How Tone Sandhi Helps Us Understand the Processing of Phonological Alternation

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The understanding of how speakers internalize patterns of morpheme alternation (e.g., *dog[z]*, *cat[s], bus[ɨz]*) is one of the fundamental goals of phonological research. The generative approach to the phenomenon is to assume that the different allomorphs of a morpheme are united by one underlying representation, and an input-output mapping mechanism, as part of the competence grammar, maps the underlying representation to the different surface representations in the appropriate contexts. Although phonological theories along this line do not make the claim that speakers perform the mapping in on-line production, they do make predictions about the different levels of representations that speakers are able to access in the production and perception processing of words that involve alternation, and some psycholinguistic research based on priming has shown that abstract underlying representations of morphemes play a role in spoken word recognition [1-5]. However, experimental work that investigates the processing of alternation remains relatively scarce, and current models of speech production [6-8] and spoken word recognition [9-12] are largely agnostic regarding where alternation fits in the model.

In this talk, I discuss a series of work on the productivity and processing of tonal alternation (commonly known as tone sandhi) patterns in dialects of Chinese and show that (a) the richness of the attested tone sandhi patterns provides a fertile testing ground for the processing of alternation, and (b) how an alternation is learned and processed on-line by speakers is strongly influenced by the phonological nature of the alternation. In particular, I focus on the comparison between tone sandhi patterns that can be driven by surface-true phonotactics and those that involve a circular chain shift and hence cannot.

One set of comparisons comes from tone sandhi patterns in which the nonfinal syllables of the tone sandhi domain undergo paradigmatic substitution, as illustrated by the Mandarin, Hailu Hakka, and Taiwanese Southern Min patterns in (1). Wug test results showed that the phonotactically motivated substitution patterns in Mandarin [13] and Hailu Hakka [14] are generally productive, while substitution patterns that involve a circular chain-shift in Taiwanese Southern Min lack full productivity and often categorically fail to apply to nonce words [15, among others]. Auditorily primed lexical decision tasks showed that disyllabic words undergoing tone sandhi in Mandarin [16] and Hailu Hakka [14] are more strongly primed by the first syllable of the word carrying the underlying tone, while tone sandhi words in Taiwanese Southern Min are more strongly primed by the sandhi tone [17]. Moreover, the priming effect of the underlying tone in Mandarin and Hailu Hakka does not interact with the frequency of the target word, while the priming effect of the sandhi tone in Taiwanese Southern Min is regulated by frequency.

(1a) Mandarin: $213 \rightarrow 35 / \_\_ 213$
(1b) Hailu Hakka: $13 \rightarrow 33 / \_\_ X$
(1c) Taiwanese Southern Min: $51 \rightarrow 55 \rightarrow 33 \leftarrow 24 / \_\_ X$
$$\nwarrow \quad \swarrow$$
$$21$$

Another set of comparison comes from tone sandhi patterns in which the tone on the initial syllable of a tone sandhi domain is spread over the domain, either directly or after substitution, as illustrated by the Shanghai Wu and Wuxi Wu patterns in (2). Wug test results showed that the tone spreading pattern in Shanghai Wu is generally productive [18], while the substitution aspect of the tone sandhi in Wuxi Wu, which involves a circular chain shift, is not [19].

(2a) Shanghai Wu: $51\text{-}X \rightarrow 55\text{-}31$
(2b) Wuxi Wu: $53\text{-}X \rightarrow 43\text{-}34$

Although the studies reported here only focus on one property of phonological alternation — whether the alternation is driven by surface-true phonotactic, the results suggest that different types of phonological alternations may be learned by speakers in different ways and involve different processing mechanisms on-line. When accompanied by additional experimental paradigms as well as replication studies of similar phenomena, these studies have the potential to inform both models of lexical access and the nature of phonological grammar. It is also interesting to observe that the relation between the productivity of phonological alternation and how the alternation is processed has a striking parallel to the well-studied relation between morphological irregularity/semantic compositionality and morphological processing [e.g., 20]. It is hoped that the vast psycholinguistic and neurolinguistic literature on the latter can provide guidance for our investigation and modelling of phonological alternation.

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