On Non-recycling of Tonal Derivation in Chinese Dialects*

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ABSTRACT

This paper argues that No-Backtracking proposed by Chen (2000:115, 159) to deal with directionality and interacting sandhi processes in Chinese dialects can be subsumed under the more general One Step Principle (OSP henceforth), which prohibits a derived tone serving as input to another sandhi rule. Ample cross-linguistic evidence for OSP comes from Taiwanese secret language, Changting, Tianjin, Dongshi Hakka, and Yaoping. The interaction of OSP with other constraints, such as Well-Formedness Condition and Temporal Sequence, well illustrates dialect variation. All possible efforts we can make to translate OSP into optimality terms are futile. OSP even finds a counterpart in segmental derivation of Chinese secret languages.

Key Words: tonal derivation, One Step Principle

1. Introduction

What is special about Chinese dialects? For most people, the instinctive answer is tone. Of particular interest is that changes may occur when one tone is juxtaposed to another. It is not surprising that with an earlier history than intensive generative research on segmental phonology, tone sandhi has engaged many formal studies in the past decades (Cheng 1973, Yip 1980, Chan 1985, Shih 1986, Hung 1987a, Zhang 1988, Duanmu 1990, Bao 1990b, 1999, Hsiao 1991, Lin 1992, Zhang 1992, Hsu 1994, Chan 1998, Chen 2000 among others).

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Endeavors ever made on this subject matter find the incarnation in Chen's (2000) *Tone Sandhi: Patterns across Chinese Dialects*. This book with comprehensive materials and in-depth analyses best intrigues the present author on directionality and interacting sandhi processes in chapters 3 and 4. Among the posited tonal constraints, No-Backtracking (Chen 2000:115), which demands that tonal derivations should not backtrack, leaves room for reconsideration. This paper argues that No-Backtracking can be subsumed under the more general One Step Principle (OSP henceforth), which prohibits tone change in a totally derived environment. Taiwanese secret language, Changting, Tianjin, Dongshi Hakka, and Yaoping all lend support for OSP. Diverse rankings between OSP and two other constraints, namely Well-Formedness Condition (WFC) and Temporal Sequence, explicitly account for dialect variation with respect to tone sandhi. Possible efforts to find OSP an optimality version are in vain. As OSP demands tone change once in a given syllable at most, segmental substitution of Chinese secret languages also operates only once on a given syllable. In addition, WFC is demonstrated not a family of constraints. If it is split up instead, a ranking paradox incurs in Changting.

The rest of this paper is organized as follows. Section 2 presents tonal derivation in Taiwanese secret language to facilitate later presentation of more witness for OSP. Section 3 offers a detailed analysis of trisyllabic tone sandhi in Changting. The key point is that No-Backtracking can be overwritten by OSP. Section 4 portrays how Tianjin exhibits a similar picture to Changting. Sections 5 and 6 demonstrate that OSP is undominated and WFC on tonal strings is violable in Dongshi Hakka and Yaoping only if a better output candidate cannot be expected. Theoretical implications and conclusion are given in section 7.

2. Taiwanese Secret Language

Taiwanese secret language (Li 1997:86-87) patterns with many other Chinese secret languages in that the source syllable is expanded in two by the method of *Fanqie* 'reverse cut'. Following Bao (1990a), three steps required to produce the desired output are total copying, onset substitution, and rime substitution. Specifically, the onset of the r-syllable becomes *l* by onset substitution, and rime substitution turns the rime of the o-syllable into *i*.[1] Example (1) below

1. According to Bao (1990a), the r-syllable carries the source rime and tone, and the o-syllable retains the source onset.

illustrates the derivation.

(1) t^hau 'head'
t^hau t^hau total copying
lau t^hau onset substitution
lau t^hi rime substitution

As Chen (2000:98) states, "within a tone group[2] of indefinite length, Xiamen[3] simply replaces every non-final base tone by its corresponding sandhi tone . . . tone sandhi generates the output in one sweep . . . ." Here the focus is placed on how Taiwanese secret language behaves with respect to tone sandhi. A quotation from Li, now translated into English, says that

> "basically secret language and the source language it is based on conform to the same sandhi rules. . . . Within a certain syntactic domain, all the syllables in secret language, except the penultimate one, accompany identical tones to those of their counterparts in the source."

Take example (2) below for illustration. A pronoun differs from other types of subject in its ability to form a tone group with the predicate, and hence all the non-final syllables carry sandhi tones, as seen in the comparison between the first two lines of IPA transcription. The "tone stability" in secret language is driven by OSP, defined in (3), due to a ban on further change of a derived tone. In contrast, since *pũĩ33* 'meal' in the source carries the base tone, its end result in secret language, namely ***nũĩ11*** *pũĩ33*, abides by the regular tone sandhi. (Key: #=tone group boundary)

(2) gua53 bue?3 tsia33 pũĩ33 # 'I want to have meal'
I want eat meal
↓ ↓ ↓
gua55 bue55 tsia11 pũĩ33#
(lua55 gi55) (lue55 bi55) (lia11 tsi11) (**nũĩ11** puũĩ33) #

2. The reader is referred to Chen (1987a) and Lin (1994) for the issue of how to define a tone group in Xiamen.
3. Xiamen, also known as Amoy, behaves the same as Taiwanese Southern Min with respect to tone sandhi.

