FREQUENCY EFFECTS IN THE LEXICAL ACCESS THAT INVOLVES PHONOLOGICAL ALTERNATION: EVIDENCE FROM MANDARIN TONE 3 SANDHI

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Mandarin tone 3 sandhi refers to the phonological alternation of which a tone 3 (T3; a dipping tone) syllable changes to a tone 2 (T2; a rising tone) when followed by another T3. In a Mandarin disyllabic word composed of two T3 morphemes, T3 sandhi creates a mismatch between the phonological realizations at the morphemic- and word-levels, such that the initial syllable is underlyingly a T3 at the morphemic level (e.g., *hai* /T3/ 'sea') but realized as a T2 in the disyllabic word (e.g., *hai-zao* /T3-T3/→[T2-T3] 'seaweed'). Using frequency effect as a diagnostic tool, we conducted two cross-modal lexical decision priming tasks to investigate the influence of the two-level tonal deviation on the representation and access of Mandarin T3 sandhi. Both experiments used disyllabic sandhi words as visual targets (e.g., *hai-zao* 'seaweed') and monosyllabic T1 (control; *hai* [T1]), T2 (surface-overlapping; *hai* [T2]) or T3 (underlying-overlapping; *hai* [T3]) as audio primes.

Experiment 1 (N=33) used a total of 45 target sandhi words varying in the frequencies of the initial (sandhi-undergoing) characters and words. Condition 1 consisted of high-frequency words with a high-frequency initial character (e.g., *li-jie* 'comprehend'); Condition 2 contained low-frequency words with a high-frequency initial character (e.g., *hai-zao* 'seaweed'); for words in Condition 3, the frequencies of both the initial character and the whole word were low (e.g., *bu-ru* 'breastfeed'). The results showed distinctive priming patterns across conditions: for low-frequency sandhi words containing a high-frequency character (i.e., Condition 2), only the T3 prime showed a significant facilitation compared with the control prime (β=-0.062, t=-3.691, p<0.001), whereas for target words of which both morphemic and lexical frequencies were low (i.e., Condition 3), only the T2 prime showed a significant facilitation (β=-0.031, t=-2.003, p<0.05). These results showed how the frequencies (and dominance) of two morphological levels are associated with the underlying and surface tones of T3 sandhi words.

Experiment 2 (N=35) investigated the role of two-level tonal competition in the access of T3 sandhi by operationalizing the relative frequency of the initial T3 character's realization as a sandhi T2—we referred to this effect as "sandhi rate". A total of 36 sandhi words were used as targets, with the minimal sandhi rate being 0.02, i.e., *bian-sun* /T3-T3/ 'derogate' and the maximal rate reaching 1, i.e., *di-hui* /T3-T3/ 'defame'. Our results showed an interaction between sandhi rate and prime tones: higher sandhi rates facilitate the recognition of sandhi words in general, but the T3, not T2, prime exhibits a significantly different slope relative to the control prime (β=0.067, t=2.272, p<0.05). We posit that it is because the more frequently the initial T3 character surfaces as a sandhi variant, the more strongly the sandhi word is represented as /T2-T3/, hence the easier it is to directly access the surface form; however, the saliency of the surface tone cannot easily override the strong availability of the underlying form /T3-T3/; thus, when the prime is a T3 audio, sandhi rate showed no effect. Results of Experiment 2 further support our postulation on the role of the two-level tonal competition in the access of T3 sandhi words, indicating that native speakers can utilize the distributional properties of the morphemes and the associated tonal forms to internalize the deviation.

Taken together, our study demonstrates the availability of both the underlying and surface tones in processing T3 sandhi. The way language users internalize the competition between the underlying and surface phonological forms exhibits a parallel to morphological processing, pointing to a multi-level lexical access model where individual morphemes, the whole word itself, and the phonological forms associated with each morphological level all play a role and compete with each other in the mental lexicon.