Two Constraints on Tonal Derivation in Chinese

漢語的兩個聲調衍化制約

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TWO CONSTRAINTS ON TONAL DERIVATION IN CHINESE*

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ABSTRACT

This paper aims to further examine two working constraints on tonal derivation proposed in some recent generative studies on Changting, namely One Step Principle (OSP) and Moving Window Constraint (MWC). Our extension of the scope of discussion to other Chinese dialects leads to the necessity of proposing the more general Domain Constraint (DC) which subsumes the MWC. The comparison and contrast between OSP and DC exhibits a see-saw battle at present. Both successfully account for Dongshi Hakka, Tianjin, and Yaoping. OSP wins in Changting (Hsu 1994, 1995) and Taiwanese secret languages, whereas DC wins in Changting (Chen 2003, Chen et al. 2004) and fast speeches in Xuzhou and Standard Mandarin. Different from the above-mentioned cases, Tianjin fast speech demonstrates a dual nature in regard to both constraints. Furthermore, DC receives non-Sinitic support from Hakha Lai; segmental derivation of *fanqie* languages reveals an OSP counterpart. How these two constraints behave in African tone languages awaits further study.

1. INTRODUCTION

Although not initiating the methodology, Chen (2000) offered the most comprehensive analysis to date of the various patterns of tone

* This paper is dedicated to Professor Matthew Y. Chen, my advisor at the University of California, San Diego during the period from 1989 to 1994. He has set an example of the study of Chinese tonology that surpasses description. In the Chinese linguistic circle, a certain kind of "academic ethics" is highly respected, and generally speaking, junior linguists are not often encouraged to present opinions different from those in previous studies. Professor Chen is exceptionally tolerant in this regard. I am also grateful to the anonymous reviewers for their comments and suggestions which led to an enormous improvement in the paper. Of course, errors of misjudgment and misinterpretation that remain are my own responsibility.

sandhi in Chinese dialects within a constraint-based framework. From the text and a footnote in Chen (2000:158), trisyllabic tone sandhi in Changting is attributed to the interaction of One Step Principle (OSP),[1] No-Backtracking, Well-Formedness Condition (WFC), Temporal Sequence, and Derivational Economy. Except Derivational Economy which favors fewer derivational steps, all other constraints are relevant with later presentation in this paper. Of these, the focus of present interest is OSP, defined in (1).

(1) One Step Principle
A derived tone must not serve as input to another sandhi rule.

Since a syllable is composed of segmental makeup together with tone realization in Chinese dialects, OSP requires that tone sandhi apply only once to a given syllable in the course of a derivation. No-Backtracking prohibits directionality of rule implementation from shifting from one way to another; WFC represents a tonotactic constraint against any possible input to disyllabic sandhi rules at the surface; and Temporal Sequence dictates the default iterative left-to-right mode of rule operation in tandem with the planning and execution of speech.

Hsu (2002) argues that No-Backtracking can be subsumed under the more general OSP, employing a wide range of data from Changting, Tianjin, Dongshi Hakka, and Yaoping. In a joint study of Changting tone sandhi based on first-hand data, Chen (2003) and Chen et al. (2004:98) propose a Moving Window Constraint (MWC) to accommodate both OSP and No-Backtracking.

(2) Moving Window Constraint
2TS may not apply to the same local window more than once.

The so-called local window means a two-tone domain marked to scan if disyllabic sandhi rules apply.

With such background in mind, this paper intends to further examine OSP and MWC in extending the scope to other Chinese dialects. It will

[1] Hung (1985) should be given the credit of first pointing out in a footnote in his paper that no sandhi rule in Tainjin may apply to the same syllable more than once in the course of a derivation. The present author observed the same phenomenon in an effort to resolve trisyllabic tone sandhi in Changting in the summer of 1990 without having known of the reference. Little did Hung know where it would lead twenty years later.

be demonstrated that MWC can be subsumed under the more general Domain Constraint (DC) in an attempt to facilitate the comparison and contrast between the two constraints under investigation. The results indicate an ongoing tug of war: except for the possible immunity of Tianjin fast speech to OSP and DC, some dialects lend support to both constraints; some dialects confirm the application of OSP; and others provide evidence for the validity of DC. As a matter of fact, the see-saw battle between OSP and DC continues in Hakha Lai (a Tibeto-Burman language) and *fanqie* languages.[2]

An explanation for the question why one would choose the above-mentioned tone sandhi cases for the current discussion is now provided to familiarize the reader with certain background knowledge of tone sandhi.[3] Setting aside the non-Sinitic Hakha Lai, which presents simultaneous application of tone sandhi, all the Chinese dialects to be discussed in this paper have received a fine-grained and intensive study in the literature (see Zhang 1992, Bao 1999, and Chen 2000 for other better-known sandhi systems in Chinese), and more importantly, they are crucial to the focus of present interest in that they display some sort of non-recycling in tonal derivation, manifested in the constraints defined in (1) and (2) above. A careful categorization of the modes of sandhi rule application helps to illustrate the point. Specifically, Changting, Dongshi Hakka, Tianjin, and Yaoping are iterative; Xuzhou and Standard Mandarin exhibit cyclicity. No matter how different these sandhi systems are, they are identical in that polysyllabic tone strings at the surface are derivable by a recursive application of disyllabic tone sandhis, which makes OSP and/or DC relevant. Ilan, on which Taiwanese secret languages are based, presents direct mapping between the input and the output, and all syllables except the final one in a syntactically-demarcated domain undergo tone sandhi. Created by partial reduplication of the base syllable (see section 3.2 for the details), Taiwanese secret languages retain the base tone except for the penultimate syllable, which relates to the above-mentioned non-recycling in tonal derivation. An interesting observation is that the chosen Chinese cases fall into either the tonal systems or the mixed

[2] Reflecting the method *fanqie* (literally, reverse cut) used in the traditional Chinese philological literature to specify the pronunciation of a novel character/syllable through two known ones, the terminology *fanqie* language was created in Chao (1931) to name Chinese secret languages in general.