(3) One Step Principle

A derived tone must not serve as input to another sandhi rule.[4]

Since a syllable is composed of segmental makeup together with tone realization in Chinese dialects, OSP amounts to a demand that tone sandhi apply only once to a given syllable in the course of a derivation.

Example (4) gives further support for OSP. Note that a toneless syllable does not undergo secret language formation, and the concealment function (Lin 1999) which changes the onset of the o-syllable into *g* takes place if both output syllables deriving from secret language formation would otherwise start with *l*. Since *ho* 'good' in the source accompanies the base tone, its corresponding output syllables observe tone sandhi as usual. In the other tone group, OSP is satisfied in the secret language except for *lai33* which develops from *lai24*, a syllable carrying the base tone.

(4) ho53 e # bo24 ai11 lai24 # 'the good is not coming'
good Suf. no love come
↓ ↓
ho53 e # bo33 ai53 lai24 #
(**lo55** hi53) e # (lo33 bi33) (lai53 i53) (**lai33** gi24) #

3. Changting[5]

Spoken at a border county located west of Fujian province, Changting is a Hakka dialect with five citation tones [33, 24, 42, 54, 21], where numbers denote pitch height on a five-point scale. For ease of later presentation, disyllabic tone sandhi rules are given in Table 1. The leftmost column lists the base tones of the first syllable, and the top row, the second syllable. The cells contain the surface forms of the combined disyllabic strings. When tone sandhi applies, a tone pattern is recorded in the cross-referenced cell. Note that the capital Roman numerals indicate the four traditional tonal categories, and *a* and *b* denote the split based on the voicing of the initial.

4. OSP has nothing to do with the mode of rule application. Evidence for this constraint on tonal derivation is obtained in languages with direct mapping (Taiwanese Southern Min), iterative (Changting, Tianjin, Dongshi Hakka, and Yaoping), or cyclic (Huojia (Hsu 1994)) mode of rule implementation.
5. This section heavily relies on chapter 5 of Hsu (1994) and Hsu (1995). Sources of data to be discussed come from Luo (1982) and Rao (1987). Another study on Changting tone sandhi by Chen et al. (2003) is based on first-hand data which exhibit radically different sandhi patterns.

TABLE 1

1st \ 2nd	IIIa 54	Ia 33	IIIb 21	Ib 24	IIa 42
IIIa 54	- -	- -	- -	- -	- -
Ia 33	- -	- -	21 -	21 -	- -
IIIb 21	33 -	33 -	- -	- -	33 -
Ib 24	- -	44 -	- 42	- -	- -
IIa 42	- -	213 -	213 42	21 -	33 -

In Changting, trisyllabic tonal sequences at the surface derive from applying disyllabic sandhi rules iteratively left to right, tangential with morphosyntactic structure. Given the same citation tone combination, two cases with opposite branching structures share the identical sandhi form, as manifested in (5). Following Chen (2000), the arrows symbolize the directionality of rule implementation which proceeds on the basis of the two-tone window scansion.

(5) a. [lɔ fu] tsiaŋ 'tiger well'
tiger well
b. lɔ [ku toŋ] 'antique'
old curios

⇨

42 42 42
33
33
33 33 42

⇦

42 42 42
33
213
*213 33 42

The story of trisyllabic tone sandhi in Changting does not end here. Instead, it provides excellent witness for the notion of constraint interaction. The gist of my derivational analysis is summed up as follows:[6, 7]

6. There exist sporadic examples which appeal to the notion of set consistency, the spirit of which reflects similarity-to-category in psychology (Smith 1990) and Optimal Paradigms in Optimality Theory (McCarthy 2002). Since set consistency is of peripheral relevancy with the current discussion, we will just put it aside.
7. The present tonal analysis, though constraint-based, is derivational in nature. Chen's (2000) serial OT analysis is vulnerable to technical and conceptual criticisms (Bao 2003). Of all, the fundamental problem lies in serious curtailment of the output pool since Gen enjoys unconstrained freedom of analysis.

(6) a. Temporal Sequence dictates the default iterative left-to-right application of sandhi rules.
b. Directionality reversal occurs if the default mode of rule implementation leads to a violation of OSP or WFC.
c. OSP takes dominance over WFC in a conflict relation.

Temporal Sequence requires that the default mode of rule operation be iterative left to right in tandem with the planning and execution of speech, as exemplified by (5a-b) above. Note that Temporal Sequence can be infracted as a tradeoff to satisfy a more dominant constraint. Examples (7) and (8) below demonstrate how OSP triggers directionality reversal of rule implementation. More precisely, the left-to-right derivation offends OSP (marked by boldface), and the reverse rule operation guarantees the correct output at the cost of Temporal Sequence.

(7) [siɔ ho] saŋ 'pupil'
primary school student

⇨			⇦		
42	21	33	42	21	33
213	42			33	
	213		213		
*213	**213**	33	213	33	33

(8) mɔ [va ti] 'didn't inform'
no inform

⇨			⇦		
24	21	33	24	21	33
	42			33	
	213		44		
*24	**213**	33	44	33	33

In a constraint-based derivational approach, the constraint hierarchy of OSP >> Temporal Sequence decides on the evaluation of output analyses. In tableau (9), both candidates have a violation. That candidate b is chosen as optimal indicates the lower ranking of Temporal Sequence.

