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AN OPTIMALITY ACCOUNT OF THE VARIABILITY OF THE THIRD
TONE SANDHI DOMAIN IN MANDARIN*

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Abstract: In this paper I use the framework of Optimality Theory to explain the possible tonal patterns of continuous third tones in Mandarin. The constraints indicate that the third tone patterns are sensitive to the syntactic structures, such as complement and adjunct.

1. Introduction

Mandarin third tone sandhi applies across the word boundary, given (1).¹

- (1) a. Gou pao le.
dog run ASP 'The dog ran away.'
3 3 N UT
2 3 N ST
- b. Xiao gou pao le.
*small dog run ASP 'The small dog ran away.'
3 3 3 N UT
2 2 3 N ST

The OCP-type of tone sandhi rule disallows two consecutive third tones in Mandarin.² In (1), the first third tone (T3) of the consecutive third tones changes to the second tone (T2). In the traditional generative framework of rules-and-derivations phonology, third tone sandhi rule would need to apply cyclically to account for the above Mandarin data. In this paper I provide a one-step analysis in the current framework of Optimality Theory (OT). I will show that the proposed OT approach is superior to derivational analysis in two aspects. First, it provides an account for all well-formed tonal patterns. Second, this constraint-based analysis which allows minimal violation shows that phonology interacts with other components in the grammar, namely morphology and syntax. Third, this

study sheds light on the emergence of the avoidance of the consecutive third tone sandhi, which turns out not to be a surprising phenomenon.

The paper is organized as follows. In section 2, I investigate the avoidance of the third tone sandhi. I provide a one-step analysis in Section 3 in the framework of OT (Prince and Smolensky 1993). I also explore the universality of the constraints with the support of other tone languages. The paper concludes in Section 4 with the discussion of the consequences and implications of this study.

2. The Avoidance of the Third Tone Sandhi: Category Dependent?³

In gathering my Mandarin data, I consulted native speakers and Zhang (1997). The five tones in Mandarin are T1 (High), T2 (Rising), T3 (Low), T4 (Falling) and a neutral tone (cf. Chao 1968, among others). Consider the following sentences taken from Zhang (1997:293-294).

(2)	<i>gou bi ma xiao.</i>	
	dog than horse small	'The dog is smaller than a horse.'
	3 3 3 3	UT
	(2 3) (2 3)	ST1 (unmarked, moderate)
	3 (2 2 3)	ST2 (unmarked, moderate) ⁴
	(2 2 2 3)	ST3 (presto)
(3)	<i>ma hen shao hou</i>	
	horse very seldom roar	'Horses seldom roar.'
	3 3 3 3	UT
	* <u>(2 3) (2 3)</u>	ST1
	3 (2 2 3)	ST2
	(2 2 2 3)	ST3

The T3 sandhi domain may be the entire syntactic clause (Shih 1986, Zhang 1997), or the domain may be more than one. For instance, both sentences in (2) and (3) form one sandhi domain, given ST3 in (2) and ST3 in (3). The well-formed ST1 and ST2 in (2) indicate that *gou bi ma xiao* forms two sandhi domains. Yet *ma hen shao hou* forms only one T3 sandhi domain, given ill-formed ST1 in (3). Zhang (1997) points out that the avoidance of the tone sandhi occurs in the second syllable in (2), but not in (3). The added underline shows the surface T3 which avoids the tone sandhi. Zhang (1997:294-295) claims that in general, prepositions may keep the third tone without applying the tone sandhi under the term 'category dependency in avoidance of tone sandhi.'

However, I noticed that the monosyllabic subject NP *gou* 'dog' in (2) and *ma* 'horse' in (3) may avoid the application of the sandhi, given the correct tonal

pattern 3223 in both sentences. Consider the following sentence with a disyllabic subject, where the tone sandhi may not be applied.

- (4) Xiao gou wang bei pao le.
 small dog toward north run ASP 'The small dog ran toward the north.'
 3 3 3 3 3 N UT
 (2 3) (2 2 3) N ST1
 (2 2 3) (2 3) N ST2
 (2 2 2 2 3) N ST3
 *3 (2 3) (2 3) N

In addition, verbs may also avoid the T3 sandhi. This is shown in (5) and (6).