[3] I am greatly indebted to an anonymous reviewer for this invaluable suggestion.

systems Bao (2004) proposes. Despite great dialectal variations (Qian 1992, Cao 2002), Wu dialects are peripheral to the tonal constraints in question since they belong to the accentual systems characteristic of sandhi tones spread un-triggered (Bao 2004). To sum up, the dialects to be discussed later in this paper are not randomly chosen; they have sandhi patterns fit for examining OSP and DC.

The rest of this paper is organized as follows: section 2 demonstrates that OSP and WMC make a tie in Dongshi Hakka tone sandhi, among other Chinese dialects. Section 3 indicates that OSP rather than DC accommodates Changting (Hsu 1994, 1995) and Taiwanese secret languages. In section 4, DC instead of OSP holds true in Changting (Chen 2003, Chen et al. 2004) and fast speeches in Xuzhou and Standard Mandarin. Section 5 presents that Tianjin fast speech exhibits a dual nature with respect to the constraints. In section 6, Hakha Lai lends non-Sinitic support to DC. In section 7, OSP wins in the virtual battlefield in the segmental derivation of *fanqie* languages. Concluding remarks are given in section 8.

2. A TIE IN DONGSHI HAKKA

This section demonstrates how OSP and MWC tie in trisyllabic tone sandhi in Dongshi Hakka. From our source (Chiang 1998:16-20), this Hakka dialect contains six citation tones, including 33, 113, 31, 53, 31, and 5.[4] Tri-tonal strings at the surface derive from iterative left-to-right application of disyllabic sandhi rules. Note that tone sandhi is purely phonologically conditioned. With opposite branching structures, the two examples in (4) share both input and output tone combinations. The relevant sandhi rule is given in (3). Following Chen (2000), the arrows symbolize the directionality of rule implementation which proceeds on the basis of the two-tone window scansion. A dot is placed between tones for presentational clarity. 'n/a' means no applicable rule to the current window.

[4] Note that 31 and 5 are two checked tones. According to Chiang (1998:19), tone 5 actually features a slightly falling contour, and hence rule (3) presents contour dissimilation.

(3) 53 → 55 / ___ {31, 53, <u>31</u>, 5}

mien53 fun31	→	mien55 fun31	'flour'
t^hien53 fa53	→	t^hien55 fa53	'telephone'
ʃoi53 muk<u>31</u>	→	ʃoi55 muk<u>31</u>	'sleep'
ɲi53 ʃip5	→	ɲi55 ʃip5	'twenty'

(4) a. [t^hi ɲi] tʃi 'index finger'
second finger

b. tso [t^hai ʃui] 'flood'
make big water

⇨ ⇦

<u>53.53</u>.31	53.<u>53.31</u>	
|	|	
55.<u>53.31</u>	<u>53.55</u>.31	(n/a)
|		
55.55.31	*53.55.31	

To discern how either OSP or MWC handles trisyllabic tone sandhi in Dongshi Hakka, we will move on to more complicated examples. The relevant rules are listed in (5). On the premise that tone sandhi operates to remedy ill-formed tonal combinations, the offending substring 33.113 (highlighted in italics) in the actual outputs of (6) and (7) below constitutes a WFC violation due to its satisfaction with the structural description of (5a). The answer as to why such an infraction is tolerable lies in the absence of a better output candidate. As seen in the following demonstrations, neither directionality reversal (whereby tone implementation proceeds from right to left) nor backtracking (whereby the two-tone window scansion goes to and fro and tone sandhi applies as long as the structural description of a rule is met) helps to yield a better output form than the one which derives from rule operation by Temporal Sequence.

(5) a. 33 → 35 / ___ {113, 31, <u>31</u>}[5]
b. 113 → 33 / ___ 113

[5] The reader may have noticed that the operation of (5b) creates an environment for (5a) to apply.

(6) [kaŋ tʰien] ɲin ‘farmer’
till field person

⇨	⇦	
33.113.113	33.113.113	
35.113.113	33.33.113	(n/a)
35.*33.113*	*33.*33.113*	
⇨ + ⇦ *35.**35**.113	⇦ + ⇨ *33.**35**.113	

(7) pʰa [liuŋ ʂion] ‘paddle dragon boat’
paddle dragon boat

⇨	⇦	
113.113.113	113.113.113	
33.113.113	113.33.113	(n/a)
33.*33.113*	*113.*33.113*	
⇨ + ⇦ *33.**35**.113	⇦ + ⇨ *113.**35**.113	

Note that OSP filters out all the above backtracking cases since the output tone 35 (marked in boldface) ensues from applying tone sandhi to the second syllable twice. In contrast, MWC merely eliminates the two left-hand backtracking derivations because the same local window, demarcated by the second and third underlines,[6] serves as the domain of disyllabic tone sandhi twice.