(9)

24.21.33	OSP	Temp
a. ⇨	*!	
☞ b. ⇦		*

Let us now turn to WFC. If tone sandhi is viewed as a repair strategy to fix ill-formed tonal combinations, a possible input to sandhi rules at the surface violates the well-formedness condition on tonal sequences.

(10) Well-Formedness Condition
No possible input to sandhi rules is allowed in the tone patterns at the surface.

From (11) and (12) below, WFC infractions also trigger directionality reversal of rule application. Offending substrings are highlighted in italics, and 'na' means no applicable rule to the current two-tone window.

(11) seŋ [no mi] 'new glutinous rice'
new glutinous rice

⇨			⇦		
33	21	42	33	21	42
21				33	
	33		na		
21	*33*	42	33	33	42

(12) [mai li] fa 'white jasmine'
jasmine flower

⇨			⇦		
21	21	33	21	21	33
na				33	
	33		33		
21	*33*	33	33	33	33

The ranking WFC >> Temporal Sequence selects the output with least violation, as shown in tableau (13).

(13)

33.21.42 21.21.33	WFC	Temp
a. ⇨	*!	
☞ b. ⇦		*

When due recognition is given to examples (11) and (12), the correct sandhi forms also derive from further application of tone sandhi to the WFC-sensitive substrings. Consider (14) and (15) respectively, which ignore the derivational histories and simply list three relevant output candidates to focus our attention on the comparison.

(14) seŋ [no mi] 'new glutinous rice'

	33	21	42		
⇨				⇦	
	*21	33	42	33	33	42
⇨ + ⇦					
	33	33	42		

(15) [mai li] fa 'white jasmine'

	21	21	33		
⇨				⇦	
	*21	33	33	33	33	33
⇨ + ⇦					
	33	33	33		

This backtracking mode of rule application confronts itself with counterexamples. In (16), application of tone sandhi to the malformed sequences produces legitimate, but undesired surface forms.

(16) [ʃu ko] t^hoŋ 'fruit candy'

	fruit		candy			
⇨				⇦		
	42	42	24		42	42	24
	33					21	
		21			213	42	
	33	21	24		*213	***42***	*24*
⇨ + ⇦				⇦ + ⇨		
	***21**	21	24		*213	21	24

Chen (2000:157) posits No-Backtracking to justify such rejected potential outputs. This paper argues instead that No-Backtracking is unnecessary, for three reasons. First, No-Backtracking and Temporal Sequence both regulate direction of rule operation. The theoretical machinery is redundant, as the two constraints may do the same job. Strictly speaking, backtracking constitutes a violation of Temporal Sequence. In the case of ⇨ + ⇦, Temporal Sequence is

not met after backtracking occurs. As for ⇦+⇨, Temporal Sequence is infracted in the first half of the derivation. Second, some backtracking instances also violate OSP (see (14), (16), and (18)), which will be shown cross-linguistically active in the remainder of this paper. Finally, in cases such as (7) and (8) OSP rather than No-Backtracking is the critical working constraint.[8]

Given OSP >> Temporal Sequence in (9) and WFC >> Temporal Sequence in (13), an ensuing question concerns the dominance relation between OSP and WFC. The answer is simple and straightforward in the following tableau of example (16). Each of the excluded candidates is eliminated due to a violation of the undominated OSP. The overall ranking of the three constraints is therefore OSP >> WFC >> Temporal Sequence.

(17)

42.42.24	OSP	WFC	Temp
☞ a. ⇨		*	
b. ⇦	*!	*	*
c. ⇨+⇦	*!		*
d. ⇦+⇨	*!		*

Example (18) gives additional force to the higher ranking of OSP than WFC. As seen in tableau (19), candidate b wins the competition thanks to the OSP satisfaction.

(18) tso [tʰəu fu] 'make tofu'
make tofu

⇨

24 21 21
42
213 42
*24 **213** 42

⇦

24 21 21
na
42
24 *42* 21

⇦+⇨

*24 **213** 42

8. Chen et al. (2003:98) proposes Moving Window Constraint, which demands that disyllabic tone sandhi not apply to the same local window more than once, to accommodate both One Step Principle and No-Backtracking. Yet examples (7) and (8) remain intractable since no Moving Window Constraint violation incurs. A comparison and contrast between One Step Principle and Moving Window Constraint is made in another paper in preparation.

(19)

24.21.21	OSP	WFC	Temp
a. ⇨	*!		
☞ b. ⇦		*	*
c. ⇦ + ⇨	*!		*

The ranking OSP >> WFC >> Temporal Sequence also successfully predicts example (14). From tableau (20), candidate b incurring the smallest total violation wins.

(20)

33.21.42	OSP	WFC	Temp
a. ⇨		*!	
☞ b. ⇦			*
c. ⇨ + ⇦	*!		*

Example (15) poses no problem to the current ranking hierarchy either. OSP is indecisive here. Candidates b and c tie on Temporal Sequence. In actuality, both candidates bear the same tonal strings at the surface.