- (5) Xiao-Bao yao nai-zue ma?⁵
 Xiao-Bao bite pacifier PRT 'Does Xiao-Bao use a pacifier?'
 3 3 3 3 3 N UT
 (2 3) (2 2 3) N ST1
 (2 2 3) (2 3) N ST2
 (2 2 2 2 3) N ST3
 *3 (2 3) (2 3)
 *(2 2 2 3) 3
 *(2 3) (2 3) 3
- (6) Ni you da-bian ma-yi le.
 You again hit-flat ant ASP 'You smashed the ant again.'
 3 4 3 3 3 3 N UT
 3 4 (2 3) (2 3) N ST1
 3 4 (2 2 2 3) N ST2
 *3 4 3 (2 2 3)

In (5), the avoidance of the tone sandhi is shown in the second syllable of the disyllabic subject (ST1) and in the monosyllabic verb (ST2). The second syllable of the resultative compound verb *da-bian* 'hit flat' may also avoid the third tone sandhi, given ST1 in (6). In addition, the components of the compound are always in the same sandhi domain. Otherwise the tonal patterns are unacceptable, given the ungrammatical patterns in (4) and those in (5).

In summary, empirical evidence discussed above reveals that prepositions are not the only category that may avoid the third tone sandhi. We have seen that subject NPs, verbs and adverbs may also show avoidance of the third tone on the surface. I conclude that the avoidance of the third tone is not a particular characteristic of prepositions.

The empirical evidence also suggests that wherever the domain ends, the last syllable of the domain always stays as the third tone. Thus the avoidance of the third tone sandhi, which Zhang (1997) and other linguists (Shih 1986, 1989, Zhang 1988, Hung 1989, Chen 1990, Hsiao 1991, Jin 1993, among others) view in taking the entire sentence as one tone sandhi domain, actually occurs whenever the sentence allows more than one sandhi domain. For instance, in fast speech the entire sentence is a tone sandhi domain, given ST3 in (2)-(6), where the avoidance of the third tone is not found. The task then, is to explore how a sentence of consecutive third tones breaks into several tone sandhi domain. I will address this point in the following section.

3. An OT Approach

In this section of the paper, I adopt the ideas now being explored within the framework of OT, based on Prince and Smolensky (1993), and propose five relevant constraints. I will show that the avoidance of the T3 sandhi emerges in this one-step analysis.⁶ The two-step OT analysis (Zhang 1997) requires two tableaux in deriving all the well-formed tonal patterns of sentences containing a preposition. The one-step OT analysis is superior to the two-step OT analysis in at least two viewpoints. First, I have shown in section 2 that the assumption of the two-step analysis, namely prepositions are the only category that avoids the tone sandhi in consecutive T3 environment is not correct. The two-step analysis captures the intuition that the avoidance of the T3 sandhi may take place in subject NPs, adverbs and other categories in addition to prepositions. Second, the one-step analysis which generates all the well-formed tonal patterns in one tableau is more economical than the two-step analysis, which requires two tableaux deriving all the well-formed surface forms that contain prepositions.

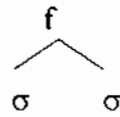
3.1 Ranked Constraints

I will propose five structural constraints. The first structural constraint is *33, following Zhang (1997:307), which bans any output with two consecutive third tones.

- (7) *33: No adjacent third tones are allowed.

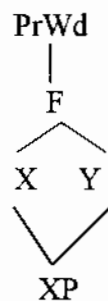
The second structural constraint is inspired by the Foot Formation Rule and Word Formation Rule (Feng 1996, 1997a, 1997c).

(8) Foot Formation Rule in Chinese (Feng 1996:355; 1997c:235)



A standard foot must be formed by at least two syllables.

(9) Word Formation Rule in Classical Chinese (Feng 1996:362; 1997c:238)



X and Y form a prosodic word, iff the combination of X with Y simultaneously satisfies the syntactic and prosodic conditions of being a phrase and a foot, respectively.

Feng (1996:362) further points out that X and Y in (9) through repeated use will attach together and 'form an Idiomatized PrWd, which can easily be further lexicalized as a compound.' Given (9), *Xiao-Bao* in (5) forms a disyllabic foot and has lexicalized to a compound. The observation is that the components of a compound are always in the same T3 sandhi domain. Otherwise the tonal pattern is ungrammatical. For instance, *Xiao-Bao* and *nai-zue* 'pacifier' in (5) are both compounds. Separating the monosyllabic components of a compound to different sandhi domains results in a grammatical error. This is shown below.

