

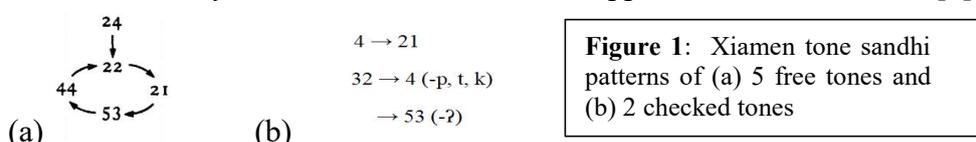
## The Acquisition of Xiamen Tone Sandhi by Children

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Previous studies on Cantonese and Mandarin showed that tonal acquisition starts early but finishes late [4][5]. However, these 2 languages either does not have a complex tone system or does not have (complex) tone sandhi. It is still largely unknown how children would acquire a complex tone system and complex tone sandhi. The Xiamen dialect is a good test case because of its complex tonal system. The Xiamen dialect belongs to the Southern Min dialectal group. It has 7 citation tones, including 5 free tones (44, 22, 24, 53 and 21) on open syllables or syllables with a nasal coda and 2 checked tones (4, 32) with a stop coda. The Xiamen dialect has very complex tone sandhi patterns. Every tone in the Xiamen dialect has a citation tone and a sandhi tone. The 5 free tones' sandhi patterns or the 5 free tones form a tone sandhi circle as shown in Figure 1a. Tone sandhi patterns for the 2 checked tones depend on the coda as shown in Figure 1b. Some studies show that syntactic structure decides the application of tone sandhi [1].



**Figure 1:** Xiamen tone sandhi patterns of (a) 5 free tones and (b) 2 checked tones

There were very few studies on the acquisition of Taiwanese tone (a Southern Min dialect which is very similar to the Xiamen dialect), and none on the Xiamen dialect. Hsu observed that although sandhi tones were more difficult for children, but they already had very few mistakes in production at 2 [2]. Acoustic analysis also revealed that children had acquired the checked tones well by the age of 3 [3]. However, these studies were all based on natural speech data in corpus without rigorous control on the speech materials. It is unclear if the high accuracy of tone sandhi production was because of children's successful repetition of the sandhi production in their input, or because children already had the abstract knowledge of the tone sandhi rules. It is particularly noteworthy that some previous studies [6][7] demonstrated that tone sandhi in Taiwanese is not productive in adults. Thus, it is important to investigate the productivity of tone sandhi during the course of acquisition by children.

The present study used a picture naming experiment with real words and wug words to investigate children's production of the citation tones and tone sandhi patterns in the Xiamen dialect. Three groups of participants were included: the young children group (Y)(age 5;6-8;1, M=6;8, N=8), the old children group (O)(age 9;2-12;0, M=10;7, N=8) and adults (A)(age 25-57, M=43, N=8). All speakers spoke the Xiamen dialect natively and used it as the usual language in daily life, although they all spoke Mandarin as well. They had very limited exposure to English or other Chinese dialects.



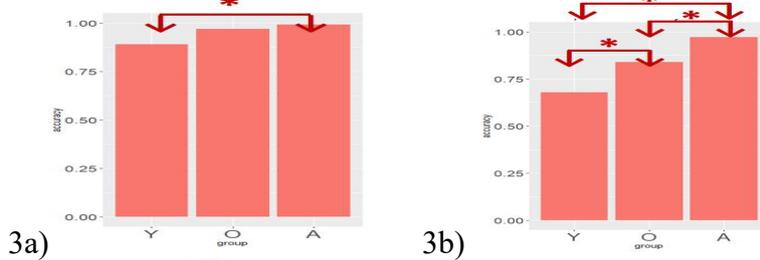
a) “面” (noodle) b) “面包”(bread) c) “面包”(bread) d) “面豆” (noodle and beans)