(21)

21.21.33	OSP	WFC	Temp
a. ⇨		*!	
☞ b. ⇦			*
☞ c. ⇦ + ⇨			*

One point worth emphasizing here is: such a tied situation does not occur by chance; it is a matter of necessity instead. A closer look at the two derivational patterns in (22) reveals that the vacuous application of tone sandhi in the first two-tone window of the lefthand derivation is crucial for one and the same output form in (22). This is exactly what happens in example (15).

(22) ⇨ + ⇦ ⇦

x	y	z	x	y	z
na				x	
	x		z		
x	*x*	z	z	x	z
↓					
z	x	z			

Pursuant to Chen (2000:120-122), No-Backtracking is understandable in view of language processing; it also finds witness from syllabification and stress assignment. A question to ask at this moment remains what the cognitive basis of OSP is. One possible reason lies in the strict direct mapping between an input tone and its output tone to facilitate the speed of language processing. One may not be content with the explanation, and yet it does no harm to our analysis. If the same problem is raised to Obligatory Contour Principle (OCP), we wonder why two identical elements cannot be adjacent at the same melodic tier. Though geminates and homorganic NC clusters in diverse languages can be represented as doubly-linked structures in the autosegmental machinery in order not to constitute OCP violations, the question about the spirit of OCP remains unaccountable.

4. Tianjin

Tianjin is probably the most frequently studied Mandarin dialect except for Standard Mandarin (Chen 1987b, Hung 1985, 1987b, Tan 1987, Zhang 1987, Milliken et al. 1997, Chen 2000 among others). This section demonstrates that No-Backtracking is superfluous, and the ranking hierarchy of OSP,[9] WFC >> Temporal Sequence suffices to solving the crux of Tianjin trisyllabic tone sandhi.[10]

Tianjin (Li and Liu 1985) has a four-tone system, namely 21, 45, 213, and 53. Backward disyllabic sandhi rules and illustrative examples are listed in (23). Again, the first and second lines below the Pinyin transcription indicate the base tones and sandhi tones respectively.

9. Hung (1985) [in a footnote in his paper] first points out that no tone sandhi rule of Tianjin may apply to the same syllable more than once in the course of a derivation.
10. The tonal string 53.21.21 which has engaged many linguists' attention is ignored here. The interested reader is referred to Hsu (in press) for more details.

(23) a.	21 → 213 / ___ 21	gong ji 'rooster' 21. 21 213
b.	213 → 45 / ___ 213	xi lian 'wash one's face' 213.213 45
c.	53 → 21 / ___ 53	man hua 'caricature' 53.53 21
d.	53 → 45 / ___ 21	ding hun 'engage' 53.21 45

In Tianjin, trisyllabic tonal strings at the surface derive from the default iterative left-to-right application of disyllabic sandhi rules, irrespective of morphosyntactic structure (Chen 2000), as manifested in (24) and (25).

(24) zi [xin xin] 'self-confidence'
self confidence

⇨	⇦
53 53 21	53 53 21
21	45
45	na
21 45 21	*53 45 21

(25) mu [lao hu] 'tigress'
female tiger

⇨	⇦
213 213 213	*213 213 213
45	45
45	na
45 45 213	*213 45 213

Among the sixty-four (4^3) combinatorial possibilities for trisyllabic utterances, four tonal combinations involving the so-called backtracking, which are reminiscent of examples (14) and (15) in the analysis of Changting, are the focus of our interest. Let us now see how OSP manages to replace No-Backtracking, and how the ranking OSP, WFC >> Temporal Sequence correctly predicts the actual output. Unlike the case in Changting, Tianjin prohibits either OSP or WFC violations. From tableau (28) of examples (26) and (27), candidate b emerges

due to least violation of the constraint set.

(26) kai [fei ji] 'pilot a plane'
open airplane

⇨

21 21 21
213
213
*213 213 21

⇨＋⇦

***45** 213 21

⇦

21 21 21
213
na
21 213 21

(27) [su liao] pu 'plastic cloth'
plastic material cloth

⇨

53 53 53
21
21
*21 21 53

⇨＋⇦

***213** 21 53

⇦

53 53 53
21
45
45 21 53

(28)

21.21.21 53.53.53	OSP	WFC	Temp
a. ⇨		*!	
☞ b. ⇦			*
c. ⇨＋⇦	*!		*

The same constraint ranking explains (29) and (30) below. Though OSP does not exert its influence on candidate evaluation, the dominance of WFC over Temporal Sequence resolves the conflict. As tableau (31) predicts, candidates b and c in both examples tie on Temporal Sequence, which is empirically reflected by the identical sandhi form they present.

(29) [bao wen] pei 'thermo cup'
keep heat cup

⇨

213 21 21
na
213
*213 213 21

⇦

213 21 21
213
45
45 213 21

⇨+⇦

45 213 21

(30) [xin cang] bing 'heart attack'
heart disease

⇨

21 53 53
na
21
*21 21 53

⇦

21 53 53
21
213
213 21 53

⇨+⇦

213 21 53

(31)

213.21.21 21.53.53	OSP	WFC	Temp
a. ⇨		*!	
☞ b. ⇦			*
☞ c. ⇦+⇨			*

5. Dongshi Hakka

Trisyllabic tone sandhi in Dongshi Hakka spoken in Taichung County, Taiwan further demonstrates that No-Backtracking can be subsumed under OSP. From our source (Chiang 1998:16-20), Dongshi Hakka has six citation tones, including 33, 113, 31, 53, 31, and 5.[11] A relevant disyllabic sandhi rule and supporting examples are given below.