- (10) (=5) *Xiao-Bao yao nai-zue ma?*
Xiao-Bao bite pacifier PRT 'Does Xiao-Bao use
 pacifier?'

3	3	3	3	3	N	UT
(2	3)	(2	2	3)	N	ST1
(2	2	3)	(2	3)	N	ST2
(2	2	2	2	3)	N	ST3
*3	(2	3)	(2	3)	N	

*(2 2 2 3) 3 N
 *(2 3) (2 3) 3 N

In light of the empirical evidence, I propose the second constraint Lexical Integrity (LI), stated in the following:

- (11) Lexical Integrity (LI)
 The components of a compound are always in the same T3 sandhi domain.

LI ensures that components of compounds stay together in one sandhi domain, which arises to the avoidance of the T3 sandhi. In essence, the avoidance takes place when more than one sandhi domain is allowed. LI provides the situation that predicts the avoidance. In addition, LI mirrors the spirit of the Lexical Integrity Hypothesis (Huang 1984:61), in that the tone sandhi domain must not separate the components of a word.

- (12) Lexical Integrity Hypothesis
 No phrase-level rule may affect a proper subpart of a word.

Anderson (1995) along the line of Huang, proposes Integrity(Word), which disallows introduction of new material inside a phonological word. LI in this sense bans the boundary of tone sandhi domain between the subparts of compounds. Thus LI draws a line between compounds and others, in that the tonal patterns of compounds are morphologically constrained.

Now we proceed to the problem: what is the difference between PP and AdvP, since the latter shows avoidance of the T3 sandhi (3) but the former does not (4)? I discovered that the head and the complement of an XP are more likely to be in separate T3 domains than the adjunct and the head of an XP. The following illustrates this point, wherein the head and its complement are underlined, and parentheses indicate the edge of a T3 sandhi domain.

- (13) a. Gou wang bei zou .
 dog toward north walk 'The dog walked toward north.'
 3 3 3 3 UT
 (2 3) (2 3) ST1
 3 (2 2 3) ST2
 (2 2 2 3) ST3
- b. Wo ba gou da-pao le.
 I BA dog hit-run ASP
 'I hit the dog so much that the dog ran away.'

3	3	3	3	3	N	UT
(2	2	3)	(2	3)	N	ST1
3	(2	3)	(2	3)	N	ST2
(2	2	2	2	3)	N	ST3

Both *wang bei* and *ba gou* contain a head (*wang*, *ba*) and a complement (*bei*, *gou*).⁷ Notice that the head may either be in the tone sandhi domain with the preceding syllable (ST1) in both sentences, or not (ST2). In addition, the relationship of the constituents is head-and-complement in both phrases. Now, consider (14).

- (14) a. (=1b)
 Xiao gou pao le.
 small dog run ASP
 'The small dog ran.'
 3 3 3 N UT
 (2 2 3) N ST
 *3 (2 3) N
- b. (=3)
 Ma hen shao hou.
 horse very seldom roar
 'Horses seldom roar.'
 3 3 3 3 UT
 3 (2 2 3) ST1
 (2 2 2 3) ST2
 *(2 3) (2 3)

In contrast with (13), sentences in (14) show that the underlined constituents must be in the same tone sandhi domain. In (14a), the head *gou* and its modifier *xiao* must be in the same sandhi domain, so are the head *shao* and its modifier *hen* in (14b). Otherwise the tonal patterns are unacceptable. The connection between the components in both cases is a head-adjunct relation.⁸ Thus the generalization is captured in the following constraint:

- (15) Minimal T3 Sandhi Domain (MIN)
 The head and its adjunct of a disyllabic XP are always in the same T3 sandhi domain.

Notice that instead of stating the boundary of the tone sandhi domain, MIN specifies that the head and the adjunct are always together, thus allowing the possibility that constituents in the sentence which are outside the disyllabic XP be in the same domain with the XP. In this vein, MIN confines the syntactic head-adjunct relation in phonology, which reveals that the tonal pattern of consecutive

third tones is syntactically constrained. On the other hand, LI entails that the behavior of the consecutive third tones is morphologically constrained, which is motivated by the Word Formation Rule.

The fourth constraint is EdgeMost, which ensures that T3 in the left edge of the input must change, and that T3 in the right edge must not change.

- (16) EdgeMost (EdgM)
 " T31, T32.....T3n,
 T31 must change to T2, and T3n must not change.

