An Experimental Investigation of Positionally Conditioned Tone Sandhi in Hailu Hakka
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Previous research on tonal sandhi patterns in Chinese dialects has shown that native speakers internalize the sandhi patterns differently depending on their phonological nature. The T3 sandhi in Mandarin (1) applies productively to novel words (Zhang and Lai 2010), while the sandhis in the circular chain shift in Taiwanese Southern Min (2) do not (Hsieh 1976, Wang 1993, Zhang et al. 2011). In addition, in auditory lexical decision with auditory priming, Mandarin disyllabic words that undergo the T3 sandhi (e.g., /fu²¹³-dao²¹³/ “to assist”) are significantly primed by a T3 monosyllable (fu²¹⁷), but not by a T2 monosyllable (fu²⁵⁵), when compared to a control prime (fu²⁵⁵) (Chien et al. 2016a), while Taiwanese words undergoing the 51→55 sandhi primarily exhibit surface tone priming (Chien et al. 2016b). These results have been interpreted as an opacity effect: tone sandhisis that are motivated by surface-true phonotactic generalizations are represented in their underlying tones and derivable through productive phonological processes, while those that do not rely primarily on lexical listing and are represented in their surface tones.

(1) Mandarin third-tone sandhi: T3 → T2 / ___T3 (213 → 35 / ___ 213)
(2) Taiwanese tone sandhi in non-phrase-final positions: 51 → 55 → 33 ← 24

Mandarin and Taiwanese tone sandhis, however, differ in another respect: the Mandarin pattern is triggered by an adjacent tone (a following T3), while the Taiwanese pattern is positionally triggered (non-phrase-final position). This leaves open the possibility that their difference in representation is due to the nature of the trigger. In this paper, we address this alternative by an experimental investigation of a positionally triggered, yet transparent tone sandhi in Hailu Hakka, a Chinese dialect spoken in Taiwan.

Hailu Hakka has a five-tone inventory on CV or CVN (N=nasal) syllables: 53, 44, 13, 21, 33. In non-phrase-final positions, however, 13 is neutralized to 33 regardless of the following tone: 13→33/ ___ X. We conducted a nonce-probe experiment to investigate the productivity of this sandhi pattern in novel items and an auditory lexical decision experiment with auditory priming to further tap into the lexical representations of tone-sandhi words that the speakers use in spoken word recognition.

In the nonce-probe experiment, subjects produced two types of /13-X/ disyllabic words: real words and novel words with a nonce first syllable. Real words were of either modifier-noun or verb-noun structure, and were produced after the subjects were given the monosyllabic morphemes auditorily in their underlying tones. The first syllable of a novel word was first provided either a verb or noun meaning, and the subjects were asked to combine it with an existing noun. Each subject produced 64 real words and 64 nonce words. 19 native Hailu speakers with a mean age of 58.6 participated in the experiment in Hsinchu, Taiwan.

The f0 values of the first syllables were measured at 10% duration intervals using VoiceSauce (Shue et al. 2011), then converted into semitone and z-scored. Growth curve analysis with quadratic orthogonal polynomials was then used to compare the f0 curves from the real words and novel words. The analysis showed that the addition of WordType or its interaction with the linear or quadratic time terms did not significantly improve the model. There is, therefore, no significant difference in the slope or peak sharpness between the sandhi realization of real words and that of novel words. This suggests that the sandhi has applied productively in the novel words (Figure 1).

In the lexical decision experiment, 20 /13-X/ words (e.g., /tʃʰu¹³-li¹³/ “to deal with”) were used as critical targets, and each target was preceded by one of four monosyllabic prime types: UR-match (tʃʰu¹³), SR-match (tʃʰu⁴⁶), Segmental-match (tʃʰu⁴⁶), or Unrelated (hi²³). These targets were presented to the subjects in a Latin-square design so that each subject only heard one of the primes. 80 filler trials with
disyllabic words of other tonal combinations as targets and a balanced mixture of primes as well as 100 nonword trials were also used. These trials were shared by all subjects. During each trial, the subjects first heard the prime, and then the target after a 250ms interval. Their task was to judge whether the target was a real word or not by a mouse click as quickly and as accurately as possible. 32 native Hailu speakers with a mean age of 57.3 participated in the experiment.

The log reaction times (RTs) for the correct responses to the critical trials were analyzed using Linear Mixed-Effects models with PrimeType as a fixed effect and Subject and Item as random effects. RT responses over two standard deviations above or below the mean of a given subject were excluded from the analysis. PrimeType had a significant effect on RT ($\chi^2=26.6, p<0.001$). Using Unrelated as the baseline, the model showed that all primes with a segmental match (UR-match, SR-match, Segmental-match) had shorter RTs; using Segmental-match as the baseline, however, the model showed that only UR-match had a significantly shorter RT ($t=-2.602, p=0.0096$), but not SR-match ($t=-1.072, p=0.2842$) (Figure 2). The latter result is consistent with Chien et al.’s (2016a) result on Mandarin and suggests that words with the 13→33 tone sandhi in Hailu Hakka are represented in their underlying tones.

Collectively, the nonce-probe and lexical decision experiments on the positionally triggered tone sandhi 13→33 in Hailu Hakka show that the speakers internalize this sandhi similarly to how Mandarin speakers internalize the T3 sandhi, but differently from how Taiwanese speakers internalize the chain shift. The results, therefore, strongly suggest that the unproductivity and lexicality of tone sandhi in Taiwanese is the result of its opacity, not its positional trigger.

Finally, although the Ethnologue classifies Hakka as a language in vigorous use, due to the influence of Mandarin, Hakka speakers are mostly bilingual, and younger speakers are typically Mandarin-dominant. Within Taiwan, Hailu is also not the most widely spoken variety of Hakka, which further compounds the attrition issue. Therefore, an added value of the study is that it provides experimental data on an understudied and arguably endangered language.

References: