Squibs
and
Discussion

TONAL CONTOUR AND REGISTER
HARMONY IN CHAOZHOU
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The proper treatment of tonal contour has been a perennially controversial issue in nonlinear phonology. The controversy pits the Africanists, who work mainly on African tone languages, against the Asianists, who work on Asian tone languages, especially Chinese. The fault line predates the advent of generative linguistics. Pike (1948), for example, explicitly recognizes two typologically different tone systems: contour tone systems, which are typical of Asian languages, and terraced-level tone systems, which are typical of African languages.[1] In generative phonology, attempts have been made to analyze contour tone systems with the same theoretical assumptions and representational structure motivated for terraced-level tone systems. Woo (1969) made among the first attempts in that direction, arguing against the feature system proposed by Wang (1967). More recently, Yip (1989, 1992, 1995), Chen (1992, 1996), Duanmu (1990, 1994), Chang (1992), Tsay (1994), and I (Bao 1990, in press) have continued the debate.

In this squib I discuss the tone sandhi facts from one Chinese dialect, Chaozhou, and argue that tonal register is separate from tonal contour. The representation of tone must accommodate the register-contour separation.

1 The Facts

Chaozhou (Teochow in the dialect) is a Southern Min dialect of Chinese spoken in the region comprising southern Fujian Province and northern Guangdong Province, and, owing to emigration, in Southeast Asia. Chaozhou has eight citation tones, as follows:[2]

[1] The terms *Asianist* and *Africanist* are a mnemonic convenience. Some Chinese dialects, for instance, exhibit tone sandhi behaviors that are remarkably similar to those found in African languages; see Chen 1996.

[2] All Chaozhou data are cited from Cai 1991, which is based on the Jieyang subdialect. See also Li 1959 and Yuan et al. 1989.

(1) a. 33   A. 55
    b. 53   B. 35
    c. 213   C. 11
    d. 2   D. 5

The numbers represent relative pitch, 5 being the highest, 1 the lowest. The single-digit tones, (1d,D), are the so-called checked tones, which are realized on syllables ending in *p/t/k/ʔ*. These tones are in complementary distribution with the other six tones. Historically, (1a–d) and (1A–D) are derived from tones that cooccur with voiceless and voiced consonants, respectively. In modern Chaozhou, however, all the tones are contrastive.

    As is typical of Southern Min dialects, the tones, except 33 and 11 (1a,C), undergo sandhi in non-phrase-final position.[3] The patterns are shown in (2).

(2)   *Citation*   *Sandhi*   *Environment*
    a. 33   33   all tones
    b. 53   35   53, 55, 5
                      24   33, 213, 11, 2, 35
    c. 213   53   53, 55, 5
                      42   33, 213, 11, 2, 35
    d. 2   5   53, 55, 5
                      3   33, 213, 11, 2, 35
    e. 55   11   all tones
    f. 35   21   all tones
    g. 11   11   all tones
    h. 5   2   all tones

From (2) we can see that the two checked tones, 2 and 5, behave like 213 and 55, respectively (cf. (2c,d,e,h)). For this reason I will treat

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[3] Tone sandhi in Chaozhou, as in other Southern Min dialects, takes place within a tone group, which can consist of more than two syllables; see Chen 1987. Within a tone group, tone sandhi is iterative, from right to left, as seen in the trisyllabic phrase in (ii).

  (i) hue 35 (<53) tsung 55   'ship'
  (ii) hue 24 (<53) tsung 11 (<55) pu 33   'ship siren'

In (ii) the medial tone triggers the lowering of the first tone. It may appear that it is the surface value of the trigger tone that determines the pitch of the sandhi tone, as pointed out by one reviewer. The matter is more complicated, however. In Chaozhou 53 becomes 21 in phrase-final position. (Other tones do not undergo sandhi in that position.) But the register of the preceding sandhi tone is determined by the citation tone 53, not the surface sandhi tone 21.