EdgM and *33 together ensure that the optimal candidates do not have any other tone except T2 and T3. This is because while *33 bans any consecutive third tones, EdgM further specifies that for every T3T3, the first T3 can only change to T2 (not T1 or T4, for instance). EdgM and *33 are thus closely related, in that violation of EdgM often triggers violation of *33. In addition, we cannot merge EdgM and *33 into one constraint. This is because EdgM is violable but *33 is inviolable, which I will discuss shortly.

The fifth constraint concerns alignment, which specifies that each polysyllabic compound itself is a tone sandhi domain.

- (17) ALIGN
 a. Align (L, compound; L, T3 sandhi domain)
 The left side of a compound coincides with the left side of the T3 sandhi domain.
 b. Align (R, compound; R, T3 sandhi domain)
 The right side of a compound coincides with the right side of the T3 sandhi domain.

One point is crucial here. First, MIN and ALIGN are not language specific constraints, nor are any other constraints in the OT framework. One of the tenets of OT is that the constraints are universal, and that the difference lies only in the order of the ranking of the constraints. MIN and ALIGN are inactive in tone-less languages, but they are relevant in tone languages. Bao (1996) proposes the following constraints in the OT framework in the study of the tone sandhi phenomena in Xiamen, Shanghai and Chaozhou.

- (18) ALIGN: (Bao 1996:42)
 a. Xiamen: ALIGN{R, Xmax, R, TG}
 b. Shanghai: ALIGN{L, LexMax, L, TG}

- (19) ANTI-ALIGN (both Xiamen and Shanghai) (Bao 1996:43)
 No edge of X0 coincides with an edge of TG⁹.

Bao further points out that in Xiamen, ANTI-ALIGN dominates ALIGN, and the opposite is true for Shanghai. In other words ANTI-ALIGN is inviolable in Xiamen but violable in Shanghai. (18a) as a constraint applies to XP, which mirrors MIN. (18a) differs from MIN, however, in that (18a) does not refer to the grammatical function of an XP, which is crucial in Mandarin. (18b) concerns Xo, and LI is its counterpart in Mandarin. ANTI-ALIGN would be inactive in Mandarin, in that ALIGN stated in (17) is active. To recapitulate, MIN, LI and ALIGN are not isolated nor language specific. We found support from other Chinese languages that the interface of syntax and phonology and that of morphology and phonology are crucial in the studies of tonal patterns at the clause level. In addition, the inviolable *33 which reflects the spirit of OCP is also universal (see Myers 1997 for dissimilatory effects from the OCP in Bantu languages), though it may rank low in other languages.¹⁰

In Mandarin, ALIGN is another violable constraint in addition to EdgM. It is obvious that when there is one or more third tones to the right of a compound, the right edge of the tone sandhi domain may not always correspond exactly to that of the compound. The optimality-theory principle of minimal violation in this vein distinguishes itself from the rules-and-derivations analysis, which does not allow violation of constraints. The OT clearly lays down the ground for violation: the constraint must be satisfied except that in doing so violates a more important constraint. Take EdgM for example. Suppose *33, LI and MIN are inviolable, and that EdgM and ALIGN are ranked lower. LI is not relevant when the input does not have compounds, nor is MIN when the input does not have any adjuncts. ALIGN becomes negligible when the input does not contain any compounds. Now consider (20), where * = a violation, ! = the point at which a candidate is rejected, F = optimal candidate. The dotted line between the constraints entails that these two constraints are not seriously ranked. Parentheses indicate the boundary of T3 tone sandhi domain. The output is rejected at the point it has a fatal violation. The irrelevant cells are shaded.

(20) (=4) Xiao gou wang bei pao le. 'The small dog ran toward the north.'

33333N	*33	MIN	EdgM
a. 3(223)3N	*!	*!	*
b. (23)(23)3N	*!		
☺c. (223)(23)N			
☺d. (22223)N			
e. 3(23)(23)N			
☺f. (23)(223)N			

In (20), *xiao gou* is underlined in the input, because it contains an adjunct and a head. Notice that (20b) satisfies EdgM, yet in doing so triggers the violation of *33, which is inviolable. EdgM must ranked lower than *33. Thus (20b) is correctly predicted as ill-formed. (20a) fatally violates all three candidates. The inviolable MIN tallies (20e). The well-formed tonal patterns are also correctly predicted. (20c) (20d) and (20f) are optimal because they do not violate any constraints which are inviolable. The general picture emerges from (20) is that violation of *33 and MIN are fatal. Now, consider (21).

