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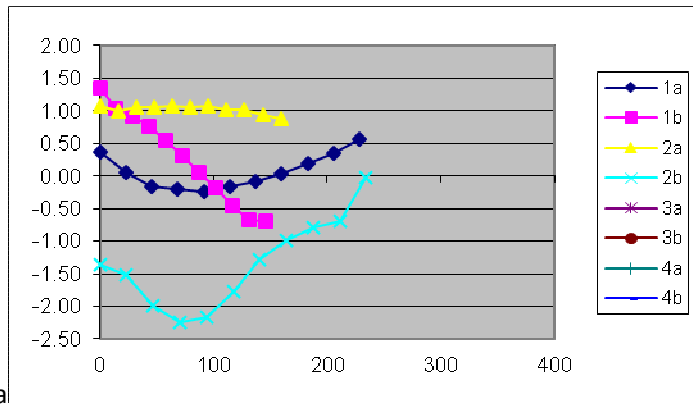
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### Phonological tone types of Southwest Mandarin

Previous studies on the cross-dialect comparison of tones are mostly based on the perceptual description, which is described in a five-degree pitch contour model. This paper examines tone types of Southwest Mandarin around Sichuan and Chongqing area in the Multi-Register and Four-Level tonal model with four parameters: register, length, pitch height and contour. This paper is based on the log Z-score normalized mean F0 of 32 dialects. Analysis of the tone types illustrates that there are four tonal categories (2 rising/dipping, and 2 falling) in most of the locations. Only a few locations have five tonal categories, in which the enter tone is different from the others. The two falling tones can be distinguished by feature [+/-high], e.g. /52/ and /32/, or by both [+/-high] and [+/-straight], e.g. /553/ and /32/, or only by the contour feature [+/-straight], e.g. /342/ and /32/. The last case is a puzzle because feature [+/-straight] usually does not distinguish tones alone. Zhu (2012) considered that one of the falling tones, e.g. /32/ as pure low tone (PLT), then it is a variant of /22/. However, this phonological treatment cannot be applied in Shiquan dialect. In Shiquan, there is a low dipping tone /324/, a high dipping tone /434/, a high falling tone /53/ and a high level tone /55/, as shown in Figure 1. In this tonal system, the low dipping tone /324/ should be considered as a variant of PLT.

According to the treatment of PLT, there are two types in Southwest Mandarin. In the first type, PLT is realized as a falling tone. In this type, the two falling tones cannot be distinguished by feature [+/-high], so define one of the falling tones to be PLT is useful to distinguish the two falling tones. In this type, the tail of the front-dipping tone usually rises very high which makes it distinguishable from other tones. As for the second type, PLT shifts to the low dipping tone. In this type the two falling tones are distinguished by feature [+/-high]. The first type is found in Chongqing (Figure 2), Shizhu and Wuxi. The second type is found in Zigong, Mianyang (Figure 3).

The evolutionary map is depicted to trace the changing route of tones, as shown in Figure below:



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Figure 1. Log Z-score of mean F0 in Shiquan

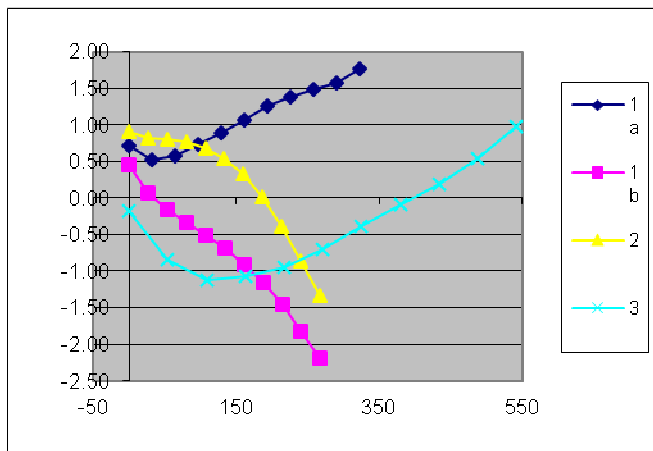


Figure 2. Log Z-score of mean F0 in Chongqing, speaker PP

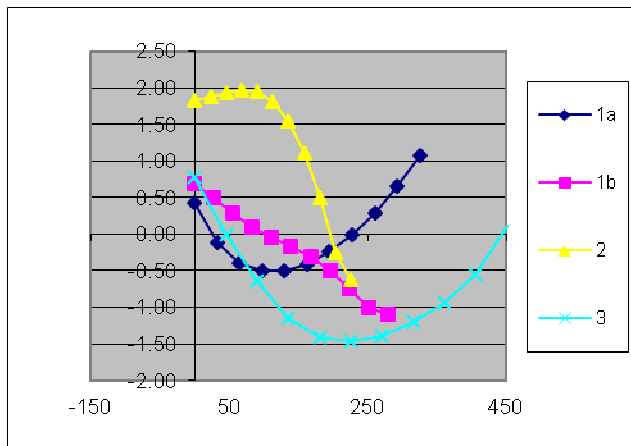


Figure 3. Log Z-score of mean F0 in Mianyang

Tonal evolutionary map of Southwest Madarin