  (iii) sang 53 (<213) mia 21 (<53)   'to lose life'
  (iv) pang 35 (<53) png 21 (<53)   'edition'

In fact, it is not important whether the Chaozhou tone sandhi is phonetic or phonological. The register harmony issue remains.
   I am grateful for the reviewers' comments that led to this clarification.

the checked tones as being derived from their unchecked counterparts.[4] I will focus on the sandhi behavior of 53 and 213, which shows influence from the following tones (cf. (2b–c)). I summarize the patterns informally as follows:

(3) a. 53 → $\begin{cases} 35 / \underline{\hspace{1em}} & 53, 55 \\ 24 / \underline{\hspace{1em}} & 33, 213, 11, 35 \end{cases}$

   b. 213 → $\begin{cases} 53 / \underline{\hspace{1em}} & 53, 55 \\ 42 / \underline{\hspace{1em}} & 33, 213, 11, 35 \end{cases}$

From the present perspective, the interesting phenomenon is register harmony: the pitch height of the sandhi tone—its register—is determined by the register of the following tone.[5]

2 The Analyses

The analysis of the facts in (3) crucially depends on the representation of contour tones. I will consider the three models of tone shown in (4).

(4) a. LH   b.   H   c.   t

           l   h   r   c

                              H   l   h
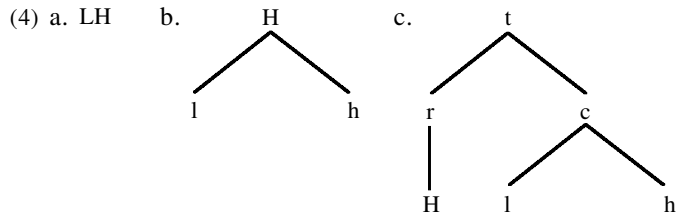
The structures in (4) all represent the high rising tone. H, L, h, l can be defined in terms of the tonal features [upper] and [raised] proposed by Yip (1980, 1989) and Pulleyblank (1986), as follows: H = [+upper], L = [−upper], h = [+raised], and l = [−raised]. (4a) is the Africanist model, which represents the falling tone as a concatenation of level tones. (4b–c) are the Asianist models, which represent

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[4] One may say that the short, checked tones are the first half of their contour tone counterparts, shortened because of the relatively short duration of the checked syllables on which they are realized. Although this is true of Chaozhou, crosslinguistically, tonal contour is independent of the duration of the host syllable; see Yip 1980, 1989, and Bao 1990, in press. The exact formulation of the rules that derive the checked tones from their unchecked counterparts depends on the representation of contour tone, which I will not attempt to specify here.

[5] It has been suggested, as pointed out by one reviewer, that the tone sandhi seen here, and in Southern Min in general, is an example of allomorphy (see Schuh 1978, Chen 1996, Tsay and Meyers 1996). I have argued elsewhere (Bao 1996) that the nature of Southern Min tone sandhi is phonological, not allomorphic. The issue is not crucial for present purposes. An allomorphy analysis still needs to account for the register harmony exhibited in the data.

contour as an integral part of the structure of tone. (4b) is proposed by Yip (1980, 1989) and, with some modification, by Inkelas (1987) and Snider (1990). (4c) is the model that I have proposed (Bao 1990, in press). The major difference between (4b) and (4c) is the relationship between register and contour: in the former, register dominates contour; in the latter, they are sisters. I will show that the Africanist model accounts for the Chaozhou sandhi facts with great difficulty, whereas the Asianist models provide a straightforward account of the same range of facts.

2.1 The Africanist Model

Given the Africanist model, the tonal inventory of Chaozhou is as follows:

> (5) a. 33 M   A. 55 H
>   b. 53 HM   B. 35 MH
>   c. 213 LM   C. 11 L

The difference between 2 and 1 is ignored. Li (1959) describes 213 as having very slight concavity, so treating it as underlyingly rising poses no descriptive problem.

   To account for the facts in (3), we need a rule that turns a fall to a rise (53 → 35) and a rise to a fall (213 → 53), and another rule to determine the proper pitch register (35 and 24, or 53 and 42), in accordance with the pitch of the following tone. I will call the first rule, stated in (6), *Contour Metathesis.*

> (6) *Contour Metathesis*
>   X Y → Y X
>   where X, Y ∈ {H, M, L} and are associated with the same tone-bearing unit.

This rule gives the partial derivation shown in (7) (using (3a) as an example).

