Incomplete neutralisation stems from planning, not gradient representations

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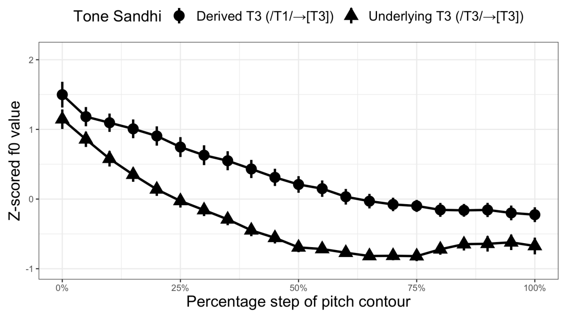
Introduction A particularly fecund area where the debate over the sufficiency of abstract-discrete phonological representations has played out is the phenomenon of *incomplete neutralisation* [1, 2, 3, 4, 5, amongst others], wherein a putative neutralisation of phonological categories is incompletely realised phonetically. However, it is important to note that such arguments make auxiliary assumptions [6, 7, 8], which could themselves be questioned. We suggest that the auxiliary assumption at fault is one of viewing phonology as an abstraction over production, where the idealised surface representation wholly affects the phonetics. This auxiliary hypothesis is inconsistent with the classic generative view that phonology is *knowledge* distinct from other factors. On the latter view, abstract-discrete representations are consistent with the phenomenon of incomplete neutralisation. More specifically, we will argue: (a) phonetically incomplete neutralisation is observed even when there is phonological neutralisation; (b) there are actually at least two kinds of incomplete neutralisation that don't stem from task effects/confounds; (c) the phenomenon is an outcome of planning using abstract/discrete phonological knowledge.

Background Huai'an Mandarin has three relevant tone sandhi patterns: (1) T1 sandhi: /T1 T1/ → [T3 T1]; (2) T4 sandhi: /T4 T4/ → [T3 T4], (3) T3 sandhi: /T3 T3/ → [T2 T3] (Note: T1 and T4 sandhis are optional; T3 sandhi is mandatory). Crucially, the outputs of T1 and T4 sandhis *feed* into T3 sandhi: /T3 T1 T1/ → [T2 T3 T1]; /T3 T4 T4/ → [T2 T3 T4]. This suggests that the T1 and T4 sandhis completely neutralise to T3 phonologically.

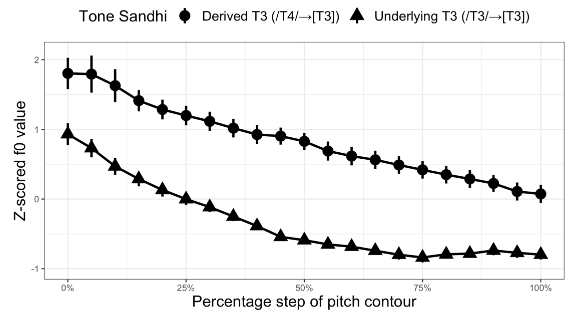
Experiment We conducted a production experiment on 8 native speakers of Huai'an (4 female, ages: 41-59 yrs). Test items consisted of 3 groups of trisyllabic sentences; each group had 4 sets; each set had 6 sentences differing only in tonal patterns. *e.g.*, (a) /T2 T3 T1/ → [T2 T3 T1]; (b) /T3 T3 T1/ → [T2 **<u>T3</u>** T1]; (c) /T2 T1 T1/ → [T2 T3 T1]; (d) /T3 T1 T1/ → [T2 **<u>T3</u>** T1]. The first syllable alternated between T2 and T3. The second syllable, which is the test syllable, alternated for the target tone sandhi pattern. The crucial comparison is boldfaced and underlined.

Despite the categorical phonological behavior of the derived T3 in triggering a subsequent T3 sandhi, there is incomplete neutralisation of T3 in T1 and T4 sandhis (Figures 1a-1b), even when we only focus on derived T3 that actually triggers T3 sandhi. Furthermore, we studied the incomplete neutralisation of T2 in T3 sandhi (Figure 1c). By comparing T1 and T4 sandhis with T3 sandhi in the same experiment, we observe that the effect size of incomplete neutralisation can be significantly affected by the optionality of phonological processes. T3 sandhi is mandatory and has a very small effect size. In contrast, T1 and T4 sandhis are optional and have a large effect size of incomplete neutralisation. Notably, the latter effect is not conditioned by the degree of optionality, but simply by the presence or absence of optionality for the process. Accounting for such patterns in terms of gradience in representations fails to *explain* the correlation between optionality and the effect size of incompleteness. We instead suggest that the former smaller effect stems from incremental planning [9, 10, 11], and the latter larger effect stems from the same incremental planning that is sensitive to optionality.

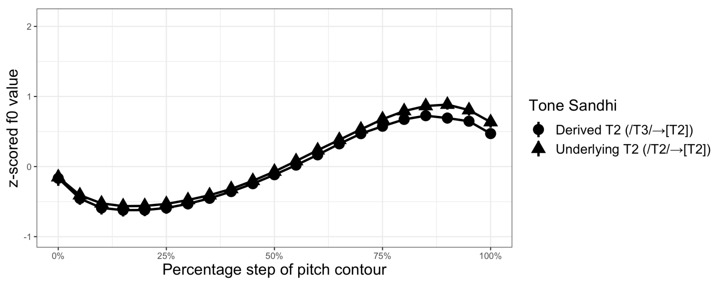
Conclusion Our results suggest that phonetic incompleteness is not diagnostic of phonological incompleteness, and therefore cannot inform us about phonological representations directly. Furthermore, it suggests that there is a need to understand performance mechanisms better before assigning gradience to phonological representations [4, 12].



(a) Tone 1 Sandhi contours



(b) Tone 4 Sandhi contours



(c) Tone 3 Sandhi contours

Figure 1: Contour comparison of the second syllable in each Tone sandhi case (error bars indicate standard errors). Corresponding Growth Curve Analysis models where estimates are for differences in the tone contours: (a) Intercept= -0.67; $\hat{\beta}_{linear}$=0.47; $\hat{\beta}_{quadratic}$=4.45; $p<0.01$; (b) Intercept= -1.18; $\hat{\beta}_{linear}$=0.71; $\hat{\beta}_{quadratic}$=5.29; $p<0.01$; (c) Intercept=0.08; $\hat{\beta}_{linear}$=1.18; $\hat{\beta}_{quadratic}$=0.78; $p<0.01$.

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