(21) (=5) *Xiao-Bao yao nai-zue ma?* 'Does Xiao-Bao use the
pacifier?'

33333N	*33	LI	ALIGN	EdgM
☺a. (23)(223)N				*!
b. (23)(23)3N	*!	*	*	*
☺c. (223)(23)N				
☺d. (22223)N			**	
e. 3(23)(23)N		*!	*	**
☺f. (23)(23)2N		*!	*	*

Both *Xiao-Bao* and *nai-zue* are underlined in the input as compounds. The ill-formed candidates are correctly predicted due to the violation of the higher ranked *33 and LI. (21a) violates ALIGN because the left edge of *nai-zue* 'pacifier' does not correspond to the left edge of the tone sandhi domain. This violation is not fatal, because the higher ranked constraints are obeyed. (21b) is rejected at the point it rejects the higher ranked *33 and LI. (21c) violates ALIGN because the right edge of *Xiao Bao* does not match the right edge of the tone sandhi domain. *Xiao-Bao* is in. (21d) violates ALIGN twice. Again the violation of (21c) and that of (21d) are not fatal. (21e) fatally violates LI because *nai-zue* 'pacifier' is separated into two tone sandhi domains. (21f) also violates LI, which is fatal.

Notice that (21a) and (21c) violate ALIGN, and that (21d) violates ALIGN twice. Yet they do not violate higher ranked *33 and LI. In other words, in comparison with other candidates, (21a) (21c) and (21d) conform better with the ranked body of constraints than the rest of the candidates. This is another crucial tenet of OT, given that optimal candidates may not obey all the constraints.

In addition, LI and ALIGN are only relevant when the input contain compound(s). The violation of LI always triggers violation of ALIGN, given (21b,e,f), but not vice versa (21a).

Until now we have determined that *33, LI and MIN are equally ranked and that they are higher than EdgM and ALIGN. Now we turn to the lower ranked constraints. Are they equally ranked? Consider the following tableau.

(22) Gou pao le. 'The dog ran away'

33N	*33	EdgM
a. (33)N	*!	*
b. (32)N		**!
c. (23)N		

(22) omits LI, MIN, and ALIGN because the input does not contain compounds and adjuncts. (22a) violates *33, thus it is rejected. Despite the fact that (22b) complies with the *33 constraint, its double violation of the lower ranked EdgM results in its rejection as well. Thus we conclude that (22c) is the optimal candidate. Since double violation of EdgM is crucial (22b) and double violation of ALIGN (21d) is not, EdgM must dominate ALIGN.

In summary, the ranking of the proposed constraints are illustrated below, where >> signifies dominance:

(23) *33, LI, MIN >> EdgM >> ALIGN

3.2 More Tableaux

Now we have determined the ranking of the constraints. The following illustrates how the OT analysis predicts the tonal patterns accurately.

(24) Xiao-Bao pao le. 'Xiao-Bao ran away.'

333N	*33	LI	EdgM	ALIGN
a. (23)3N	*!			*
☺ b. (223)N				
c. 3(23)N		*!	**	**
d. (32)3N			**!	

Xiao-Bao is a disyllabic compound, which is indicated by the underline in the input. (24a) is rejected at the point it violates the higher ranked *33. (24c) is rejected also, because it violates the higher ranked LI. (24d) violates EdgM twice, which is also a fatal violation.

(25) (=2) Gou wang bei zou. 'The dog walked toward

3333	*33	EdgM
☺ a. (23) (23)		
☺ b. 3(223)		*
c. (223)3	*!	
☺ d. (2223)		

The prepositional phrase *wang bei* 'toward north' consists of a head and a complement, thus MIN is not relevant in (25). The minimally violated EdgM tallies the first unchanged T3 in the (25b). This is not a fatal violation,¹¹ because (25b) only violates the lower ranked EdgM once. In contrast, when the candidate violates EdgM twice (24b), it is rejected. (25c) fatally violates *33, therefore causing its rejection. The optimal candidates, correctly predicted as well-formed tonal patterns, are thus derived.

(26) (=3) Ma hen shao hou. 'Horses seldom roar.'

3333	*33	MIN	EdgM
☺ a.3 (223) N			
b. (23)(23)	*!	*!	*
c. (223)3	*!		
☺ d. (2223)N			**
e. 3(23)2			**!

