The Mechanism of Rising Tone Merger in Hong Kong Cantonese: An Acoustic Approach

Roxana S.Y. Fung[1], Cathy S.P. Wong[1] and S.P. Law[2]
[1]Hong Kong Polytechnic University, [2]University of Hong Kong
ctsyfung@polyu.edu.hk, egcathyw@polyu.edu.hk, splaw@hkucc.hku.hk

Hong Kong Cantonese (HKC) stands out from other tone languages in the world by having a rich system of tonal contrast. There are six contrastive tones in standard HKC, namely high level, high rising, mid level, extra-low level, low rising and low level tone. However, this highly complex system is in the process of merging (e.g. Bauer, Cheung and Cheung 2003; Mok and Wong 2010a, 2010b). In a production and perception study on contemporary HKC tones conducted by the first and second authors, it is confirmed that the two rising tones, high rising (HR)[35] and low rising (LR)[23], are merged in a sub-community of HKC speakers. What remains unclear is the mechanism of the merger. Are the HR tone words transferred to the LR tone or vice versa? What are the acoustic differences of the rising tones produced by the mergers as compared with those by the non-mergers? This paper takes on the above questions by examining the acoustic properties of the two rising tones produced by the mergers as well as the non-mergers of two different age groups.

The data of this paper were based on the speech samples produced by 12 subjects of two different age groups collected in the previous study. The younger group comprised six speakers who have a mean age of 22.3. The elder group comprised six speakers who have a mean age of 53.17. In each group, half of the members (two female and one male) were mergers who scored less than 70% correct in the production of either one of the two rising tones; the other half (also two female and one male) were non-mergers who scored 100% correct in the production of all six contrastive tones in HKC. The speech samples were generated by embedding 12 different CV syllables (6 HR tones and 6 LR tones) into two sentence carriers. In total, 288 sentences (12 CV syllables x 2 sentence carriers x 12 subjects) were read out by the subject. The speech samples were recorded and the fundamental frequency (F0) values of the target syllables were measured using Praat.

The F0 of each target CV syllable was exacted at ten equal distant points using a Praat script. The initial position of the vocalic segment was set at the first upward-going zero-crossing of the voicing cycle. The final position was set to the maximum point of the rising trajectories near the final vocalic portion. The F0 values excluding the one at the onset point were normalized using the T-value formula. (eg. Rose, 1987; Shi 1986). The acoustic properties of the produced tones were then compared by the following three predictors: the difference of average F0 (difference between the mean F0 value of the HR and that of the LR), the offset F0 (the F0 value at the offset point), and the slope of F0-rise (the regression coefficient of the F0 values generated by SPSS).

Table 1 shows the average F0 values of the three predictors across speakers. As shown in the table, the two rising tones produced by the two age groups are highly similar among the non-mergers but not the mergers. Among the elder mergers, the HR tone was well

preserved. But the offset F0 value and the slope of the LR increased significantly. These phenomena suggest that the LR is merged into the HR. However, a different merging mechanism among the younger mergers is revealed. In their production, the difference of average F0 value between two tones decreased greatly. The offset F0 of LR was raised. The slope of HR increased sharply whereas the slope of LR decreased sharply. These phenomena suggest that both HR and LR have undergone changes and the two tones approximate each other. In short, the merger-by-transfer is adopted by the elder generation but the merger-by-approximation by the younger generation.

Table 1. The mean values of the predictors of the two rising tones across speakers.

Predicators / Speakers		Difference of average F0 (T-value)	Offset F0 (T-value)		Slope of F0-rise (T-value/s)	
			HR	LR	HR	LR
Non-mergers	Elder Group	0.548	4.008	2.183	0.344	0.104
	Younger Group	0.529	4.216	2.484	0.305	0.095
	Total	0.539	4.110	2.333	0.325	0.099
Mergers	Elder Group	0.471	3.830	2.701	0.340	0.194
	Younger Group	0.106	4.141	3.877	0.185	0.148
	Total	0.286	3.984	3.273	0.261	0.169

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