Complete and incomplete neutralisation in Fuzhou tone sandhi

Incomplete neutralisation (IN) refers to phonological alternations that produce perceptually (almost) identical outputs that nevertheless leave instrumentally detectable differences. IN has been widely reported in final devoicing processes in European languages [1]–[3]. Theoretically, IN is a challenge for classical modular feed-forward model of phonology [4], [5]: If the derivation of surface voiceless from underlying voiced obstruents is discrete, then phonologically neutralised objects should have identical acoustic outputs. IN would be a surprise.

One confounding factor in final devoicing IN is orthography [4], [6], e.g. German rad and rat suggesting underlying voicing distinction. This paper reports production and perception experiments on potential IN effects in Fuzhou Min tone sandhi, where results are largely free from orthographic (no tone marking in writing) and metalinguistic (low in Fuzhou) confound. Most neutralisations investigated to date are of the A / B → B type, e.g. /d/ and /t/ neutralised into [t]. In Fuzhou tone sandhi a single surface tone may come from multiple underlying tones, none of which are identical to the surface tone. This is shown in Table 1: in a tone sandhi domain, the final syllable retains its citation tone, while all pre-final (target) syllables undergo sandhi. Sandhied tones are determined jointly by target tones and context tones. Two neutralisation groups will be the focus in this paper. They are listed in (1) and (2) and are in bold in Table 1.

(1) 44, 53 → 44 / ___ 53
(2) 242, 44 → 53 / ___ 32

20 native Fuzhou listeners were first asked to categorise apparently homophonous disyllabic words which minimally differ in the underlying tone of the first syllable, with the auditory stimuli created from multiple tokens and speakers. Mixed-effects logistic regression reveals that underlying tone is not significant in categorisation performance for both (1) and (2). 10 native speakers of Fuzhou then read disyllabic words embedded in an invariant carrier phrase [juai̯31 puoʔ44 tʰøy44 ___ kʰøy44 ny31 tʰianʔ55], “I want to read _ for you to listen”. Within each neutralisation group in (1) and (2), test words crucially differ in the first underlying tone with segments held constant. Statistical analysis combines SS ANOVA [7] and Bayesian inference [8]. The former creates smoothed splines with surrounding ribbons representing the 95% confidence intervals. The latter produces Bayes Factors, which in contrast to previous approaches can both confirm and reject the IN hypothesis.

Figure 1 (right) shows that sandhied T44 and T53 overlap almost completely, a sign of complete neutralisation into surface T44. As for surface T53 (left), in both conditions sandhied tones start from the top and falls steeply, reflecting the citation acoustics of T53. While the ribbons overlap considerably, the initial section (0–20%) of the F0 from underlying T44 is significantly higher than that of underlying T232. The average difference is 0.68 semitones, or 6.75 Hz, above just-noticeable threshold but below that of typical tonal contrast. Bayesian inference corroborates the acoustic sameness for surface T44 and difference for surface T53.

The co-existence of both complete and incomplete neutralisation puts particular challenge on Turbidity Theory’s [9] account of final devoicing, where voiced obstruents but not underlying voiceless ones are posited to have a monovalent [voice] feature. Highly ranked FINDEV constraint forces [voice] to be unparsed and its ambiguous phonetic interpretation results in IN [9, p. 1371], see also [10]. This argument is difficult to advance in the present case, as the tonal analogue to the supposed difference in segmental [t] and [d] is hard to come by and in any case contrary to the observation that the type of tone sandhi in Fuzhou involves whole-tone substitution rather than feature alteration [11], [12]. Further, theories along this line have to posit differences in phonological representations only for those tone sandhi groups which show IN effect, but not for sandhi groups which do not, reducing predictive power. The solution to IN favoured here is a hybrid model of phonological competence which encompasses both abstract categories and stored exemplars [13]–[15], with IN following from the co-activation of morphologically related forms [16].
Table 1. Fuzhou tone sandhi.

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<thead>
<tr>
<th>Target tone ↓</th>
<th>Sandhi tone ↓</th>
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<td>213</td>
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<td>242</td>
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Figure 1: Time normalised F0 contour of sandhi T53 from underlying T44 and T232 (left) and T44 from underlying T44 and T53 (right), in semitones, with 95% confidence interval shown as ribbon, from 10 speakers.

References