A point worth mentioning is that both OSP and MWC hold true in Tianjin and Yaoping as well. To avert expositional redundancy, this paper refers the reader to Chen (2000:107, 115) and Hsu (2002) for examples.

3. TROPHIES OF OSP

This section demonstrates how Changting (Hsu 1994, 1995) and

[6] “[T]he sameness or difference of the local window is defined positionally, not in terms of the identity of the constituent tones” (Chen et al. 2004:100).

Taiwanese secret languages (Li 1985, 1997) argue for OSP instead of MWC.[7]

3.1 Changting

Distinguishing itself from many other Hakka dialects with its extremely rich sandhi system, Changting has five citation tones, including 54, 33, 21, 24, and 42 (Rao 1987).[8] In Table 1 below, the contents of the leftmost column and the top row contain the underlying form of the five tonal categories associated respectively with the first and second syllables. The sandhi forms are given in the cells at the points where the relevant column and row interact. Cells representing two-tone strings which do not yield change are marked with two hyphens.

Table 1

2nd σ / 1st σ	54	33	21	24	42
54	- -	- -	- -	- -	- -
33	- -	- -	21 -	21 -	- -
21	33 -	33 -	- -	- -	33 -
24	- -	44 -	- 42	- -	- -
42	- -	213 -	213 42	21 -	33 -

Same as the case in Dongshi Hakka, tri-tonal strings at the surface in Changting also derive from iterative left-to-right application of disyllabic sandhi rules (Hsu 1994, 1995).[9] With identical underlying tone combination, (8a) and (8b) share the surface tonal string even though they possess opposite branching structures. To avoid redundancy, the relevant rules are referred to Table 1 above.

[7] As will be demonstrated shortly, MWC has to be subsumed under the more general Domain Constraint to facilitate later comparison between the two tonal constraints under discussion in other languages.

[8] This tonal inventory based on auditory impression is somewhat different from that in Chen (2003) and Chen at el. (2004) posited with the aid of spectrographic display. Though not impossible, an inventory of three falling tones is rare, and more interestingly, it cannot be accommodated by tone models such as Yip (1980) and Bao (1999) which use the binary features [±upper] and [±raised] to respectively represent register and contour.

[9] The reader is referred to Hsu (1995, 2002) for more details.

(8) a. [lɔ fu] tsiaŋ ‘tiger well’
tiger well

b. lɔ [ku toŋ] ‘antique’
old curios

⇨ ⇦

⇨	⇦
42. 42.42	42. 42.42
|	|
33. 42.42	42.33.42
|	|
33.33.42	*213.33.42

As seen in examples (9) and (10) below, the OSP violation in the left-hand derivation triggers directionality reversal which gives rise to the correct output. In contrast, MWC is not contravened at all. Disyllabic tone sandhi does not apply to the same local window more than once although two rules successively target the middle syllable in the course of the derivation.

(9) [siɔ ho] saŋ ‘pupil’
primary school student

⇨ ⇦

⇨	⇦
42.21.33	42. 21.33
| |	|
213. 42.33	42.33.33
|	|
*213.**213**.33	213.33.33

(10) mɔ [va ti] ‘didn’t inform’
no inform

⇨ ⇦

⇨	⇦
24.21.33	24. 21.33
|	|
24. 42.33	24.33.33
|	|
*24.**213**.33	44.33.33

3.2 Taiwanese Secret Languages

Li (1985, 1997) describes three varieties of Taiwanese secret languages in terms of onsets and rimes. This section discusses the first two types alone. In considering segmental makeup, the working principles of the first type include total copying, onset substitution, and rime substitution. Roughly speaking, the first step is to make two copies of the base, followed by converting the onset of the first syllable into *l* and the rime of the second syllable into *-i*, *-ĩ*, *-in*, or *-it* depending on the original quadripartite (namely oral open, nasalized open, nasal, and checked) rime distinctions.[10] The second type is relatively simpler in that after breaking each syllable into two, the onset of the second syllable is replaced as *l*.

As for tonal behaviors, Taiwanese secret languages and the source dialect Ilan on which they are based conform to the same sandhi rules (Li 1985, 1997). Within a certain syntactic domain, all syllables in the secret language except the penultimate one accompany identical tones to those of their base counterparts. An immediate question which arises concerns what makes the penultimate syllable special. The answer has something to do with OSP.

First consider example (11) which shows the first type of Taiwanese secret language. In Ilan (and other Taiwan Southern Min dialects), every non-final citation tone is replaced by its corresponding sandhi tone within a tone group, indicated by the arrows. From the last two lines, Taiwanese secret language forms (parenthesized for visual clarity) basically keep the base tones intact, attesting to tonal stability which is motivated by the ban on applying tone sandhi to an input which has previously been altered. Since *ho* 'good' in the source bears the citation tone, its corresponding output syllables comply with tone sandhi in the expected way. Likewise, the boldfaced *lai33* in the second tone group ensues from the application of tone sandhi to the base *lai24*, a syllable carrying the citation tone. (Key: # = tone group boundary)

[10] In the literature (Bao 1990, Li 1985, 1997, Lin 1989, 1999), the rime substitution proposed here is separated into nucleus substitution which changes the second nucleus into *i* and coda coronalization which neutralizes the nasal/stop codas as *-n/t*. Bao (1990) proposes that vowel nasality in ĩ derives from a leftward spreading of a nasal glide which lacks a place of articulation.

