

Phonetically Identical Forms can Have Different Phonological Behaviors

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There is a lot of research since at least mid-1980s documenting the effect of incomplete neutralization of phonological contrasts (Port & O'Dell, 1985; Kawahara & Braver, 2013; inter alia). Some researchers have taken this as evidence against traditional formal phonology where categorical phonological representation is assumed (Port & Leary, 2005). By such way of using phonetic measurements to directly infer phonological representation, two assumptions have been made. First, phonetically different forms should be different in phonology; Second, phonetically identical forms should be identical in phonology. The first assumption has been largely undermined in the case of prosodic words lengthening in Japanese (Kawahara & Braver, 2013). It has been showed that although lengthened prosodic word has identical phonological behavior with their underlying counterpart in Japanese, their durations are significantly different. As an attempt to oppose the second assumption, the current study investigates Tone 4 Sandhi of Huai'an Mandarin (Huai'an hereafter). I will show that although *Lexically Derived Tone 3* is phonetically indistinguishable from *Post-Lexically Derived Tone 3* with regard to F₀, their phonological behaviors are different with regard to the ability to trigger another tone sandhi process. F₀ is measured since it contains all critical phonetic cues that can distinguish Mandarin tones (Tupper et al., 2020). For convenience, I will use T plus numbers to indicate tones, i.e. T3 for Tone 3.

Background: Huai'an has four phonemic tones: T1 (high falling), T2 (high rising), T3 (low/low rising), and T4 (high level). The disyllabic tone sandhi patterns of relevance are shown in (1):

(1) a. T3 sandhi: T3 + T3 → T2 + T3 b. T4 sandhi: T4 + T4 → T3 + T4

T4 Sandhi optionally applies at both lexical and post-lexical levels. To be more specific, T4 Sandhi applies at the right edge of non-compositional words as in (2), and at utterance-final position as in (2). For a flat-structure loanword plus a monosyllabic suffix as in (2), only the last two syllables of the loanword constitute a sandhi domain; (2) is a sentence with each syllable forming a separate word, and the last two syllables form a phrasal sandhi domain.

(2) a. [[ɕia-lo-tʰɛ] tɛyn] b. pa zɑŋ lu suŋ uei su
Charlotte county father let Mr.Lu give Mr.Wei tree
"The county of Charlotte" "Father lets Mr.Lu give Mr.Wei trees."
UR T4 T4 T4 T4 UR T4 T4 T4 T4 T4 T4
SR1 T4 T4 T4 T4 SR2 T4 (T3 T4) T4 SR1 T4 T4 T4 T4 T4 T4 SR2 T4 T4 T4 T4 (T3 T4)

Crucially, the T3 outputs of T4 sandhi pattern at both lexical and post-lexical levels optionally feed into T3 Sandhi process across the boundary between subject and predicate as in (3):

(3) a. o pa-tɕã b. o to zəu
1sg arrogate 1sg chop meat
[DP[VP]]_{TP} "I arrogate (something)." [DP[V[DP]_{VP}]]_{TP} "I chop meat."
UR T3 T4 T4 SR1 T3 T4 T4 SR2 T3 T3 T4 SR3 T2 T3 T4

Experiment: I conducted a production experiment, and recorded acoustic data from 5 native speakers of Huai'an (2 male, 3 female, ages: 34-56). Each speaker produced 4 repetitions of 48 sentences (40 test, 8 filler) at a consistent natural speech rate. Test items consisted of 6 sets of trisyllabic sentences similar to those in (3) where 3 sets were at the lexical level and the other 3 were at the post-lexical level. The pattern of the 3 sets at both levels were the same: (a) *Underlying T3*: /T3 T3 T4/ → [T3 T3 T4] or [T2 T3 T4]; (b) *Derived T3 with Feeding Order*: /T3 T4 T4/ → [T3 T4 T4] or [T3 T3 T4] or [T2 T3 T4]; (c) *Derived T3 without Feeding Order*: /T2 T4 T4/ → [T2 T4 T4] or [T2 T3 T4]. The 6 sets were different only for tonal patterns, and not for segmental content. Furthermore, the crucial second syllable was always CV (C = [p, t, k]; V = [ɛ, ə, a]). The

pitch trajectories for the surface tones in the second syllables were measured using Praat scripts. The results in Figure 1 suggest that *Derived T3s* are not completely phonetically neutralized with the *Underlying T3s* at both lexical and post-lexical levels, and the phonetic differences are quite substantial and undeniable at both levels. Moreover, by overlaying contours at both levels, Figure 2 indicates that pitch contours of *Underlying T4*, *Derived T3* and *Underlying T3* at the lexical level are indistinguishable from their counterparts at the post-lexical level.

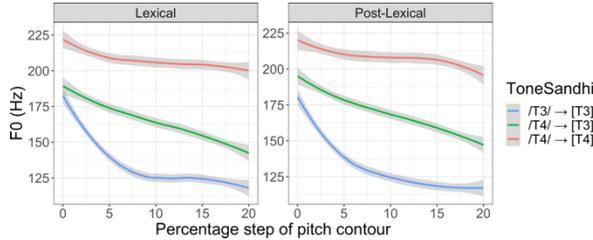


Figure 1: Side-by-Side Comparison of Tonal Contours at Different Levels

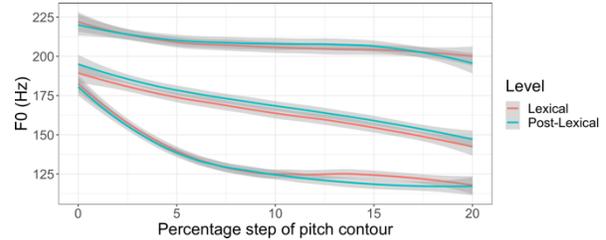


Figure 2: Tonal Contour Overlay of Different Levels

Despite the phonetic similarity of *Derived T3s* at the lexical and post-lexical levels with regard to F_0 , their rates of triggering T3 Sandhi across the boundary between subject and predicate are different as shown in Table 1. Although *Derived T3s* at both lexical and post-lexical levels trigger T3 Sandhi at a lower rate than their underlying counterparts, *Lexically Derived T3* triggers T3 Sandhi at an even lower rate than *Post-Lexically Derived T3*. The difference of triggering rates between *Lexically Derived T3* ($M=0.27$; $SD=0.21$) and *Post-Lexically Derived T3* ($M=0.48$; $SD=0.26$) is confirmed by a paired t-test: $t(4)=-3.04$, $p=0.04$.

Tone Condition	Level	Triggered/Total	Triggering Rate
Derived Tone 3	lexical	23/86	26.74%
Derived Tone 3	Post-Lexical	43/90	47.78%
Underlying Tone 3	lexical	110/116	94.83%
Underlying Tone 3	Post-Lexical	97/99	97.98%

Table 1: Abilities of Different Tones Triggering Tone 3 Sandhi

Discussion: The results suggest that even phonetically identical forms can have different behaviors. It is difficult to assign such difference outside phonology to language planning window effect since factors like verb/phrase frequency would make the opposite prediction of *Lexically Derived T3* triggering at a higher rate. In contrast, the difference can be straightforwardly explained by tone sandhi domain-building process in Mandarin languages. According to Dunamu (2007), tone sandhi domain is built according to the stress pattern. The trochaic foot ensures a stress that is realized abstractly on the second syllable of lexical-level stimuli. Such stress triggers a boundary before that can optionally block the feeding process. By rejecting the second assumption stated before, this study further proves phonetic measurements should not be used to directly infer phonology.

References

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