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COMPLETE AND NOT-SO-COMPLETE TONAL NEUTRALIZATION IN PENANG HOKKIEN

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ABSTRACT

This study shows that Southern Min chainshift tone sandhi rules have been reduced to a binary H vs. L contrast among young generation speakers of Penang Hokkien. More remarkably, both complete and incomplete neutralization of sandhi tones are attested in this language. Some possible explanations will be discussed, including preservation of phonological identity and/or the (non-)completion of sound change as well as its consequences for redistribution of exemplars.

Keywords: Penang Hokkien, Southern Min, Tone sandhi, Incomplete neutralization

1. INTRODUCTION

Penang Hokkien (PH) is a representative variety of Southern Min Chinese spoken in the Northern region of Peninsular Malaysia. It is observed in [2] that PH has undergone independent evolution,[1] probably due to the isolation from its motherland, i.e., China, and the fact that PH did not have intense language contact with Standard Chinese (cf. "new" tone sandhi rules in Tianjin Chinese [15]). One of the major findings in [2] is that the famous tonal chainshifts in Southern Min are simplified to a great extent among young generation speakers, while these tone sandhi rules remain intact among old generation speakers (cf. [4]'s study of Melaka Hokkien). More specifically, a four-way contrast of sandhi tones is reduced to a binary H vs. L contrast among young speakers. In other words, large-scale tonal mergers occur in non-final sandhi position and, to our knowledge, cases of neutralization as such are an unprecedented pattern of sound change in Southern Min tone sandhi systems (see, e.g., a general survey in [3]).

The goal of this paper is thus two-fold. First, we will present experimental results obtained from more speakers and more age groups to vindicate the findings reported in [2]. Second, and more importantly, with the help of a novel statistical method (SS ANOVA; see section 2.4), we will look into an important yet understudied issue in Chinese tone sandhi systems, namely whether or not the tonal mergers in PH are complete neutralization (cf. [13]).

2. EXPERIMENT

2.1. Participants

Eight (8) speakers (6 males and 2 females[2]) participated in this study. We recruited one (1) old male PH speaker, who is a 2nd generation immigrant in his seventies, one (1) mid-aged male PH speaker, a 3rd generation immigrant in his forties, and six young speakers (4 males and 2 females). They were all born and raised in Penang (as 3rd or 4th generation immigrants). The average age of the young generation participants was 21. They all speak PH as their first language and (Malaysia-accented) Mandarin Chinese,

English, Malay and some other Sinitic languages, such as Cantonese, Teochew, and/or Hainanese as their second/third/fourth languages. None of them reported any speech or hearing problems and they were paid for participating in this study.

2.2. Stimuli and procedure

The test words in this study included 90 monosyllabic words (5 non-checked/long tones × 10 words + (2 checked tone with p/t/k codas + 2 checked tones ending in ʔ) × 10 words) and 189 disyllabic words (9 sandhi tones × 7 citation tones × 3 words). Syllable structures were also controlled for: they are all CV for mono-syllabic words (C={p, t, k}; V={a, i, u}) and CV. CV for di-syllabic words (C={p, t, k, ts, s}). The test words were all real words for speakers of PH.

The target words were randomized and embedded into a carrier phrase ([gua445 tsʰau21 ____ tsʰau21 tsit3 pai445] 'I transcribe ___ once.'). Each sentence was repeated 3 times (i.e. 90 monosyllabic words + 189 disyllabic words × 3 repetitions = 837 tokens for each speaker), yielding a total number of 6696 tokens among eight speakers.

The recordings were conducted in a quiet hotel room in Penang. Background noise was about 40dB. We used a digital recorder (Roland Edirol R09) and a unidirectional microphone (Bayerdynamic TGX480), which was placed approximately 3 inches from the speaker's mouth.

2.3. Data analysis

The recording was digitalized with a sampling rate of 44.1 kHz and all measurements were made with the help of Praat ([1]). The segmentation of a rime was determined by the beginning and ending points of F2. Time-normalized F0 values (11 points) and duration of the segmentation were extracted by means of Yi Xu's Praat script (ProsodyPro version 5.0). F0 values were converted into logarithmic Z-score (LZ-score) values ([16]) in order to minimize inter-speaker variation.