11. 31 and 5 are two checked tones. According to Chiang (1998:19), 5 actually feature a slightly falling contour, and hence rule (32) presents contour dissimilation.

(32) 53 → 55 / ___ {31, 53, 31, 5}

mien53 fun31	→ mien55 fun31	'flour'
tʰien53 fa53	→ tʰien55 fa53	'telephone'
ʃoi53 muk31	→ ʃoi55 muk31	'sleep'
ɲi53 ʃip5	→ ɲi55 ʃip5	'twenty'

Again, on the basis of the two-tone window scansion, trisyllabic tonal combinations at the surface develop from iterative left-to-right application of disyllabic tone sandhi without reference to morphosyntactic structure. As shown in (33), tone sandhi in Dongshi Hakka is purely phonologically conditioned.

(33) a. [tʰi ɲi] tʃi 'index finger'
second finger

b. tso [tʰai ʃui] 'flood'
make big water

⇨			⇦		
53	53	31	53	53	31
55				55	
	55		na		
55	55	31	*53	55	31

With the view that tone sandhi occurs to remedy ill-formed tonal combinations, of much interest are cases where the attested outputs allow for WFC violations. In (35) and (36), though the substring of *33 113* at the surface meets the structural description of (34a), nothing happens. An observation is that WFC violations are tolerable only if a better output candidate is not expected. Neither directionality reversal nor backtracking helps improve the status qua which derives from rule operation by Temporal Sequence.

(34) a. 33 → 35 / ___ {113, 31, 31}
b. 113 → 33 / ___ 113

(35) [kaŋ tʰien] ɲin 'farmer'
till field person

⇨			⇦		
33	113	113	33	113	113
35				33	
	33		na		
35	*33*	*113*	*33	*33*	*113*
⇨+⇦			⇦+⇨		
*35	**35**	113	*33	**35**	113

(36) p ʰa [liuŋ ʃion] 'paddle dragon boat'
paddle dragon boat

⇨			⇦		
113	113	113	113	113	113
33				33	
	33		na		
33	*33*	*113*	*113	*33*	*113*
⇨+⇦			⇦+⇨		
*33	**35**	113	*113	**35**	113

Following the line of reasoning in the earlier discussion, we would expect that trisyllabic tone sandhi in Dongshi Hakka is accountable by the interaction among OSP,[12] WFC, and Temporal Sequence. A major problem resides in how to pinpoint the ranking hierarchy. Given three constraints, there are thirteen possibilities in total, as shown below:

(37) three scales $3!=6$
two scales $C_2^3+C_2^3=6$
one scale 1

Among the thirteen possibilities, three which fail to make the evaluation are (a) WFC >> OSP >> Temporal Sequence, (b) WFC >> Temporal Sequence >> OSP, and (c) WFC >> OSP, Temporal Sequence. It indicates that the avoidance of ill-formed tonal sequences cannot be the first priority. According to the current discussion, OSP is undominated in Dongshi Hakka. Temporal Sequence allows no exception either. Just for presentational clarity, we posit the ranking OSP, Temporal Sequence >> WFC to illustrate trisyllabic tone sandhi in Dongshi Hakka. As seen in tableau (38), candidate a is chosen for satisfying both OSP and Temporal Sequence.

12. Chiang (1998:18) observes that in Dongshi Hakka tone sandhi cannot apply in a totally derived environment.

(38)

33.113.113 113.113.113	OSP	Temp	WFC
☞ a. ⇨			*
b. ⇦		*!	*
c. ⇨ + ⇦	*!	*	
d. ⇦ + ⇨	*!	*	

6. Yaoping

Yaoping is another Hakka variety rarely touched upon. Results of previous research (Yang 1961, 1963, Zhan 1993, Lü 1993) are limited to preliminary description of the phonological system and disyllabic tone sandhi. This section focuses on trisyllabic tone sandhi of this Hakka dialect spoken at Liujia, Hsinchu County, Taiwan, based on field notes by the present author in 1997 and 1998.[13]

6.1 Background Information

Yaoping has a six-tone system [11, 55, 53, 55, 3, 5].[14] They are marked as tones Ia, Ib, IIa, IIIb, IVa, and IVb respectively, in accordance with historical sources. In Yaoping, subtonal split does not occur in either Tone II or Tone III. Tone IIIb is neutralized with Tone Ib in isolation. In disyllabic tonal strings, tone sandhi takes place according to table 2.

13. This investigation was completed thanks to the sponsor of the research project NSC87-2411-H-009-003.

14. Zhan (1993) and Lü (1993) also claim that Yaoping has six citation tones. The difference among the three studies concerns the tone value of Tone IIIb. Zhan posits 35, and Lü 33.

