3.1. Experiment 1

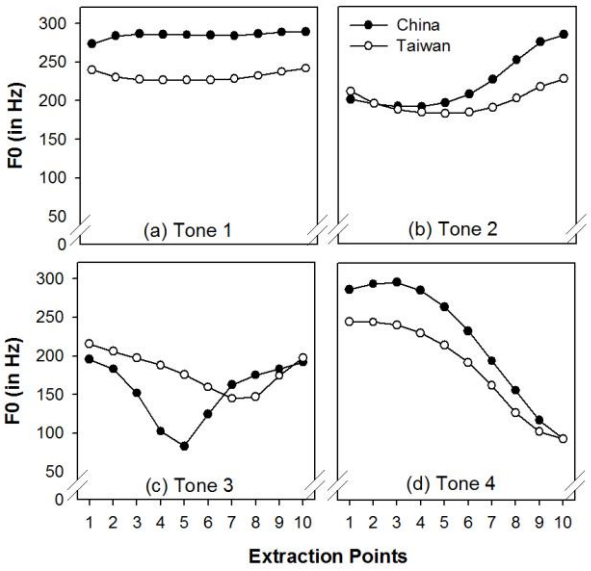
Figure 1 shows the time-normalized pitch contour at 10 equal-interval points for the four Mandarin tones in Experiment 1.

For Tone 1, a planned independent *t*-test was conducted to see whether the F_0 maximum of Tone 1 was different between dialectal groups. Results showed that the F_0 maximum of Tone 1 in Taiwan Mandarin was significantly lower than that in the China group [$t(295.40) = -14.18$, $p < .001$].

For Tone 2, planned analyses were performed by examining the F_0 at the three reference points. Independent *t*-tests showed that the F_0 of the Tone 2 for Taiwan Mandarin was significantly lower relative to the China variant at the medial lowest point and the final highest point, while the trend was in the opposite way for the initial F_0 maximum [initial: $t(333.87) = 2.75$, $p < .01$; medial: $t(280.75) = -4.15$, $p < .001$; final: $t(286.76) = -19.38$, $p < .001$].

Since there are two ways of realizing Mandarin Tone 3 in Taiwan but the China variant has merely the dipping contour [7, 10], only tokens that were realized as dipping were further analyzed to make comparisons. For Tone 3 realized as dipping contours, independent *t*-tests were conducted on the three reference points to examine the existence of dialectal differences. Results showed that F_0 of the initial F_0 maximum and the medial F_0 minimum of the Taiwan variant were significantly higher than that of the China variant [initial: $t(297.7) = 8.39$, $p < .001$; medial: $t(165.51) = 12.04$, $p < .001$]. No significant dialectal difference was found for the final F_0 maximum.

Figure 1: Time-normalized F_0 contours of four tones in Mandarin in Taiwan and China.

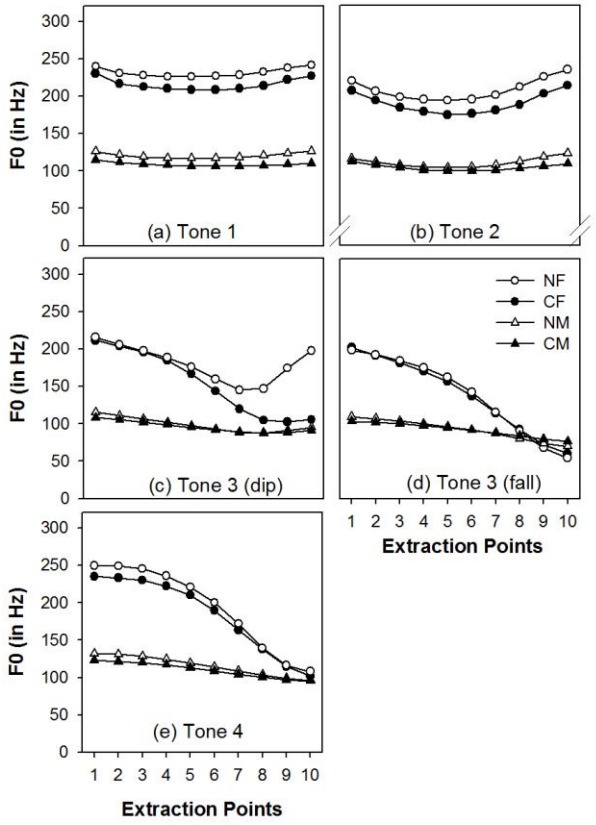


For Tone 4, independent *t*-tests were carried out on the two reference points, the initial F_0 maximum and the final F_0 minimum, to see if there was any dialectal effect. Results showed that the initial F_0 maximum of the Taiwan variant was significantly lower than that of the China variant [$t(337.71) = -14.27$, $p < .001$]. For the final F_0 minimum, dialect effects were not significant.

3.2. Experiment 2

Figure 2 shows the tonal contour for the tones in Mandarin produced by speakers of the northern dialect (Taipei) and the central dialect (Taichung) in Taiwan.

Figure 2: Time-normalized F_0 contours of the four tones in Taiwan Mandarin produced by northern female (NF), northern male (NM), central female (CF), and central male (CM) speakers.



For Tone 1, independent *t*-tests were carried out on the F_0 maximum to see whether dialectal differences existed. For males, results showed that the central dialect significantly had lower F_0 maximum for Tone 1 relative to the northern dialect [$t(202.57) = 11.36$, $p < .0001$]. The effect was also significant for female speakers [$t(247.40) = 6.53$, $p < .0001$].