2.4. Statistical analysis

A Smoothing Spline ANOVA (SS ANOVA) ([7, 9]) was performed with the help of R (version 0.97.320). SS ANOVA is a statistical technique developed specifically for contours that are comprised of dependent variables. The procedure of SS ANOVA is as follows: A polynomial function connects discrete data points to construct a smoothing spline. The function tries to fit the data and penalizes it ([7]), thus the resulting spline is a regression line with 95% confidence intervals. If points from two curves on the time dimension do not overlap, we may be confident that the critical pair in question is distinct, and the difference is statistically significant.

3. RESULTS

3.1. Tonal systems of Penang Hokkien

It is well known that base/citation/underlying tones appear in domain-final position in Southern Min, while sandhi tones occur elsewhere. The base tone inventory is given in Table 1 below. In this study, the following three age groups are distinguished, i.e., Group 1: ages 60~80; Group 2: ages 40~60; Group 3: ages 20~40. The LZ-normalized F0 contours from one male Group 3b speaker are plotted as normalized time in Fig. 1. Note also that T4 (Yangshang) is missing because T4 was diachronically merged with Tones 3 or 6 in PH.

Table 1: Base tone inventories in different age groups

	T1	T2	T3	T5	T6	T7	T8
Group1 (n=1)	44	24	51	22	21	3	4
Group2 (n=1)	33	24	53/445	21	21	3	4
Group3a (n=2)	33	23	445	21	21	3	4
Group3b (n=4)	33	23	445/53	21	21	3	4

Figure 1 LZ-normalized F0 contours of base tones from one male Group 3b speaker (note that checked tones are not included)
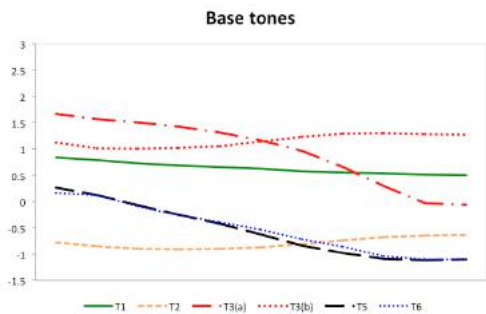
From Table 1, we see that T1, T2, T5, T6, T7 and T8 are more or less identical across these three age groups. Remarkably, however, T3 is a high falling tone for old generation speakers (Group 1), while T3 tends to have two variant forms for mid-aged speakers (Group 2), largely depending on speech style: a high falling tone (53) in careful speech (e.g. recording) vs. a high rising tone (445) in casual speech. For some young generation speakers (i.e. Group 3a), this sound change is completed, i.e. T3 as a base tone is invariably a high rising tone (445). By contrast, for Group 3b speakers, much like the mid-aged speakers, T3 may be either 445 or 53, although our observation is that 53 is outnumbered and is possible on an individual lexical item basis. In other words, the above sound change is not entirely completed in Group 3b.

Regarding sandhi tones, it is evident in Table 2 that the sandhi tone inventories are simplified across all age groups, i.e., a three-way contrast in Group 1 and a two-way contrast in Groups 2 and 3a. We also see in Group 3b that T5' (from base tone T5:21) may be either 44 or 53, again, depending on an individual lexical item basis.

The LZ-normalized F0 contours from one male Group 3b speaker are plotted as normalized time in Fig. 2.