(11) 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) #[11]

Additional support for OSP comes from example (12) which represents the second type of Taiwanese secret language. 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 separated by the arrows. Again, the formation of the secret language retains the base tones in order not to produce any OSP violation, except for the boldfaced ***pat5*** which derives from regular tone sandhi since the base syllable *pat3* 'eight' carries the citation tone.

(12) li53 tsin55 sam55 pat3 # 'you are really not sedate'
you really three eight
↓ ↓ ↓
li55 tsin33 sam33 pat3 #
(li55 gi55) (tsin33 lin33) (sam33 lam33) (**pat5** lat3) #

Let us now examine if the operation of MWC is tenable in Taiwanese secret languages. Recall that MWC demands that disyllabic tone sandhi should not apply to the same local window more than once. Strictly speaking, a direct input-output mapping constitutes the mode of rule application in Taiwanese secret languages when necessary, and hence MWC as proposed on the basis of the two-tone window scansion is irrelevant. In (11) and (12) above, the parentheses are used to demarcate each disyllabic secret language form, instead of the so-called "local window". Even if the parentheses do circumscribe a two-tone window, the whole course of tonal derivation is not appropriate for confirming the application of MWC. In Taiwanese secret languages, the base syllable is doubly duplicated, and yet it is never the case that disyllabic sandhi rules

[11] Note that a toneless syllable is immune to secret language formation, and hence the suffix *e* remains unchanged. Due to the concealment function (Lin 1999), *g* replacement applies to the final syllable in example (11) (and the second syllable in example (12) as well) as a repair strategy to avoid the possibility that both syllables in the secret language form start with *l*.

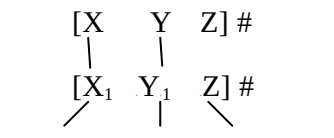
serve as the building block of tonal derivation.

A closer inspection of Changting and Taiwanese secret languages reveals that the left-hand derivations in (9) and (10) are wrongly sanctioned by a more general constraint prohibiting tone sandhi from applying to the same domain more than once (see (13)), and examples (11) and (12) are wrongly excluded by the same constraint.

(13) Domain Constraint (DC)[12]
Tone sandhi may not apply to the same domain more than once.

Specifically, DC possesses three crucial properties, inclusive of (a) the various (iterative, cyclic, direct mapping, or simultaneous) modes of rule application are unimportant, (b) the domain around which the current discussion centers is not limited to a two-tone window, and (c) it is the domain instead of tonal content that matters.[13] Given this latitude in rewriting MWC as DC, we now turn to the sandhi behavior of Taiwanese secret languages. Recall that tone sandhi affects all non-final full tones within a tone group in one sweep. In (14), X, Y, and Z denote any citation tone. Their respective counterparts marked by a subscription stand for the corresponding sandhi tones. Of particular interest is that the bracketed tone group boundary is fixed; what changes in the course of derivation is the tonal content. Note that DC does not consider how many input-output mappings occur, but focuses instead on the once-and-for-all completion of tone sandhi within a certain domain. What really happens in Taiwanese secret languages is: second-round tone sandhi occurs within the same domain as long as the input tone is not derived, which obviously constitutes a DC violation.

(14)



[12] As the more specific MWC accommodates Dongshi, Tianjin, and Yaoping, so does the more general DC.

[13] Recall that Chen et al. (2004:100) emphasize that "the sameness or difference of the local window is defined positionally, not in terms of the identity of the constituent tones."

4. TROPHIES OF DC

Contrary to the discussion in section 3, the discussion in this section demonstrates that Changting (Chen 2003, Chen et al. 2004:97, 100)[14,15] and fast speeches in Xuzhou (Su 1985) and Standard Mandarin favor DC instead.

4.1 Changting

Reported in Chen (2003) and Chen et al. (2004), Chiangting has a five-tone system which consists of three level tones (H, M, and L), one rising tone (R), and one falling tone (F).[16] Trisyllabic tone sandhi in this Hakka dialect is claimed to be derivable from a recursive application of disyllabic sandhi rules. In Table 2 below, disyllabic sandhi forms are given in the cells at the points where the relevant column and row interact. The reader is referred to Chen et al. (2004) for more data demonstration and an in-depth exploration about the directionality of rule application.

Table 2

2nd σ / 1st σ	H	M	L	R	F
H	- -	FM	FL	FR	- -
M	- -	- -	LL	LR	- -
L	MH	MM	- -	- -	MF

[14] Though both claimed to be an investigation of tone sandhi in the Hakka dialect spoken in the prefectural center of Changting, previous studies by Hsu (1994, 1995) on the one hand and Chen (2003) and Chen et al. (2004) on the other are based on separate sources of data, which might explain the different results they obtained.

[15] Note that MWC is employed to resolve Changting tone sandhi in Chen (2003) and Chen et al. (2004). We use DC here to make possible a comparison with OSP among languages which may be far apart from one other both geographically and linguistically.