For Tone 2, independent *t*-tests were performed on three reference points. For males, results showed that the central dialect had lower pitch register across all three reference points compared to the northern dialect [initial: $t(272.25) = -3.27$, $p < .01$; medial: $t(233.65) = -6.25$, $p < .001$; final: $t(283) = -10.35$, $p < .001$]. For females, the trend was significant as well [initial: $t(295) = -6.15$, $p < .001$; medial: $t(181.56) = -8.44$, $p < .001$; final: $t(246.20) = -6.65$, $p < .001$].

The two types of realization for Tone 3, dipping and falling, were analyzed separately. For the dipping tokens, independent *t*-tests were implemented on the three reference points. Results of male speakers showed that for the initial point, the central dialect was significantly lower than the northern dialect [$t(171) = -4.27$, $p < .001$]. However, dialectal effects did not exist at the medial lowest and the final highest points. For females, results showed that the central dialect had significantly lower F_0 for all three reference points relative to the northern dialect [initial: $t(184.96) = -2.2$, $p < .05$; medial: $t(184.84) = -6.95$, $p < .001$; final: $t(188) = -9.95$, $p < .001$]. For falling Tone 3s, independent *t*-tests were conducted on the initial F_0 maximum and the final F_0 maximum. For male speakers, independent *t*-tests showed that the central dialect was significantly lower than the northern dialect at the initial F_0 maximum [$t(123) = -2.98$, $p < .01$]. For female speaker, no significant dialect effect was found.

For Tone 4, independent *t*-tests were carried out on the two reference points, the initial F_0 maximum and the final F_0 minimum. Results for male speakers showed that the central dialect was significantly lower than the northern dialect at initial F_0 maximum [$t(298) = -6.96$, $p < .001$]. For females, the central dialect had significantly lower F_0 for the initial F_0 maximum [$t(269.11) = -5.21$, $p < .001$]. No significant dialectal variation was found for the final lowest points of both gender groups.

4. DISCUSSION & CONCLUSION

In Experiment 1, we examined tones produced by Mandarin speakers of Taiwan and China to test the effect of Min. Results showed that tones in Taiwan Mandarin did have lower pitch register and narrower pitch range than the China counterpart. Since the greatest difference between the language backgrounds of the two speaker groups was that Taiwanese subjects spoke Min as a native language while subjects from China did not, it was plausible to infer that Min might play a role in the lowering effects of tonal register in Taiwan Mandarin [4, 6]. However, owing to the fact that Southern Min is also spoken in other regions, i.e., Fujian Province of China, one should find Min's lowering effects on Mandarin there as well. More acoustic data is required to affirm this hypothesis for future studies.

Results of Experiment 2 showed that central speakers of Taiwan Mandarin had lower pitch register than northern speakers, affirming our prediction that tonal realization was indeed influenced by the frequency of Min use and Min proficiency. However, it was uncertain that whether the tonal variation found here was caused

by dialectal variation per se or it was induced by speakers' differences on Min proficiency of the two target metropolis. If it was the former factor that played a role, tonal variations should be discovered from speakers coming from different dialectal areas but having similar level of Min proficiency. On the other hand, if it was the latter factor that resulted in tonal variation, one could predict that speakers from the same dialectal area but only differing in their Min proficiency demonstrated tonal variation. Either design would act as a good way to tease apart potential entangled factors. A previous study controlling for subjects' dialectal areas in Taipei showed that proficient Min speakers had lower pitch register in Mandarin compared to non-proficient Min speakers [11], affirming that Min proficiency at least played a role on tonal variation for speakers of the same Min dialect (Taipei) to some degree.

Another phenomenon worth noticing was that the direction of tonal variation was related to the target type in a tone. For high tonal targets, the China variant was higher in pitch register than Taiwan Mandarin. However, for low tonal targets, the pitch register of the China variant was lower relative to the Taiwan variant. Hence, Mandarin tones of the China variant presented the tonal characteristics of having higher H targets and lower L targets in F_0. Since most of previous studies focused on the tonal variation of Mandarin on high targets [8, 9], the current study shed light on how dialectal variations influenced the realization of low tonal targets by demonstrating that the tonal variations in Mandarin between China and Taiwan, realized by shifting pitch height, were not achieved monotonically. Specifically, Mandarin tones in the China variant were not wholly realized in the higher register compared to those in the Taiwan variant, but were instead dependent on the type of tonal targets, with high tonal targets being higher while low tonal targets being lower relative to the Taiwan variant.

The reason why there was lack of tonal variation on low targets between the two variants of Taiwan Mandarin might be due to human's physiological constraints on producing low tones. As tones in Taiwan Mandarin have already occupied the lower pitch register of one's voice compared to those in China, it would be difficult for central speakers to distinguish their dialects from the northern variant by using much lower register. Hence, within the two variants of Taiwan Mandarin, the lowering effects only occurred for high tonal targets but not for low tonal targets.

To sum up, it was found that Min played a part in the realization of tones in the three Mandarin variants, Beijing Mandarin, northern Taiwan Mandarin, and central Taiwan Mandarin. Our findings suggested that for speakers who were more proficient in Min and were exposed to Min more frequently, their tonal realization was more influenced by Min, reflected by lower register, narrower range, and less drastic tonal contour.

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