TABLE 2

2nd / 1st	Ia 11	Ib 55	IIa 53	IIIb 55	IVa 3	IVb 5
Ia 11	- -	- -	- -	- -	- -	- -
Ib 55	53 -	33 -	53 -	33 -	53 -	33 -
IIa 53	33 -	11 -	33 -	11 -	11 -	11 -
IIIb 55	33 -	33 -	33 -	33 -	33 -	33 -
IVa 3	5 -	5 -	5 -	5 -	5 -	5 -
IVb 5	- -	- -	- -	- -	- -	- -

From table 2, all sandhi rules in Yaoping are leftward. The two entering tones get neutralized in disyllabic utterances, and the contrast between tone Ib and tone IIIb appears in some disyllabic cases. Illustrative examples of disyllabic tone sandhi are given in (39). As usual, the first and second lines below the IPA transcription lay out the base tones and sandhi tones respectively.

(39) tʰi ʃiu 'shave' — se loŋ 'son-in-law' — mien fun 'flour'
53.11 — 53.55 — 53.53
33 — 11 — 33

hoi fin 'seashore' — fi kʰut 'water pit' — ʃiu ʃiuk 'procedure'
53.55 — 53.3 — 53.5
11 — 11 — 11

von kua 'cucumber' — ɲiu ma 'cow' — ɲiu ɲian 'longan'
55.11 — 55.55 — 55.53
53 — 33 — 53

sui ʃi 'any time' — ɲin ket 'personality' — ʃin lok 'promise'
55.55 — 55.3 — 55.5
33 — 53 — 33

man tuŋ 'late winter' — pʰiaŋ ɲin 'patient' — heu poi 'back'
55.11 — 55.55 — 55.53
33 — 33 — 33

ni vui 'where'	tʰai siet 'heavy snow'	tʰai hok 'university'
55.55	55.3	55.5
33	33	33
mok tʃu 'eye'	ɲit tʰeu 'sun'	hiet kʰun 'rest'
3.11	3.55	3.53
5	5	5
tsok liuŋ 'massage'	pat pak 'eight hundred'	liok sip 'sixty'
3.55	3.3	3.5
5	5	5

Note that 33 and 11 in table 2 are not free variants, as witnessed in the following minimal pair.

(40) a. mi lu 'get lost'
lost road
55 55
33

b. mi lu 'pay to pass a road'
buy road
53 55
11

6.2 Trisyllabic Tone Sandhi

Yaoping tone sandhi is indifferent to morphosyntactic structure just as all the earlier discussed dialects. Rather, it is purely phonologically conditioned. Example (41a) is a left-branching construction, where the immediate constituent is a verb-object structure, and the outer cycle presents a modifier-head relation. With opposite branching structure, example (41b) displays a modifier-head configuration at both the inner and the outer cycles. Given identical base tone combination, the two examples present the same sandhi form. In Yaoping, surface trisyllabic tonal patterns are also achieved by iterative left-to-right application of disyllabic sandhi rules.

(41) a. [[fat tʰien]$_{VO}$ tɕʰioŋ]$_{MH}$ 'power station'
generate power station

b. [tʰiet [pʰon van]$_{MH}$]$_{MH}$ 'secure job'
iron rice bowl

⇨

3 55 53
5
33
5 33 53

⇦

3 55 53
33
na
*3 33 53

As is the case in disyllabic constructions, the contrast between Tone Ib and Tone IIIb emerges in trisyllabic utterances, manifested by the comparison between (42) and (43) below.

(42) [ʒioŋ nen] fun 'goat milk powder'
goat milk powder

⇨

55 53 53
53
33
53 33 53

⇦

55 53 53
33
na
*55 33 53

(43) [tʰien ʒaŋ] ʒan 'theater'
film hall

⇨

55 53 53
33
33
33 33 53

⇦

55 53 53
33
na
*55 33 53

Trisyllabic utterances involving Tone Ib which reveal constraint interaction are of central importance. It is argued that directionality reversal is employed to remedy offending substrings, as exemplified by (44).

(44) han [ap lon] 'salty egg'
salty duck egg

⇨

55 3 53
53
5
*53 5 53

⇨+⇦

11 5 53

⇦

55 3 53
5
33
33 5 53

In optimality terms, OSP, WFC, and Temporal Sequence umpire the competition. From tableau (45) of example (44), the realization of candidate b reflects the lowest ranking of Temporal Sequence. The dominance relation between OSP and WFC is indeterminate here.

(45)

55.3.53	OSP	WFC	Temp
a. ⇨		*!	
☞ b. ⇦			*
c. ⇨+⇦	*!		*

If a WFC violation cannot be removed without running into a more serious problem, the surface tonal strings deriving from the default mode of rule application stay, as evidenced by (46-48). In other words, no repair strategy takes place when it would yield no progress. A conclusion drawn thus far is: whether Yaoping allows for WFC infractions hinges on the presence or absence of a better output candidate.

(46) p ʰun [kie koi] 'boast'
blow chicken jaw

⇨

55	11	11
53		
	na	
53	*11*	11

⇨+⇦

33	11	11

⇦

55	11	11
	na	
53		
53	*11*	11

⇦+⇨

33	11	11

(47) [tet ɲin] nau 'irritating'
get people angry

⇨

5	55	11
na		
	53	
5	*53*	*11*

⇨+⇦

*5	**33**	11

⇦

5	55	11
	53	
na		
5	*53*	*11*

⇦+⇨

*5	**33**	11

(48) tso mo tet 'cannot do'
do not can

⇨			⇦		
53	55	3	53	55	3
11				53	
	53		33		
11	*53*	*3*	*33	*53*	*3*
⇨+⇦			⇦+⇨		
*11	**11**	3	*33	**11**	3

In the following tableau for examples (46-48), that candidates c and d lose to candidate a manifests the ranking OSP >> WFC. An integration of OSP, WFC >> Temporal Sequence in tableau (45) with the current ranking gives rise to the complete ranking OSP >> WFC >> Temporal Sequence, which successfully makes the evaluation.