[16] Their respective tone values based on a five-point scale are 55, 33, 11, 24, and 42. Chen et al. (2004:11) point out in a footnote that the low level tone is actually low-falling 21, presumably of an intonational nature, and that this minute phonetic detail is ignored for simplicity of exposition. Setting aside the difference of tonal descriptions, it is the case that the respective sandhi patterns in Rao (1987) and Chen et al. (2004) are almost the same, except for the first two-tone rows in Tables 1 and 2.

R	- -	HM	RF	- -	- -
F	LH, FM	RM	RF	LR	MF

Let us now focus on the issue of how Changting behaves with respect to OSP and DC. First, consider example (15).[17] The unattested RM does not contravene OSP since sandhi rules never apply to a derived input. Rather, DC, which prohibits tone sandhi from applying to the same domain more than once, explains its ungrammaticality.

(15) hao xiao 'funny, laughable'
FH
|
FM
|
RM (unattested)

OSP wrongly sanctions example (15), whereas it wrongly rules out examples (16) and (17). As seen below, the OSP violation on the part of the boldfaced F is allowed. It is DC that sanctions the realization of the actual output as tone sandhi never applies to the same domain (as underlined).

(16) [chang ting] hua 'Changting dialect'
xing [gong lu] 'take the highway'
R M L
|
R L L
|
R **F** L (attested)

[17] New Chongming (Bao 2003:10) also presents such shallow opacity.

(i)	Input:	H-HM	H-H	
		?	?	
	Output	H-o	H-HM	
			?	
			H-o	(unattested)

The point here is that both OSP and DC predict why H-o cannot surface as the output for H-H.

(17) [pu tong] hua ‘putonghua’ (lingua franca)
zong [si ling] ‘commander in chief’
F <u>M L</u>
|
<u>F L</u> L
|
R **F** L (attested)

4.2 Xuzhou Fast Speech

Additional corroboration for the application of DC is found in Xuzhou (Su 1985) fast speech. Xuzhou has a four-tone inventory of 213, 55, 24, and 51. The relevant disyllabic sandhi rules are given in (18). Note that (18b) operates in fast or casual speech alone.

(18) a. 213 → 24 / ___ 213
b. 24 → 55 / 55 ___ {213, 55, 24, 51}

Trisyllabic tonal strings at the surface can be achieved by a recursive application of disyllabic sandhi rules. One point to note is that Xuzhou exhibits an asymmetry with respect to the mode of rule application, depending on morphosyntactic structure. A constraint-based interpretation by Chen (2000:162) states,

> “When [Structural] Affinity and Temporal Sequence conspire to dictate a left-to-right direction of rule application…only one reading is permissible. On the other hand, in right-branching constructions, while Temporal Sequence calls for a uniform left-to-right iteration of the sandhi process, Affinity motivates an opposite directionality. The indeterminate dominance relation between these two conflicting constraints gives rise to the alternative readings.”

Consider the illustrative examples in (19), adopted from Chen (2000:163).

(19) a. [lu yin] ji ‘ cassette recorder’
213.213.213 base tone
24. 24. 213 sandhi form

b. kai [fei ji] ‘ pilot an airplane’
213.213.213 base tone
i. 24.24.213 sandhi form
ii. 213.24.213

Example (20) below indicates that fast speech is immune to OSP. The second syllable undergoes tone sandhi twice in the course of the derivation. In contrast, DC indicates the well-formedness of the fast speech reading. Given the cyclic mode of rule application, tone sandhi proceeds from the innermost cycle out. (18d) is a trisyllabic sandhi rule. As seen below, tone sandhi (not necessarily the same rule) never applies to the same domain twice.

(20) xong [qian bi] ‘ red pencil’
red pencil
55.<u>213.213</u>
|
<u>55.24.</u>213 (n/a)

<u>55.24.213</u>
|
55.**55**.213

If rule implementation abides by Temporal Sequence, which is permissible for a right-branching structure, the result remains the same. OSP is violated, and DC holds true, as demonstrated below:

(21) <u>55.213</u>.213

55.<u>213.213</u> (n/a)
|
<u>55.24.213</u>
|
55.**55**.213

4.3 Standard Mandarin Fast Speech

Third tone sandhi in Standard Mandarin demonstrates a decisive influence from morphosyntactic structure (Shih 1986). As displayed in (22), the same underlying tone combination may lead to distinct tonal outputs. The difference can be made more precise by applying third tone sandhi cyclically.

(22) a. [zong tong] fu ‘presidential hall’
213.213.213 base tone
35.35.213 sandhi form

b. jiang [zong tong] ‘President Jiang’
213.213.213 base tone
213.35.213 sandhi form

According to Chao (1991:15-16), in addition to the third tone sandhi, Standard Mandarin also has another sandhi rule which only affects fast speech, given in (23).

(23) 35 → 55 / {55, 35} ___ {55, 35, 213, 51}

Now, we will consider a crucial example which further indicates the inertness of OSP. As seen in (24), the unexpected but attested 55 surfaces after rule (23) affects 35 which results from the application of third tone sandhi. In contrast, the role of DC remains tenable in Standard Mandarin fast speech since tone sandhi never applies to the same domain.

(24) [fen shui] ling ‘ watershed’
divide water hill
<u>55.213</u>.213 (n/a)

55.<u>213.213</u>
|
<u>55.35.213</u>
|
55.**55**.213

Although DC holds valid in Xuzhou and Standard Mandarin fast

speeches, it is premature to advocate the inviolability of this constraint. As will be presented shortly, Tianjin fast speech does not completely abide by this constraint.