> (7) a. HM-HM → MH-HM
>   b. HM-M → MH-M

(7a) is complete; Contour Metathesis derives the correct surface form. (7b) needs a rule to lower MH to LM, owing to the influence of the following M. This rule, which I will call *Pitch Lowering*, can be stated as follows:

> (8) *Pitch Lowering*
>   a. H → M / ____ M, L
>   b. M → L / ____ M, L

The two rules can be considered instances of a single rule applying iteratively. For the sake of clarity, I list them separately. The derivation of (7b) continues as follows (the lowered tone is underlined):

> (9) M<u>H</u>-M → M<u>M</u>-M → <u>L</u>M-M

The long-distance assimilation effect seen in this derivation can be accounted for only through the *simultaneous* lowering of H to M and M to L. This account is ad hoc, since the second iteration of lowering is only triggered by the first iteration; in citation 53 (i.e., HM), M does not lower the preceding H.

The same argument applies to (3b), which involves pitch raising, instead of pitch lowering.

2.2 The Asianist Models

I will now show how the models in (4b–c) account for the same facts. Assuming that citation tones are underlying, Chaozhou tones can be specified as follows:[6]

(10) a. 33   L, h   A. 55   H, h
     b. 53   H, hl   B. 35
     c. 213   L, lh   C. 11   L, l

I will comment on (10B) later. The contour features h, l are dominated either by the register L, H, if we adopt the model in (4b), or by the c node, if we adopt the model in (4c), as exemplified by the representations of 53 in (11).

(11) a. Based on (4b)   b. Based on (4c)
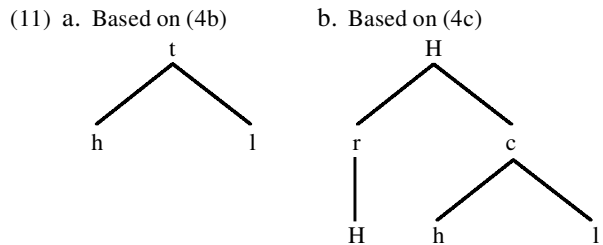
Given the Asianist models, (3a–b) can be seen as instances of register harmony: the sandhi tone and the trigger tone share the same register. Contour Metathesis is formally similar in the two models.

(12) [αraised][−αraised] → [−αraised][αraised]

However, the formulation of Register Harmony differs:[7]

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[6] L,lh is the structure for surface 213 as well as 24, which are in complementary distribution: 213 occurs phrase-finally (including citation forms), 24 in sandhi environments, derived from H,hl through Contour Metathesis and Register Harmony, as we will see.
[7] The rule is intended to apply only to the patterns summarized in (3). To highlight the nature of register harmony, I leave out structural details that are of marginal importance to the issue at hand.

(13) a. [upper] ⟶ [αupper] / ___ [αupper]

   b. t   t

            [αupper]
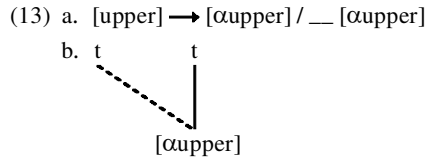
(13a) is based on the tone model in (4b); (13b) is based on the one
in (4c). Formally, (13a) is a feature-changing rule, and (13b) is the
common rule of assimilatory spread. No additional rule is required.
The following derivation illustrates:

(14) a. H,hl-H,hl → H,lh-H,hl   by Contour Metathesis
     b. H,hl-L,h → H,lh-L,h   by Contour Metathesis
            → L,lh-L,h   by Register Harmony

In (14a) Register Harmony applies vacuously, since both tones are H-
registered.

   In current phonological theorizing, assimilation is treated for-
mally as spreading. The model (4c) allows the Chaozhou sandhi to be
expressed as spreading: register spreads without contour. The model
(4b) cannot accommodate it in this manner. Since there is no a priori
reason why the spreading formalism is to be preferred, the difference
between (4b) and (4c) must be settled on empirical grounds. The
Chaozhou data are not decisive on this issue.

   The behavior of 35 (10B) is problematic. On the surface it is a
high rise, which should be specified as H,lh; yet it triggers pitch lower-
ing (see (3)). This can be easily understood in the Africanist model,
since 35 is represented as MH, and why it triggers pitch lowering on
the preceding tone is not mysterious. But in the Asianist models this
behavior is unexpected and needs to be explained.