Table 2: Sandhi tone inventories in different age groups

	T1'	T2'	T3'	T5'	T6'	T7'	T8'
Group1 (n=1)	22	21	44	53	21	4	3
Group2 (n=1)	21	21	44	44	21	4	3
Group3a (n=2)	21	21	44	44	21	4	3
Group3b (n=4)	21	21	44	44/53	21	4	3

Figure 2 LZ-normalized F0 contours of sandhi tones from one male Group 3b speaker (note that checked tones are not included)
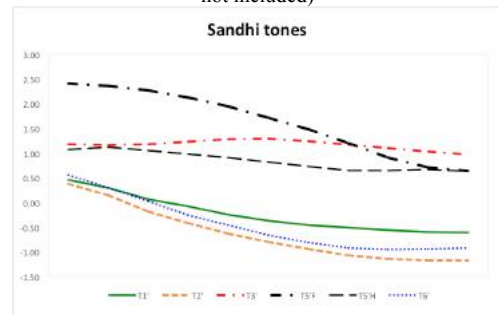
3.2. Complete vs. incomplete neutralization

We have seen in section 3.1 that sandhi tone inventories are reduced to a great extent, especially for the speakers in Groups 2 and 3a. An immediate question, then, is whether or not these sandhi tones are completely neutralized. Our participants consistently report that these sandhi tones are 'the same', for example, T1', T2' and T6' in Table 2.

First, the results of one-way ANOVA for rime duration of the neutralized tones showed no significant difference among sandhi H and L tones (see Appendix I for details).

Second, and more interestingly, the comparison of the tonal contours shows more complex patterns. See below.

Figure 3: SS ANOVA results of sandhi H tones (one representative speaker for each group)
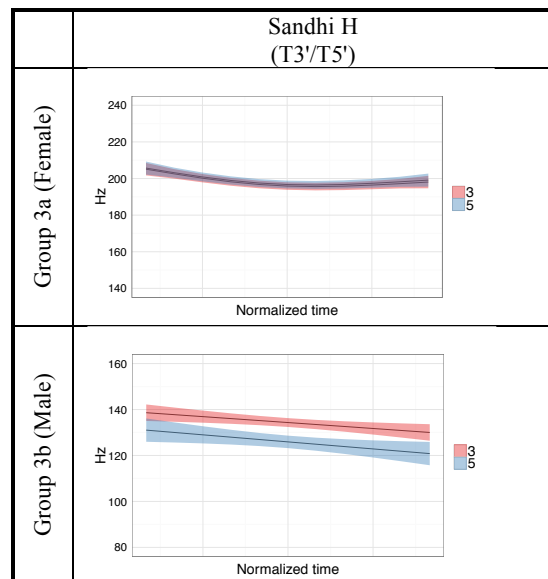
From Fig. 3, we see that there is a sharp difference between Groups 3a and 3b with respect to the SS ANOVA results. T3' and T5' are statistically different for our Group 3b speakers, whereas the two sandhi H tones are not distinguishable for our Group 3a speakers. Recall that overlapping contours mean that the difference between two contours is statistically insignificant. In other words, the present results strongly suggest that the sandhi H tones are not completely neutralized for all young generation speakers (Note that there is only one sandhi H tone for old generation (Group 1) speakers; see also Table 2).

Let us now turn to the sandhi L tones. In Fig. 4, we see that T1' may be significantly different from T2' and T6', although they are all transcribed as a low-falling tone (21). Note again that T1' does not overlap with T2' and T6' for our Group 1 speaker. That is also, *grosso modo*, true for the T1' produced by our Group 3b speakers since at least the second half of the tonal contour of T1' are different from those of T2' and T6'. By contrast, for Group 3a speakers, it is evident from the SS ANOVA results below that T1', T2' and T6' are completely neutralized. In sum, our current finding is that the sandhi L tones are not completely neutralized for all young generation, either. In addition, for old generation speakers (Group 1), the distinction is even more salient.