(49)

55.11.11 5.55.11 53.55.3	OSP	WFC	Temp
☞ a. ⇨		*	
b. ⇦		*	*!
c. ⇨+⇦	*!		*
d. ⇦+⇨	*!		*

So far, we have presented how No-Backtracking can be subsumed by OSP, and how the latter constraint interacts with WFC and Temporal Sequence to account for trisyllabic tone sandhi in Changting, Tianjin, Dongshi Hakka, and Yaoping. To refresh the reader's memory, obtained ranking scales are repeated below. It is clearly indicated in (50) that dialect variation results from different rankings of the constraint set.

(50) Changting, Yaoping OSP >> WFC >> Temporal Sequence
Tianjin OSP, WFC >> Temporal Sequence
Dongshi Hakka OSP, Temporal Sequence >> WFC

7. Theoretical Implications and Conclusion

This section first argues that OSP is derivational in character, and no possible Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993) translation is available at present. It is then shown that OSP enjoys a coincidental counterpart in Chinese secret language formation, which prohibits segmental substitution from applying twice to a given syllable.

As the comparison between (51) and (52) displays, a trisyllabic tone sequence in Changting may or may not be licit, depending on whether OSP is observed. There is no way to evaluate candidate analyses of a given input at the surface.

(51) hɔ [tseŋ ʃieŋ] 'spirited'
good spirit

⇨			⇦		
42	33	24	42	33	24
213				21	
	21		213	42	
213	21	24	*213	**42**	24

(52) kui [fa pʰu] 'bad calligraphy'
ghost draw

⇨			⇦		
42	21	24	42	21	24
213	42			na	
	21		213	42	
*213	**21**	24	213	42	24

Let us now try if a direct input-output mapping is possible to eliminate OSP. [15] In (53) below, all four examples with the underlying combination of 42.42 have various surface tone patterns. Closer inspection of the tri-tonal strings at both sides of the arrows reveals that the mapping relations in (54), actually an OT version of disyllabic rules, predict the correct outputs.

15. A direct-mapping (input-output only) approach runs into serious conceptual problems for the Tianjin facts, as argued in Chen (2000:135-139).

(53) a. 42.42.33 → 33.213.33
b. 42.42.24 → 33.21.24
c. 33.42.42 → 33.33.42
d. 42.42.42 → 33.33.42

(54) a. 42.42 b. 42.33 c. 42.24
| | |
33 213 21

Example (55) enjoys the same treatment in that the two-level analysis manages to achieve the desired output by (54a) and (54c). OSP is irrelevant.

(55) [ʃu ko] tʰoŋ 'fruit candy'
fruit candy

⇨			⇦		
42	42	24	42	42	24
33				21	
	21		213	42	
33	*21*	24	*213	***42***	*24*
⇨+⇦			⇦+⇨		
21	21	24	*213	**21**	24

One point to note is that the tonal sequence 33.21 in the chosen output of (55) violates WFC. If it is allowable, why is the WFC infraction 21.33 in example (56) fatal? The difference may be attributed to a ranking scale between two output constraints. As will be presented shortly, a ranking paradox occurs if WFC is split up into separate constraints. This reflects, in turn, the inability of a direct input-output mapping to tackle Changting tone sandhi. In addition, why the asterisked output forms in (55) are rejected may appeal to different factors if OSP is not taken into account. The question of how to find OSP an optimality version remains open.

(56) seŋ [no mi] 'new glutinous rice'
new glutinous rice

⇨			⇦		
33	21	42	33	21	42
21				33	
	33		na		
*21	*33*	42	33	33	42

Nor does Changting present a tonal template (Duanmu 1992, Sun 1998) so that template mapping can be employed to sanction tonal strings. RIGHTMOST, which is named after EDGEMOST (McCarthy and Prince 1993), as an optimality version of OSP is not viable either. An observation from examples (57) and (58) is that their underlying tone sequences respectively meet the structural descriptions of two sandhi rules. To resolve the conflict incurring at the very beginning of rule implementation, OSP can be replaced by the demand that a sandhi rule should operate if and only if the right edge of its domain coincides with the right edge of the prosodic word.

(57) [siɔ ho] saŋ 'pupil'
primary school student

⇨

42	21	33
213	42	
	213	
*213	**213**	33

⇦

42	21	33
	33	
213		
213	33	33

(58) mɔ [va ti] 'didn't inform'
no inform

⇨

24	21	33
	42	
	213	
*24	**213**	33

⇦

24	21	33
	33	
44		
44	33	33

The RIGHTMOST treatment is untenable, for two reasons. First, it does not hold true in (59) where the underlying tonal sequence satisfies the structural description of one sandhi rule alone. The right-to-left derivation which meets RIGHTMOST fails to avert, but rather leads to an OSP violation. Second, (60) below exhibits an opposite picture to (57) and (58) in that avoidance of an OSP infraction is achieved at the sacrifice of RIGHTMOST instead.