**Figure 2.** Examples of the 4 types of stimuli

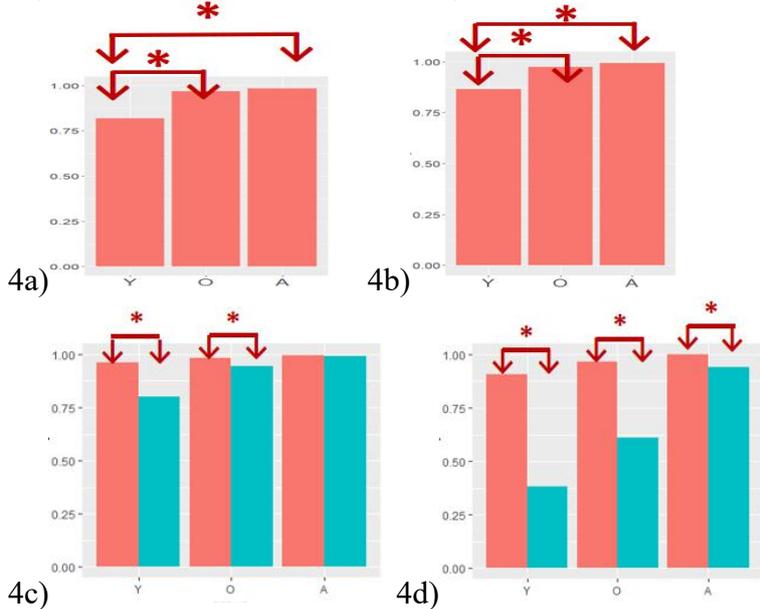
According to the Xiamen tone sandhi rules, monosyllabic words and the second syllable of disyllabic words are in citation positions and preserve citation tone. The first syllable in disyllabic words is in sandhi position. Four types of stimuli were used: 1) monosyllabic real words (Fig. 2a); 2) disyllabic real words elicited by 1 picture (Fig 2b); 3), disyllabic real words elicited by two pictures (Fig. 2c); 4) wug words using real syllables elicited by 2 pictures (Figure 2d).

2 adult native speakers received training on the Xiamen tonal system beforehand. They listened to the recordings and decided which tone they heard and whether the production was

correct according to the tone sandhi patterns. The following analysis was based on their judgement. Fig. 3a shows that the overall accuracy of young children ( $M=0.889$ ,  $SD=0.308$ ) was significantly worse than adults ( $M=0.971$ ,  $SD=0.098$ ) in citation position. In sandhi position, Fig. 3b shows that the young children ( $M=0.678$ ,  $SD=0.308$ ) had significantly lower accuracy than the old children ( $M=0.840$ ,  $SD=0.243$ ) and adults ( $M=0.971$ ,  $SD=0.098$ ). Old children also had significantly lower accuracy than adults. For monosyllabic words (Fig. 4a) and disyllabic words (Fig. 4b), young children were found to be less accurate than the other 2 groups. For disyllabic words elicited by 2 picture (Fig. 4c), both children groups were significantly more accurate in citation than in sandhi positions while there was no such difference for adults. For wug words, all three groups were significantly more accurate in citation than in sandhi position (Fig. 4d). There was a clear developmental pattern for the accuracy in tones sandhi position in wug words, and that adults had very high (>90%) accuracy. The old children reached adults' accuracy in all conditions except the sandhi position in wug words. Our data clearly demonstrated that tone sandhi in the Xiamen dialect is productive and follows the general development trend in child acquisition, though children as old as 10 years old still have not fully acquired the tone sandhi rules. Differences in experimental designs and naturalness of the materials might explain the discrepant findings in the current study and previous studies on the productivity of tone sandhi.



**Figure 3.** The overall accuracy on (a) citation position and (b) sandhi position



**Figure 4.** The accuracy of (a) monosyllabic real words, (b) disyllabic real words elicited by 1 picture, (c) disyllabic real words elicited by 2 pictures and (d) wug words elicited by 2 pictures

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