MIN tallies any output which separates the head and the adjunct into two T3 sandhi domains. In (26b), the head *shao* and the adjunct *hen* are not in the same sandhi domain. Thus (26b) fatally disobeys MIN. (26c) violates *33, which is also

a fatal violation. (26e) does not violate the higher ranked constraints. However, it disobeys EdgeM twice, because the left edge of the input does not change but the right edge of the input changes, which is contrary to EdgM. Therefore (26e) is not favored.

(27) (=6) Ni you da-bian ma-yi le. 'You smashed the ant again.'

34 33 33 N	*33	LI	EdgM	ALIGN
☺ a. 34(23)(23)N				*!
b. 343(223)N		*!	*	*
c. 34(223)3N	*!			
☺ d. 34(223)N				**
e. 343(23)3N	*1	**	*	***
f. 343(23)2N		**!	**	***

The resultative verb compound *da-bian* 'strike-flat=smash' and the compound noun *ma-yi* 'ant' are underlined in the input. They are always in the same T3 sandhi domain, according to LI. Thus the candidates that disobey LI are rejected. Notice that violation of LI and violation of ALIGN again accompany each other.

In summary, I have shown that the proposed OT analysis successfully predicts the well-formed tonal patterns. An important result of this one-step approach is that avoidance of T3 sandhi arises from the principle of minimal violation of a set of ranked constraints, which reveals the interaction of morphology, syntax and phonology.

4. Concluding Remarks

The constraints proposed in this OT approach reflect the fundamental issue behind the patterns of consecutive third tones in Mandarin. First, the tonal pattern is morphologically constrained, in that the components of a compound must be in the same T3 sandhi domain. Second, the tonal pattern is also syntactically constrained, which disallows head and its adjunct of a disyllabic XP in different T3 sandhi domains. Thus the tonal patterns are syntactically and morphologically constrained, so that the avoidance of T3 sandhi emerges.

This study also reveals that the OT approach to the tonal patterns of consecutive third tones in Mandarin provides a better solution than the traditional rules-and-derivations phonology. The well-formed tonal patterns are sometimes

multiple, which results in a situation too complex for the traditional analysis. At most, the rules-and-derivations approach would provide the tone sandhi rule 3->2/_3, plus an ad hoc solution for why some constituents are insensitive to the rule. On the other hand, the current OT analysis offers a more complete explanation for the variability in the domains of the T3 sandhi. Finally, this study shifts the focus of a pure suprasegmental problem from the perspective of a single component to other components of the grammar, which stresses the interaction of phonology with morphology and syntax.

NOTES

* This paper represents one of the results of the in-progress research on tone sandhi. I thank San Duanmu, Shengli Feng and Michael Henderson for their helpful comments and suggestions. Special thanks also go to Katie Keel.

¹ The following abbreviations are used in the examples throughout the paper:

ASP: the aspect marker

N: neutral tone

PRT: particle

OCP: Obligatory Contour Principle: Adjacent identical elements are prohibited. (cf. Leben 1978, McCarthy 1986)

² The sandhi rule also applies within the word. For instance, the disyllabic compound noun *zhan-zhuan* 'to take a roundabout course' has underlying tone 33 and surface tone 23.

³ A note is in order on my use of 'avoidance of the third tone sandhi.' The tone sandhi in nature is applied cyclically in the environment of consecutive third tones. For instance, any underlying 3333 will change to 2223 on the surface. If the surface tonal pattern is 2323, the avoidance takes place in the second syllable (underlined). Thus the 'avoidance of the third tone sandhi' is not equivalent to 'avoidance of consecutive third tones on the surface.' The latter is in essence the sandhi rule.

⁴ ST1 and ST2 are similar semantically. Basically all the surface well-formed tonal patterns do not differ much semantically.

⁵ I assume that the sentence final aspect markers *le* and the question marker *ma* are particles instead of clitics, following Dai (1992). The sentential particles always carry a neutral tone (cf. Shao 1968).

⁶ I will not review the two-step OT analysis in this paper due to lack of space.

⁷ Note that the resultative verb compound *da-pao* ‘hit-run’ forms a disyllabic foot, and it will be constrained by LI.