   Ting (1982, 1989) notes that citation tones are not necessarily
underlying; often it is the sandhi tones that are more basic. 35 is the
citation tone, whose sandhi counterpart is 21, which is L-registered
(see (2f)). If we assume that 35 is derived from an underlying L-
registered tone, the sandhi behavior is expected. We need only assume
that the surface 35 is derived after the application of Register Harmony.

   There is a technical difficulty, however. The Asianist models
allow two contrastive contour tones and four level tones, as shown in
(15).

(15) a. Fall: H,hl   L,hl
     b. Rise: H,lh   L,lh
     c. Level: H,h   H,l   L,h   L,l

When we put the citation tones and sandhi tones together, we have
three falling tones 53, 42, 21; three level tones 55, 33, 11; two rising
tones 35, 24; and one concave tone 213. Since the models only allow
two falling tones, we must treat 21 as a low level tone. But here we
run into difficulty: 33 and 11 are L-registered, since both lower the

sandhi tones. What is the structure for the tone that surfaces as 35 in citation form and 21 in sandhi form?

One way out of this quandary is underspecification. We can underspecify the tone in question as [−upper] and fully specify all other tones as in (10). To show the tones clearly, I reproduce the unchecked tones from (2) in (16) and add one column showing the underlying representation (UR) of the tones.

(16)

	Citation	*Sandhi*	*UR*	*Environment*
a.	33	33	L,h	
b.	53	35	H,hl	53, 55
		24		33, 213, 11, 35
c.	213	53	L,lh	53, 55
		42		33, 213, 11, 35
d.	55	11	H,h	
e.	35	21	L,#	
f.	11	11	L,l	

stands for the unspecified contour feature [raised]. L,# eventually surfaces as 21 in sandhi position and 35 in citation position.[8]

3 Conclusion

Chaozhou tone sandhi, specifically the sandhi behavior of 53 and 213, bears on the representation of tonal contour. After comparing alternative analyses based on the Africanist and Asianist models, I conclude that the Chaozhou data provide strong evidence in favor of the Asianist models. To account for the register harmony evident in Chaozhou tone sandhi, tonal contour must be represented as an integral part of tone, either as daughter of register (4b) or as sister of register (4c).

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[8] One reviewer points out that since the sandhi tones are H-registered before 53 and 55, but not before 35, we can formulate a rule that spreads the H register leftward only when the trigger starts with h. This analysis would assume that the sandhi tones for 53 (H,hl) and 213 (L,lh) start as L-registered, and would view register harmony as register raising. This entails the following derivation (affected elements are underlined):

(i) a. H,hl-H,h → L̲,l̲h̲-H,h → H̲,lh-H,h
    b. H,hl-L,h → L̲,l̲h̲-L,h

It is worth noting, however, that under the register-raising analysis, the sandhi behavior of 35, with the structure H,lh, is no longer problematic. Since it starts with l, it does not induce register raising. By contrast, the present analysis does not assume that the sandhi tones of 53 and 213 are L-registered, and Register Harmony, as formulated in (13), captures a more general assimilatory process involving the register. The harmonizing behavior of 35 becomes problematic.

Whatever the analysis, the sandhi behavior of 35 does not pose a serious problem for the conclusion that register and contour need to be represented separately. The main part of the Chaozhou tone sandhi, summarized in (3), remains robust in its theoretical implications.

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BARE SINGULAR EFFECTS IN
  GENITIVE CONSTRUCTIONS
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Number agreement facts in genitive constructions argue that the numeral and genitive in cases like (1) form a constituent, as indicated by the bracketing.

(1) a. [One woman's] keys fell on the floor.
    b. *[One women's] keys fell on the floor.

Our intuitions about the contrast in (2) suggest a possible further agreement relationship between a plural numeral like *two* and the head noun. In other words, with *two*, not only the genitive, but also the head noun, must be plural. If the agreement internal to the bracketing were sufficient, both of the examples in (2) should be grammatical.

(2) a. *[Two women's] key fell on the floor.
    b. [Two women's] keys fell on the floor.

These types of facts have been noted by Barker (1995:35–36) and Crisma (1997:156), although no account has been offered for the contrasts.[1]

    [1] Although Crisma (1997:154–157) does not offer a syntactic explanation for these facts, she does provide an interesting feature-based approach to (null)