

Revisiting Tone Three Sandhi Acquisition: Insights from Acoustical Analysis

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Background: Tone Three Sandhi (T3S) is a phenomenon where the first Tone 3 (T3, a falling-rising tone) syllable becomes a rising pitch when it is followed by another T3 syllable. Previous studies based on listener judgements agreed that children were equipped with T3S knowledge sometime before/around four years old (Li & Thompson, 1997 among many others). Although Xu Rattanasone et al. (2018) have demonstrated that acoustically covert contrasts among child (three, four, and five years old) and adult participants existed, the selection of the participants, the data treatment and the statistical methods in their study prevented us from understanding the trajectory of T3S acquisition. The purpose of the study is to examine the T3S productions of Mandarin-acquiring four-and-five-year-old children and adults by acoustically analyzing the F0 contours, pitch slopes and the percentages of pitch-turning points. **Methods:** Data from 10 four-year-olds (Mean: 5; 5, SD: 3.162 in months), 10 five-year-olds (Mean: 5; 5, SD: 2.449 in months) and 10 adults were collected and analyzed. The two genders were balanced in each age group. The boundaries of the vowel in the first T3 of a T3-T3 disyllabic word were manually tagged in PRAAT (Boersma & Weenink, 2019). A custom-written script was used for F0 extraction and smoothing. The time-normalized (with 11 time points) z-scored F0 contours, pitch slopes and the percentages of pitch-turning points were further computed. As the literature suggests (Zhang & Lai, 2010 among others), a statistically significant interaction between age groups and time points indicate that at least two F0 curves have different shapes. The Hyunh-Feldt method was used to correct for sphericity violations. **Results:** Figure 1 displays the F0 contours produced by the child and adult groups. Results from a mixed ANOVA (group X time points) with repeated measures indicated that there was a statistically significant interaction between groups and time points, $F(4.595, 62.032) = 5.836, p = .000$. Two additional mixed ANOVAs were performed as post-hoc tests to investigate the source of differences. The results indicated that the F0 shapes between 5-year-olds and adults were different. The differences of pitch slopes and the percentages of pitch-turning points between each child group and adults were not statistically significant. **Discussion:** (1) With the refinement of the methods, it was acoustically shown that the four-year-old children demonstrated adult-like quality of T3S productions. (2) The good performance of the four-year-olds and the decreased performance of the five-year-olds suggest that the acquisition of T3S might involve a U-shaped developmental curve. Future studies focusing on older age groups are required to testify when children become adult-like again. (3) The current results do not support the phonological acquisition model 'Articulatory-Map Model' proposed by McAllister Byun, Inkelas and Rose (2016).

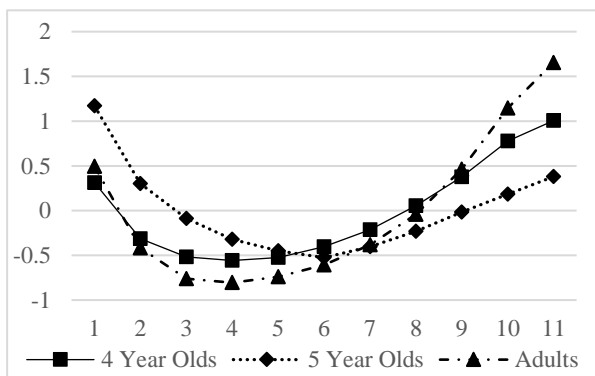


Figure 1. Time-normalized F0 contours of the three age groups (X axis: Z-scores; Y axis: Time points)

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