Figure 4: SS ANOVA results of sandhi L tones (one representative speaker for each group)
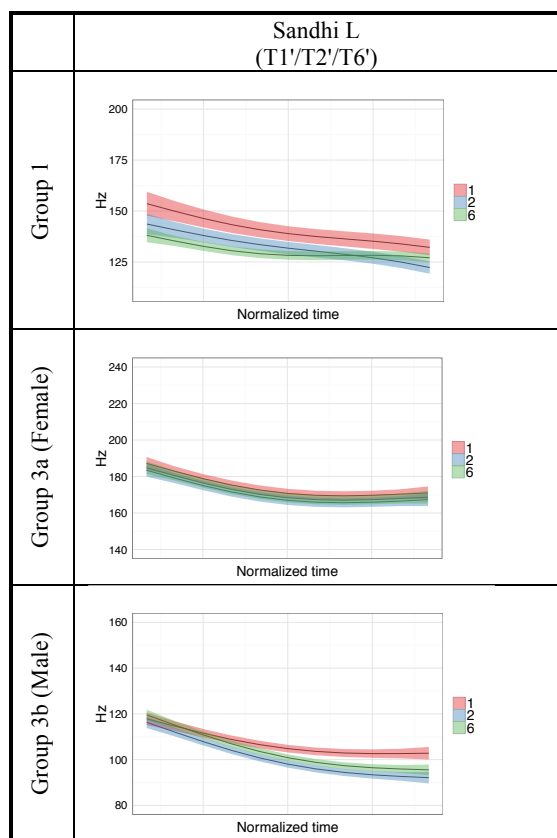
3.3. Summary

Our major findings are summarized as follows. Notice that Y means incomplete tonal neutralization and N complete neutralization. From (1), an important generalization may be attained, i.e., incomplete neutralization is only attested among our Group 1 and Group 3b speakers.

(1) Complete (N) vs. incomplete (Y) neutralization

	Group 1	Group 2[3]	Group 3a	Group 3b
Sandhi H	N/A	N	N	Y
Sandhi L	Y	N	N	Y

4. DISCUSSIONS

4.1. Whence incomplete neutralization?

The most significant discovery in this work is that complete and incomplete neutralization may co-exist within a single language [4]. Under scrutiny, however, it turns out that incomplete neutralization may well be independently motivated, as we have seen in (1). Recall Tables 1 and 2. It is important to note that only Group 3b speakers produce tonal variants. So it is very likely that tonal variation has a strong bearing on incomplete neutralization we have witnessed. Some discussion is in order. First, phonological identity may play a significant role. The two sandhi H tones (T3' and T5') correspond to T3 (445/53) and T5 (21), respectively. So it is not impossible to say that the underlying H vs. L contrast is maintained in sandhi tones because T3 is a high rising/falling tone and T5 is a low-falling tone. Likewise, from Fig. 4, we see that T1' is differentiated from T2' and T6' for both Groups 1 and 3b speakers. Under this view, that is not surprising since T1 is a high level tone (or a High register mid level tone) whereas T2 (low-rising) and T6 (low-falling) belong to the Low register, phonologically speaking. Again, we see that phonetic realization of "higher" and "lower" tones remains distinct throughout. In other words, we can say that contrast preservation is indeed evoked in phonetic implementation. More importantly, the present finding also suggests that the alternations between base and sandhi tones in Southern Min may be regulated, in OT terms, via a correspondence relations, rather than memorized pairs of allomorphs (e.g.[11]). That is to say, phonology identity is, to a great extent, preserved among the sandhi tones (hence incomplete neutralization). Otherwise, it is puzzling why incomplete neutralization is not consistently attested across all young generation speakers.

A further issue is, of course, why Group 3a speakers do not have incomplete neutralization at all. Recall Tables 1 and 2. It is remarkable that sound change is completed in Group 3a because tonal variation is not found. From an exemplar-based perspective (e.g. [13] and references cited therein), it is reasonable to say that a completed sound change may lead to less overlap among exemplar clouds. In other words, more clear-cut phonemic boundaries inhibit incomplete neutralization since fuzzier boundaries are less tolerated. By contrast, if we assume that sound change is attributed to the results of shifts and redistribution of exemplars within the exemplar space, it is then not difficult to understand why Group 3b speakers tend to opt for more incomplete neutralization. Again, it may well be the case that fuzzier phonemic boundaries encourage speakers to maintain a systematic, yet tiny production difference. In sum, the present discussion suggests that the whole picture of incomplete neutralization or near merger is far more complicated than previously assumed. It seems to be the case that both phonological identity and exemplar clouds play a significant role in PH. That is, these two factors may not be mutually exclusive as far as the PH data are concerned.