⁸ Duanmu (1995, 1997a, 1997b) argues that a modifier and noun, namely [M N], is a compound noun, and [M de N] is an NP. With this view, LI will constrain *xiao gou* ‘small dog.’ Yet regardless *xiao gou* is a compound noun or an NP, my analysis correctly predicts that *xiao* and *gou* must be in the same sandhi domain. In addition, the distinction of head-adjunct and that of head-complement proposed in this paper remain intact. Furthermore, the argument made here is also relevant to *han shao* ‘seldom’.

⁹ TG stands for tone group.

¹⁰ Bao (1996) mentions that similar tone sandhi found in Xiaomen are also found in Chaozhou, another southern Min dialect. In this vein, the constraints actively apply to Xiamen are also relevant in Chaozhou.

¹¹ The three optimal candidates are correctly predicated as well-formed. The violation of the lower ranked EdgM is minimal and not fatal, because it complies with the higher-ranked *33.

Notes

* I thank San Duanmu, Shengli Feng and Michael Henderson for their helpful comments and suggestions. I also thank Katie Keel for proofreading.

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OCP: Obligatory Contour Principle: Adjacent identical elements are prohibited. (cf. Leben 1973, 1978, McCarthy 1986)

² The sandhi rule also applies within the word. For instance, the disyllabic compound noun *zhan-zhuan* ‘to take a roundabout course’ has underlying tone 33 and surface tone 23.

³ A note is in order on my use of ‘avoidance of the third tone sandhi.’ The tone sandhi in nature is applied cyclically in the environment of consecutive third tones. For instance, any underlying 3333 will change to 2223 on the surface. If the

⁶ I will not review the two-step OT analysis in this paper due to lack of space.

⁷ Note that the resultative verb compound *da-pao* 'hit-run' forms a disyllabic foot, and it will be constrained by LI.

⁸ Duanmu (1995, 1997a, 1997b) argues that a modifier and noun, namely [M N], is a compound noun, and [M de N] is an NP. With this view, LI will constrain *xiao gou* 'small dog.' Yet regardless *xiao gou* is a compound noun or an NP, my analysis correctly predicts that *xiao* and *gou* must be in the same sandhi domain. In addition, the distinction of head-adjunct and that of head-complement proposed in this paper remain intact. Furthermore, the argument made here is also relevant to *han shao* 'seldom'.

⁹ TG stands for tone group.

¹⁰ Bao (1996) mentions that similar tone sandhi found in Xiaomen are also found in Chaozhou, another southern Min dialect. In this vein, the constraints actively apply to Xiamen are also relevant in Chaozhou.

¹¹ The three optimal candidates are correctly predicated as well-formed. The violation of the lower ranked EdgM is minimal and not fatal, because it complies with the higher-ranked *33.

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multiple, which results in a situation too complex for the traditional analysis. At most, the rules-and-derivations approach would provide the tone sandhi rule 3->2/_3, plus an ad hoc solution for why some constituents are insensitive to the rule. On the other hand, the current OT analysis offers a more complete explanation for the variability in the domains of the T3 sandhi. Finally, this study shifts the focus of a pure suprasegmental problem from the perspective of a single component to other components of the grammar, which stresses the interaction of phonology with morphology and syntax.

NOTES

* This paper represents one of the results of the in-progress research on tone sandhi. I thank San Duanmu, Shengli Feng and Michael Henderson for their helpful comments and suggestions. Special thanks also go to Katie Keel.

¹ The following abbreviations are used in the examples throughout the paper:

ASP: the aspect marker

N: neutral tone

PRT: particle

OCP: Obligatory Contour Principle: Adjacent identical elements are prohibited. (cf. Leben 1978, McCarthy 1986)

² The sandhi rule also applies within the word. For instance, the disyllabic compound noun *zhan-zhuan* 'to take a roundabout course' has underlying tone 33 and surface tone 23.

³ A note is in order on my use of 'avoidance of the third tone sandhi.' The tone sandhi in nature is applied cyclically in the environment of consecutive third tones. For instance, any underlying 3333 will change to 2223 on the surface. If the surface tonal pattern is 2323, the avoidance takes place in the second syllable (underlined). Thus the 'avoidance of the third tone sandhi' is not equivalent to 'avoidance of consecutive third tones on the surface.' The latter is in essence the sandhi rule.

⁴ ST1 and ST2 are similar semantically. Basically all the surface well-formed tonal patterns do not differ much semantically.

⁵ I assume that the sentence final aspect markers *le* and the question marker *ma* are particles instead of clitics, following Dai (1992). The sentential particles always carry a neutral tone (cf. Chao 1968).

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