5. TIANJIN FAST SPEECH

This section demonstrates that while Tianjin fast speech may support the application of either OSP or DC, it may also fail to support either of them. Tianjin has a four-tone inventory of 11, 55, 24, and 53, according to Shi's (1990) experimental evidence. This paper follows Chen (2000:105-106) in representing these tones by the mnemonic symbols L, H, R, and F. Tianjin contains four disyllabic sandhi rules, as listed below:

(25) a. LL → RL
b. RR → HR
c. FF → LF
d. FL → HL

Multi-syllabic tonal strings in Tianjin at the surface are derived by a recursive application of disyllabic sandhi rules. We will take examples (26) and (27) adopted from Chen (2000:147-148) as illustration. Restricted to p-words as sandhi domains in more deliberate speech,[18] the rules in (25) together generate the attested readings in (26a) and (27a). In casual speech, where tone sandhi operates on the intonational phrase as a whole, the same tri-tonal sequence R.L.L gives rise to different end results, respectively indicated in (26c) and (27b). The former violates OSP even though tone sandhi finally occurs in two syllables abutting the subject-predicate boundary. (26c) is also immune to DC as second-round tone sandhi operates in the same intonational phrase.[19] In contrast, (27b) conforms to OSP and DC in the way of sandhi abortion within the verb. (Key: w = phonological word, IP = intonational phrase)

[18] Phonological words in (26) are trisyllabic, and those in (27) contain two syllables. In fact, the minimal prosodic word in Chinese is disyllabic (hence a foot), and otherwise a trisyllabic super-foot is generated if a dangling syllable occurs in the end of foot assignment (Chen 1984, Feng 1997). My thanks go to an anonymous reviewer for raising this point to my attention.

[19] Note that MWC is also contravened in (26c), but observed in (27b) as tone sandhi applies to the same two-tone window twice in the former but not in the latter.

(26) [[ta kɤ] tʂʰou] [[tʂan-tou] ian]
old brother smoke fight cigarette

(F L L)$_{w}$ (F F L)$_{w}$
|
(F R L) (L F L)
|
a. (F R L) (L H L) attested

(F R L L H L)$_{IP}$
|
b. (F R R L H L) not attested
|
c. (F **H** R L H L) attested

'older-brother smokes 'tʂan-tou' (brand) cigarettes'

(27) [tian-xua] [fa-tʂʰu] [kuai tɕiau]
telephone emit strange noise
(F F)$_{w}$ (L L)$_{w}$ (F F)$_{w}$
|
a. (L F) (R L) (L F) attested

(L F R L L F)$_{IP}$
|
b. (L F R R L F) attested
|
c. (L F **H** R L F) not attested

'telephone emits strange noise'

It is worth noting that in addition to OSP and DC, Tianjin fast speech can be resistant to the undominated Well-formedness Condition (WFC). As revealed in the following comparison (Hung 1987:283), the underlying representation of L.L.L. undergoes tone sandhi iteratively right-to-left in deliberate speech to avoid a possible WFC violation incurred by the sequence of R.R, and yet this WFC contravention is ignored in fast speech.

(28) [ji guan] qiang ‘machine gun’
mechanism gun

⇨ ⇦

L.L.L L.L.L
| |
R.L.L L.R.L (n/a)
|
*R.R.L L.R.L

(29) [fei ji] shi ‘pilot’
airplane expert

⇨

L.L.L
|
R.L.L
|
R.R.L (in fast speech)

The uniqueness of fast speech shows in segmental derivation as well. Syllable contraction as a product of fast speech may not comply with phonotactic constraints, as manifested in Taiwanese Southern Min (Hsu 2003). Roca and Johnson (1999:276) also note that “in fast speech…many of the [segmental co-occurrence] restrictions [in English] appear to be flouted.”

6. A BATTLEFIELD OUTSIDE CHINA—HAKHA LAI

From the previous discussion, the results of the comparison between the application of OSP and DC in Chinese dialects present a see-saw battle in which one constraint does not dominate the other. This section demonstrates how DC wins a foreign trophy in Hakha Lai, a Tibeto-Burman language of the Kuki-Chin subgroup, spoken in the Chin State, Burma, and parts of the Mizoram State, India. Examples to be discussed in this section are adopted from Hyman and VanBik (2004).

Tri-tonal strings at the surface in Hakha Lai ensue from simultaneous application of disyllabic sandhi rules (30a-d) and a phrasal rule (30e)

following temporal sequence.[20]

(30) a. F F → F L
b. L F → L L
c. R R → R F
d. R L → L L
e. R → F / in a phrasal initial position

Take example (31) as illustration. The actual output is realized by changing the second and third underlying F into L simultaneously by rule (30a). Note that the directionality of rule application (left-to-right or the reverse) does not matter here.

(31) raàl làw hmaà → raàl law hmaa
F F F F L L

'enemy field time'

From the crucial example in (32), Temporal Sequence has to be observed. In the underlying representation, both (30c) and (30d) target the same syllable *zaán*. Given that a tone cannot undergo change twice at the same time, the former takes precedence in application due to Temporal Sequence.