(59) fʌŋ [tʃieŋ tʰʌ] 'red pillow'
red pillow

⇨

24	42	24
na		
	21	
24	*21*	24

⇦

24	42	24
	21	
	42	
*24	***42***	*24*

(60) [ʃu ko] tʰoŋ 'fruit candy'
fruit candy

⇨			⇦		
42	42	24	42	42	24
33				21	
	21		213	42	
33	*21*	24	*213	***42***	*24*

So far, there is no obvious way to translate OSP into optimality terms.[16] This derivational constraint seems indispensable for Changting and other discussed Chinese dialects as well. The situation holds of Temporal Sequence, which dictates a specific directionality of rule application. The theoretical impact to OT is obvious: apart from output constraints, we need constraints requiring access to derivational history. This, in turn, implies an important role which Gen has to play. The problem is it runs afoul of the fundamental tenet of OT that Gen enjoys unconstrained freedom of analysis.

Another point to note is that OSP finds a counterpart in Chinese secret language formation. Bao (1990a:329) clearly mentions that in addition to the steps of copy and substitution, a constraint is required for fanqie language formation.[17] Consider the nonexistent *fanqie* language in (61), where *x* or *y* is any segment:

(61) Source syllable cg.vx
Fanqie word cg.v-c.vy

According to Bao, the problem of the nonexistent *fanqie* language lies in that

> "in the second syllable the onset is replaced by *c*, and the coda x is replaced by *y*. The second syllable of this *fanqie* word cannot be derived by a single operation of Substitution, because *c* and *y* do not form a structural constituent. But it can be generated by applying Substitution twice to the second syllable, as in [(62)]:"

(62) cg.vx

cg.vx-cg.vx	copy
cg.v-cg.vx	replace rime
cg.v-c.vx	replace onset
cg.v-c.vy	replace coda

16. The claim that Changting constitutes an insurmountable challenge to OT can be too strong. Yet, if the representational machinery turns out to do patch-making, a unified derivational analysis in which OSP functions is certainly preferred.
17. Chinese secret languages are named *fanqie* languages by Chao (1931).

As a last resort, Bao stipulates a constraint on Substitution to obviate (62) from being produced.

(63) Substitution can operate only once on a given syllable.

This constraint coincides perfectly with OSP which demands tone sandhi apply only once to a given syllable in the course of a derivation.

Another important issue concerns whether WFC is a family of constraints instead.[18] That is, given *T1-T2 and *T3-T4, one may be ranked higher than the other. In a sense, the idea amounts to rule ordering, which fails to account for trisyllabic tone sandhi in Changting. For the present purpose, consider the following contrast between (65) and (66). Relevant rules are listed in (64).

(64) a. 33 → 21 / ___ {24, 21}
b. 24 → 44 / ___ 33
c. 21 → 42 / 24 ___

(65) tsaŋ [iaŋ ʃu] 'compete'
fight win lose

⇨

33	24	33	
21			(by (64a))
	44		(by (64b))
21	44	33	

⇦

33	24	33	
	44		(by (64b))
na			
*33	44	33	

(66) niẽ [tsʰu i] 'January first'
year first one

⇨

24	33	24	
44			(by (64b))
	21		(by (64a))
44	21	24	

⇦

24	33	24	
	21		(by (64a))
	42		(by (64c))
*24	**42**	24	

If (64a) and (64b) are translated into two separate WFC constraints, we arrive at a ranking paradox. Specifically, (65) requires the ranking *33-24 >> *24-33, and (66) needs the opposite ranking. Therefore, we stick to the original treatment of characterizing WFC as a whole.

In conclusion, this paper has demonstrated that No-Backtracking can be reconsidered under the rubric of OSP. Taiwanese secret language, Changting,

18. Larry Hyman is greatly acknowledged for bringing up this point to my attention.

Tianjin, Dongshi Hakka, and Yaoping all witness this constraint on tonal derivation. Possibilities of how OSP is ranked with WFC and Temporal Sequence give rise to dialect variation, as displayed in Changting, Tianjin, Dongshi Hakka, and Yaoping. So far, no viable OT translation of OSP is available. A counterpart of OSP comes from segmental derivation of Chinese secret languages. Finally, WFC is shown not a family of constraints. In Changting, a ranking paradox incurs if it is split up.

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論漢語方言聲調衍化的反再生

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摘　要

本文主張陳（2000）用以處理漢語方言變調方向與互動關係的不可折返（No-Backtracking）制約可由更具普遍性的一步原則（One Step Principle）——即衍生調不得再次變調——來涵蓋。舉凡臺灣秘密語、長汀客語、天津話、東勢客語和饒平客語都是一步原則的見證。一步原則和其他制約的互動，如表層結構合法準則（Well-Formedness Condition）及時序進程（Temporal Sequence），爲漢語方言的變調差異提供了絕佳的詮釋。做爲聲調衍化制約，一步原則在優選理論的架構下迄今尚無合適的翻版。此外，漢語秘密語的音段衍化過程也出現和一步原則如出一轍的現象。

關鍵詞：聲調衍化，一步原則