Finally, as a side remaked, we observed that the T5' sandhi rule may be phonologically conditioned. Recall that T5' has two variants for Group our 3b speakers, i.e. 44 and 53. Interestingly enough, when T5' precedes T3 (a high

falling tone), 80% of T5' in this context surface as a high level tone, suggesting that an OCP constraint is evoked to ban two consecutive high-falling tones.

4.2. The emergence of the high rising tone

Another important issue in the tonal systems of PH is the emergence of the high rising tone (T3) among young generation speakers. Given that rising tones are universally more marked than falling tones ([12, 14]), it is again puzzling why a less marked tone (51) becomes a more marked tone (445) in PH. We suspect that this high rising tone may be due to language contact. It is reported in [6] that Malay has a boundary H tone in phrase-final position. So a high-falling tone (T3 "before sound change"; see Group 1 in Table 1) might be subject to change given that intensive language contact with Malay occurred. Similarly, it is also reported in [5, 8, 10] that stress shifts to word-final position in Singaporean English and stress is normally realized as a high or high rising tone. That is in accordance with our field experience: PH speakers also tend to place stress (a high or high rising tone) in word-final position when they speak English. Therefore, it may well be the case that the marked high rising tone is not grammatically derived.

5. CONCLUSIONS

This paper is a phonetic study of tone and tone sandhi systems in Penang Hokkien, a representative Southern Min (sub)dialect spoken in West Malaysia. Our experimental results show that the tonal systems in this language have undergone some distinctive changes, for example, large-scale tonal neutralization to a binary H vs. L contrast in sandhi position and the emergence of the high rising tone, especially among young generation speakers. These findings are unprecedented in the tone literature of Southern Min and contribute to a more comprehensive understanding of Chinese tonology.

More importantly, with the help of SS ANOVA, a novel statistical analysis for comparing contours, it is experimentally confirmed that incomplete neutralization is arguably attributable to preservation of phonological identity and/or the (non-)completion of sound change (i.e. variation and re-organization of phonemes).

6. ACKNOWLEDGEMENTS

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APPENDIX I

Table 3: Results of one-way ANOVA of the overall duration of the syllable of pairs of near neutralization tones

	Speaker	Sandhi L tones T1'/T2'/T6'	Sandhi H tones T3'/T5'
Type A	ZIE	n.s. $F(2,85)=1.395$	n.s. $F(1,32)=1.715$
	YBH	n.s. $F(2,85)=2.957$	n.s. $F(1,32)=0.011$
Type B	WJP	n.s. $F(2,85)=0.092$	n.s. $F(1,19)=2.265$
	LWN	n.s. $F(2,85)=1.213$	n.s. $F(1,32)=1.3$
	XJW	n.s. $F(2,82)=0.218$	n.s. $F(1,35)=0.571$
	ZMZ	n.s. $F(2,85)=0.323$	n.s. $F(1,22)=0.183$

[1] Penang Hokkien has been considered to be a variety of Zhangzhou-accented dialect (compared to Melaka Hokkien, which is a Quanzhou accented variety). Tonal system of Zhangzhou in China is as follows: T1: 44, T2: 13, T3: 53, T5: 21, T6: 21 in base tone/final position; T1': 22, T2': 22, T3': 44, T5': 53, T6': 21 in sandhi/ non-final position ([4]).

[2] Our field experience is that female young generation speakers tend to use Mandarin and English more frequently even in casual conversations. So it is difficult to find fluent native female speakers of Penang Hokkien.

[3] Note that since Group 2 has similar F0 contour patterns with Group 3a, we do not include the SS ANOVA results here.

[4] An anonymous reviewer questioned if the Penang Hokkien data are really that special by mentioning similar phenomena reported for Thai (e.g. [1],[14]). First, a recent study [13] has convincingly showed that tonal neutralization in Thai is better analyzed as non-neutralizing contour tone simplification at the post-lexical level. Second, and more importantly, Thai does not have BOTH complete and incomplete neutralization of sandhi tones in same prosodic position, to the best of our knowledge.