(32) /ka koóy zaán raŋ/ → ka koóy zaàn raŋ
R R L R F L

'my friend's night horse'

Let us now move on to examples of central interest. In example (33), the second and third underlying R's are simultaneously converted into F

[20] Quadri-tonal strings at the surface derive in the same way, as exemplified below. Note that Hyman and VanBik (2004) give input-output tone correspondences for (ii-iv) alone.
(i) /ka koóy zaán tsaán raŋ/ → ka koóy zaàn tsaàn raŋ
R R R L R F F L
'my friend's night-time horse'
(ii) F F F F → F L L L
(iii) R R R R → R F F F
(iv) R R R F → R F F F

by virtue of (30c). Example (34) falls out naturally by applying (30c) and (30e) at the same time. Note that the desired output RFF in (33) violates the WFC since FF meets the structural description of (30a). One may say that underapplication of tone sandhi is necessary in an attempt to avoid a possible OSP infraction. The same phenomenon occurs in (34).

(33) /ka koóy zaán tsaán/ → ka koóy zaàn tsaàn
R R R R F F

'my friend's night time'

(34) % koóy zaán tsaán/ → koóy zaàn tsaàn
R R R F F F

'friend's night time'

However, OSP wrongly sanctions the unattested RFL which results from applying (30a) to the actual output RFF in (35). There is no such case where tone sandhi affects an input which has previously been altered. Instead, DC comes into play. Recall that the mode of rule application in Hakha Lai is simultaneous application following Temporal Sequence. As demonstrated in (36), the whole tri-tonal string constitutes a domain in which sandhi rules operate. DC prohibits second-round tone sandhi even if the structural description is met. Examples (33) and (34) can be explained by the same token. Notice that, as demonstrated in (37), MWC also wrongly sanctions the ill-formed RFL since disyllabic tone sandhi does not apply to the same local window more than once.

(35) /ka koóy keé hmaà/ → ka koóy keè hmaà
R R F R F F

'my friend's leg wound'

(36) [R R F]
|
[R F F]

(37)

```
R   R   F
     |
R   F   F        (attested)
         |
R   F   L        (unattested)
```

In fact, Hakha Lai exhibits an opposite picture to Taiwanese secret languages regarding the ability to apply second-round tone sandhi in a specific domain. It is the case that Hakha Lai argues for DC, whereas Taiwanese secret languages favor OSP.

7. A VIRTUAL BATTLEFIELD IN SEGMENTAL DERIVATION OF *FANQIE* LANGUAGES

The previous sections focused on the comparison between OSP and DC with respect to tone sandhi. A question that arises at this point lies in whether either of their respective segmental counterparts is available. If so, what happens? This section provides an answer through segmental derivation of *fanqie* languages.

Bao (1990a: 329) mentions that in addition to the steps of copy and substitution, a constraint is required for *fanqie* language formation. Consider the nonexistent *fanqie* language in (38), where *x* or *y* is any segment:

(38) 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 [(39)]."

(39) 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

As a solution, Bao stipulates a constraint on Substitution to obviate (39) from being generated.

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

Notre that the above constraint coincides perfectly with OSP which requires that tone sandhi apply only once to a given syllable in the course of a derivation.

In contrast, a possible segmental counterpart of DC demands that substitution operate only once in a given domain. If due recognition is given to (38), a source syllable is divided into two domains, namely the onset and the rime, in *fanqie* languages. In (39), onset replacement and coda replacement affect different domains, and hence no violation of the segment counterpart of DC incurs. Still, *c.vy* is banned.

8. CONCLUDING REMARKS

This paper demonstrated how certain Chinese dialects behave with respect to the application of OSP and DC. As summed up below, both constraints on tonal derivation are observed in Dongshi Hakka, Tianjin, and Yaoping; OSP wins in Changting (Hsu 1994, 1995) and Taiwanese secret languages; DC wins in Changting (Chen 2003, Chen et al. 2004) and fast speeches in Xuzhou and Standard Mandarin; and both support and counterevidence come from Tianjin fast speech.

(41)

	OSP	DC
Dongshi Hakka	✓	✓
Tianjin	✓	✓
Yaoping	✓	✓
Changting (Hsu 2004, 2005)	✓	×
Taiwanese secret languages	✓	×
Changting (Chen 2003, Chen et al. 2004)	×	✓
Xuzhou fast speech	×	✓
Standard Mandarin fast speech	×	✓
Tianjin fast speech	✓/×	✓/×

On the other hand, DC finds foreign support in Hakha Lai, and OSP gains endorsement from *fanqie* languages in the aspect of segmental derivation.

(42)

	OSP	DC
Hakha Lai	×	✓
Fanqie languages	✓	×

A question that arises at this point concerns whether modes of rule application, including iterative, cyclic, direct-mapping, and simultaneous application, have any bearing on the satisfaction of the two constraints under discussion. Setting aside the iterative cases where reactions to the constraints vary, the answer seems to be positive. Seen in (43) below, Xuzhou and Standard Mandarin, which feature cyclicity of tone sandhi, both lend support to DC. Since direct-mapping requires straightforward input-output correspondence and the sandhi domain stays intact from the beginning of a derivation to the end, it is not surprising that Taiwanese secret languages are blind to DC. In contrast, simultaneous application demands the once-and-for-all completion of tone sandhi, and hence Hakha Lai tone sandhi reveals DC to be a tailor-made constraint.

