

Production and Perception of Merging Tones in Dalian Mandarin

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The topic of sound change has captivated researchers in various subfields of linguistics, including phonetics, phonology, and sociolinguistics, due to their interest in understanding the forces driving the process (Hay et al, 2006; Yu, 2007). The current study focuses on a specific aspect of sound change: tone merger, particularly in its initial stages. In these early stages of tone merger, it is common for speakers to consistently differentiate the merging tones in their speech production, but struggle to distinguish them in perception (Mok and Wong, 2010; Yiu, 2009), or alternatively, to have trouble differentiating the merging tones in production but not in perception (Yiu, 2009).

Recently, there have been proposals of a merger between two falling tones in Dalian Mandarin (Gao, 2007; Liu, 2012). However, there is disagreement over which acoustic features remain distinct in the merging tones and the status of the merger, whether it is ongoing or complete. Previous research on Dalian has not documented the acoustic properties of the production stimuli, leaving the perception cues and the connection between production and perception unknown (Song, 1963). According to a study by Liu (2012), the key distinction between the two merging tones is their length. The research posits that they are perceived as completely merged. However, the study has limitations in its methods, as only a 34-year-old female Dalianese who left the city when she was 23 was used as both the speaker and the listener. This might have impacted her determination of a complete merger. Moreover, other factors, such as word frequency, age and gender of speakers, which may also have an effect on the merging process, has not been investigated. The present study intends to investigate the production and perception of the merging tones and the effects of word frequency, age and gender of speakers in the process.

A production experiment and a perception experiment (a forced-choice character identification test) were carried out with 11 speakers. The results revealed that, in terms of production, the final f_0 and contour shape had a significant impact. Tone4 was found to have a high final f_0 and a concave shape, while Tone1 had a low final f_0 and a convex shape. Additionally, word frequency was found to have a significant effect on production. As for duration, the differences between Tone1 and Tone4 were smaller for high frequency words than for low frequency words when it came to final f_0 and concave. Age and gender were also found to have significant effects, with young and female speakers producing less distinct Tone1 and Tone4 tokens compared to older and male speakers.

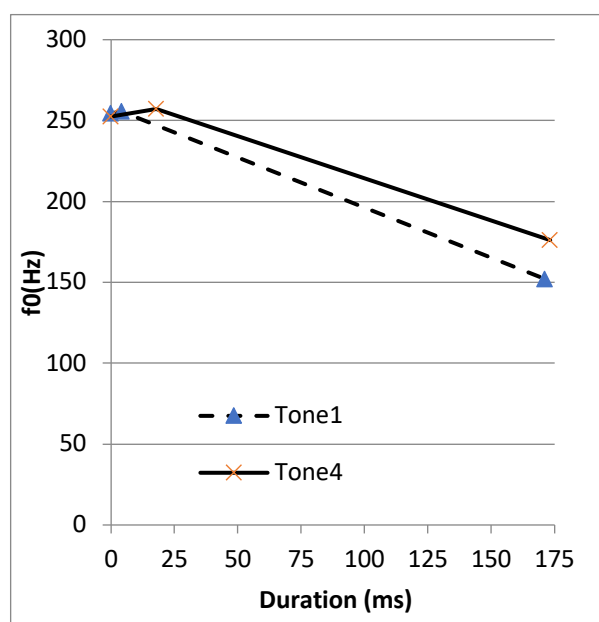
In perception, the accuracy rate across both tones was found to be 77%, which suggests that this is not a complete merger as claimed by Liu (2012). The final f_0 and contour shape acoustic cues identified in the production experiment were the cues used by listeners in perception, as revealed by the generalized linear mixed effect model. Listeners were found to be more accurate when listening to speakers whose production of Tone1 and Tone4 was more distinct, as opposed to those with highly overlapping productions in the two-dimensional space of final f_0 and contour shape. Word frequency was also found to have a significant impact, with listeners perceiving high frequency words more accurately than low frequency words. This may be due to the speaker selection, a different type of frequency such as syllable and tone combination frequency, or the effect of lexical access, which may override the weakness of acoustic cues in high frequency words. There were also variations between speakers and listeners. Some speakers had highly overlapping productions of Tone1 and Tone4, while some listeners had near chance accuracy regardless of the speaker, which indicates that this is a merger in progress.

In sum, the falling tones merger in Dalian is still a work in progress. Final f_0 and contour shape are the cues utilized by both speakers and listeners, and factors such as word frequency, as well as the age and gender of the speakers, have an impact on both production and perception.

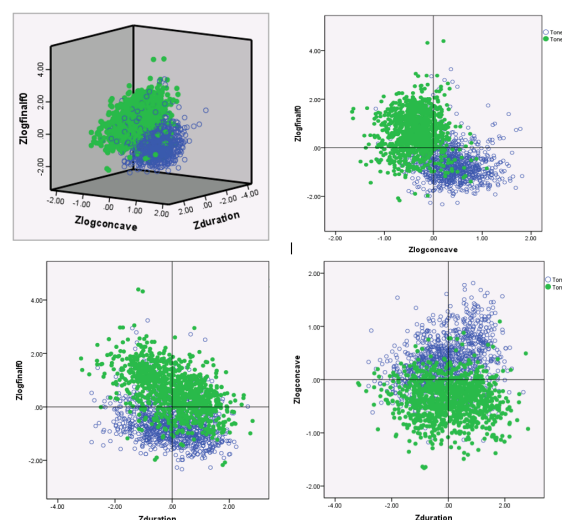
(1) Test material in production and perception experiment

Word frequency group	Word	IPA transcription	Tone	Word frequency ranking	Character frequency ranking	Gloss
High frequency	班	pæn	1	961	884	class
	办	pæn	4	261	367	to handle
	边	pjæn	1	441	316	edge
	变	pjæn	4	264	225	to change
Low frequency	蹉	tshuə	1	NA	5828	error/slip
	锉	tshuə	4	28352	4866	tool for shaping metal
	裆	taŋ	1	19694	4099	crotch of a pair of trousers
	宕	taŋ	4	NA	4231	dissipated

(2) Tone contour for Tone1 and Tone4 pooled across 11 speakers in f0 scale



(3) Zlogconcave and Zduration. (for all plots, blue empty circles= Tone1, green solid circles= Tone4)



References

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