Perturbation effects in Chongming Chinese with and without focus

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Focus is a linguistic means used to highlight or emphasize part of an utterance [1]. Several phonetic cues have been reported in the realization of prosodic focus, including variations in f0 patterns, intensity, and duration. According to [2], voiceless consonants interrupt the first 40% of the target syllables, and the onset f0 of the vowels following the voiceless aspirated bilabial stop is lower than other consonants. [3] investigated the consonant-f0 interaction in Shanghai Chinese, where there is a three-way laryngeal contrast (voiced, voiceless aspirated and voiceless unaspirated), and speakers voluntarily exaggerated the contrasts among three types of consonants, which the author attributed to both phonological contrasts and phonetic consequence on f0 perturbation.

Chongming Chinese is a northern Wu dialect, with eight contrasting tones as shown in Table 1. Although Chongming Chinese is reported to have a three-way contrast among onset obstruents (voiceless aspirated, voiceless unaspirated and voiced), tonal contrasts only exist for voicing distinction but not for aspiration distinction [4,5]. According to [6,7], Chongming Chinese showed post-focus compression in certain tones, but the perturbation effects under focus remain to be investigated. The current study aims to investigate the phonetic perturbation effects induced by different types of onset consonants under no-focus, on-focus and post-focus conditions.

Because the vowel [æ] bears the largest range of tones for different onsets in Chongming Chinese, twelve monosyllabic words, all in combination of different stop onsets and the vowel [æ], were selected as the target words. The target words were then embedded in the same sentence structure under three focus conditions: no focus, on-focus and post-focus. Different preceding and following syllables were also manipulated, so under each focus condition, the target word appeared in four sentences. There were 1,728 sentences in total (12 target monosyllables (8 tones) * 3focus conditions * 12 speakers * 4 sentences). The vowel portions of the recordings were first segmented, and f0 values were extracted at 20 normalized time points using the ProsodyPro Praat script [8]. After normalizing f0 values, we applied functional data analysis [5] to model f0 contours and compare pairs of contours, such as contours of the voiceless aspirated syllable versus the voiceless unaspirated syllable under the post-focus condition.

We listed differences found in f0 contours across tones after three contrasts of consonant onsets (i.e., voiceless unaspirated, voiceless aspirated, and voiced) under no focus, on-focus and post-focus conditions. In order to determine whether f0 contours after two different pairs of consonantal onsets are different, we performed functional t-test on each pair (i.e., voiceless unaspirated ([tæ]) vs. voiceless aspirated ([tʰæ]), voiceless unaspirated ([tæ]) vs. voiced ([dæ]), and voiceless aspirated ([tʰæ]) vs. voiced ([dæ])). According to the comparison, native speakers of Chongming Chinese showed significant perturbation effects after three contrasts of consonant onsets in the no-focus condition. However, under focus and post-focus conditions, there were less consonant perturbation effects. We also explored whether this perturbation effect can differ under on-focus and post-focus conditions. The results of this analysis revealed that perturbation effect in Chongming significantly changed, regardless of tones or consonant types in these conditions.

Our findings were contrary to the findings of Shanghai Chinese reported by [3]. The phonetic consonant perturbation effects of Chongming Chinese are suppressed under the on-focus condition for all tones. In the post-focus position, more consonant perturbation effects were found only for T5, while less effects were observed in other tones. The results indicate that speakers can voluntarily control articulatory settings not only to enhance the contrasts, but also to suppress them if f0 was used to indicate focus at the same time. It remains to be investigated whether speakers adjusted the weight of acoustic cues under focus. They may have enhanced a different acoustic cue, such as voice onset time, to signal the consonant contrasts under focus and

suppressed the use of f0, since f0 curves were changed to indicate where the focus lay in. Also, due to post-focus compression, it is likely that consonant perturbation effects were compressed in Chongming Chinese.

Middle Chinese categories		**Ping (Level) Even**	**Shang (Rising) Oblique**	**Qu (Departing) Oblique**	**Ru (Entering) Even**
Chongming allotones	High register	1 (53) H	3 (435(424)) HMH	5 (33) M	7 (55(5)short) Hʔ
	Low register	2 (24) LM	4 (241(242) LML	6 (213(313)) MLM	8 (23(2)short) Lʔ

Table 1. Eight tones in Chongming dialect (H, M, L representations)

Comparison	**No Focus**		**Focus**		**Post-focus**	
	Difference	Significant proportion	Difference	Significant proportion	Difference	Significant proportion
ta1 vs tha1	different	36-70%	Not different	N/A	Not different	N/A
ta3 vs tha3	different	1-22%	different	1-15%	different	1-20%
ta5 vs tha5	different	1-14%	different	1-8%	different	1-24%
ta7 vs tha7	Not different	N/A	Not different	N/A	Not different	N/A

Table2. Results of contour comparisons in the focus condition

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