(43)

	OSP	DC	Mode
Dongshi Hakka	✓	✓	I
Tianjin	✓	✓	I
Yaoping	✓	✓	I
Changting (Hsu 2004, 2005)	✓	×	I
Taiwanese secret languages	✓	×	DM
Changting (Chen 2003, Chen et al. 2004)	×	✓	I
Xuzhou fast speech	×	✓	C (I)[21]
Standard Mandarin fast speech	×	✓	C (I)
Tianjin fast speech	✓/×	✓/×	I
Hakha Lai	×	✓	S

In addition, one of the tenets in Optimality Theory (Prince and Smolensky 2004) that all constraints are violable is further corroborated here. Both OSP and DC allow contraventions. The competition in between can be easily expressed in Optimality Theory by the notion of constraint interaction. Three possible language-specific constraint rankings are: (a) OSP and DC stand in the same scale, (b) OSP ranks higher than DC, or (c) DC ranks higher than OSP. Of particular interest is the dual nature of tone sandhi in Tianjin fast speech which can be attributed to the notion of variable ranking (see Anttila 1997, Boersma 1998)[22] to accommodate the concomitant constraint satisfaction and violation across tone strings. Setting aside an exceptional case,[23] Hsu (2002) proposes the constraint ranking of OSP, WFC >> Temp for Tianjin trisyllabic tone sandhi. With DC as one more working constraint, let us now see how the notion of variable rankings captures the

[21] Tone sandhis in Xuzhou and Standard Mandarin demonstrate a predilection for the use of morphosyntactic structure (hence cyclic), and yet right-branching structures also allow left-to-right iterative derivation in fast speech.

[22] Take the following Taiwan Southern Min syllable contraction for example. Variable rankings in terms of sonority markedness, namely *NUC/u > *NUC/i and *NUC/i > *NUC/u, are both posited to guarantee the emergence of the two possible output nuclei.

(i) si + tsun → sin / sun 'moment'

The reader is referred to Myers and Li (2005) in this volume for more details.

[23] The underlying tone combination of HL.L.L unexpectedly fails to follow Temporal Sequence in an attempt to satisfy a more dominant constraint, Set Consistency, which demands that in Tianjin, trisyllabic utterances sharing the last two base tones constitute a category (on the basis of rhythmic pattern), which dictates a specific directionality of rule implementation for all members. The reader is referred to Hsu (2004) for the details.

differences seen in examples (26) and (27) above. Tableaux (44) and (45) only contain those candidates which take the whole intonational phrase as a domain. For expositional simplicity, the respective input strings are not listed in the candidate pools since they are eliminated by another undominated constraint demanding an absolute distinction between the deliberate speech and the fast speech. Given the constraint hierarchy of WFC >> OSP, DC, Temp, (44b) wins out due to least violation. On the other hand, (45a) emerges according to the scale of OSP, DC >> WFC, Temp.[24] The problem of which ranking applies to which tone string is outside the domain of the current discussion.

(44)

F.R.L.L.H.L	WFC	OSP	DC	Temp
a. F.R.R.L.H.L	*!			*
☞b F.H.R.L.H.L		*	*	*

(45)

L.F.R.L.L.F	OSP	DC	WFC	Temp
☞a. L.F.R.R.L.F			*	*
b. L.F.H.R.L.F	*!	*		*

Last, but not least, African tone languages, which are typologically very much different from Chinese dialects (see Yip 2002:132, 133, 173), present an excellent testing ground for OSP and DC. Pursuant to Larry Hyman (pers. comm.), "lots of African tone languages have a rule that spreads a High tone one vowel to the right, and stops. So the output of the High tone spreading cannot serve as its own input [to another sandhi rule]". There is, however, unbounded H tone spreading in other African tone languages. The issue of whether OSP finds no counterevidence in African tone languages is more complicated than might be expected. Another line of further pursuit concerns the examination of DC in African tone languages. Generally speaking, though the time is not ripe to say anything specific at the moment, our future investigation shall

[24] Note that the constraint ranking of OSP, DC, WFC, Temp also makes the correct prediction.

present important theoretical implications for both language universal and language typology.

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漢語的兩個聲調衍化制約

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近年文獻裡攸關長汀客語聲調衍化的兩大制約，一是一步原則(One Step Principle)**--即衍生調不得再次變調，一是視窗移動制約**(Moving Window Constraint)**--即同一個局部視窗至多進行一次二字組變調。在討論範圍擴及東勢客語、天津話、饒平客語、臺灣秘密語、徐州話及北京話的同時，本文提出更具普遍性又可涵蓋視窗移動制約的範疇制約**(Domain Constraint)**--即同一個範疇至多進行一次變調，以利逐一檢驗兩大制約的優劣。比較結果呈現拉鋸：兩者皆能解釋東勢客語、天津話和饒平客語。一步原則在長汀客語**(Hsu 1994, 1995)**及臺灣秘密語勝出；範疇制約取得長汀客語**(Chen 2003, Chen et al. 2004)**、徐州話快讀與北京話快讀的印證。但是兩者都無法完全掌握天津話快讀。兩大制約的競爭更延燒到藏緬語及虛擬戰場。**Hakha Lai**的聲調衍化為範疇制約提供了境外奧援，反切語則具現了一步原則在音段衍化的化身。至於兩大制約在非洲聲調語言的表現，且待日後分曉。**