

Rethinking OCP Effects on Tone Sandhi*

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The obligatory contour principle (OCP), disallowing identical elements to be adjacent, was originally observed in phenomena of tonal dissimilation in African tone languages. In Chinese dialects, contextual tone sandhi, which is sensitive to neighboring tones, is often characterized as resulting from OCP effects. This paper surveys the literature of tone sandhi in Chinese dialects and observes the OCP effects on tone roots, contours, and registers. In terms of comparative markedness, I posit that OCP must be supplemented with locus of violation, and tone retention does not follow from prosodic headship/edge privilege, but is achieved by the grandfathering effect.

Key words: comparative markedness, grandfathering effect, OCP, tone sandhi, violation locus

1. Introduction

The obligatory contour principle (OCP) bans adjacent identical elements, originally observed for phenomena of tonal dissimilation in African tone languages (Goldsmith 1976; Leben 1973). In Chinese dialects, contextual tone sandhi, which is sensitive to neighboring tones, is often characterized as resulting from OCP effects. This paper re-examines the OCP effects on tone sandhi, and proposes an analysis using notions developed from the framework of comparative markedness (McCarthy 2003). Three questions are explored: What indicates the target tone for mutation under the effects of OCP? How does tone retention apply? How does OCP interact with old/new markedness constraints? The rest of this paper consists of two major parts. Section 2 surveys the literature on Chinese tone sandhi and observes OCP effects on tone roots, contours and registers. Section 3 posits an argument that requires OCP to be supplemented with locus of violation, and that examines the grandfathering effect in pairs of bi-tonal sequence. The conclusion follows.

2. OCP effects on tone sandhi

In terms of tone geometry, tone root is the highest node of a tone, and a tone consists of two major components, contour and register (Bao 1990, 1999; Duanmu 1990, 1994; Hyman 1993; Inkelas 1987; Snider 1990; Yip 1980, 1989, 2002, among others), though different theorists have

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argued for slightly different models. In Chinese dialects, OCP effects can be observed between tone roots, between contours, or between registers. For convenience of discussion, this paper adapts Chao's (1930) numeric tonal notation into an alphabetic system that expresses each tone value in terms of register and contour. The range from 3 to 5 pertains to the high register, represented as Hr, while that from 3 pertains to 1 the low register, represented as Lr. Contours are represented by a high melody, h, and/or a low melody, l. The following tone notations are used in this paper.

(1) Tone notations

Tones	Alphabetic values	Numeric values
High:	H [Hr, h]	(5, 4)
High-rising:	MH [Hr, lh]	(35, 24)
High-falling:	HM [Hr, hl]	(53, 42)
Mid:	H [Hr, l]	(3)
Low:	L [Lr, l]	(1, 2, 21)
Low-rising:	LM [Lr, lh]	(13, 23)
Low-falling:	ML [Lr, hl]	(31, 32)
Low-concave:	MLM [Lr, hlh]	(213, 214, 313, 323)

The segments are basically presented in Pinyin, and in *italic*, with a couple of modifications. The superscript *"* after a vowel indicates vowel nasalization, and *-h* indicates the glottal stop coda.

2.1 OCP effects on tone root

When OCP scans tone roots, identical tones cannot be adjacent. In Mandarin, a low tone maps to a rising tone before another low tone, as in (2).¹ In Boshan, a high tone maps to a low-rising tone before another high tone, as in (3).² In Tianjin, a high-rising tone maps to a high tone before another high-rising tone, as in (4). In Dongshi, a low-rising tone maps to a mid tone before another low-rising tone, as in (5). In Huojia, a high-falling tone maps to a low-falling tone before another high-falling tone, as in (6).³ In Shangxian, a low-falling tone maps to a high-rising tone before another low-falling tone, as in (7).

¹ I follow the literature (such as Shih 1986) and present the Mandarin third tone as a low tone, though the phonetic shape of this tone is for some speakers concave.

² There are two types of high tones in Boshan, H α and H β ; H α maps to HM before any H, while H β maps to LM before any H (Chen 2000; Lin 2004). In any case, adjacent identical high tones are disallowed.

³ In Huojia, a pair of adjacent high-falling tones may display two other sandhi patterns: namely, the right tone maps to a low-rising tone while the left tone remains unchanged, or both tones mutate; see also §3.1.

- | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--------------|----------------|---------------|------|------|--|----|----|-----------|----|--|-------------|--|-------------|--------------|----------------|--------|-------|--|----|----|-----------|----|--|-------------|
| <p>(2) OCP-L in Mandarin
(Hsiao 1991; Shih 1986)</p> <table border="0"> <tr> <td><i>hao</i></td> <td><i>jiu</i></td> <td>‘good wine’</td> </tr> <tr> <td>good</td> <td>wine</td> <td></td> </tr> <tr> <td>L</td> <td>L</td> <td>base tone</td> </tr> <tr> <td>MH</td> <td></td> <td>sandhi tone</td> </tr> </table> | <i>hao</i> | <i>jiu</i> | ‘good wine’ | good | wine | | L | L | base tone | MH | | sandhi tone | <p>(3) OCP-H in Boshan
(Chen 2000; Lin 2004)</p> <table border="0"> <tr> <td><i>tan</i></td> <td><i>bai</i></td> <td>‘to confess’</td> </tr> <tr> <td>reveal</td> <td>blank</td> <td></td> </tr> <tr> <td>H</td> <td>H</td> <td>base tone</td> </tr> <tr> <td>LM</td> <td></td> <td>sandhi tone</td> </tr> </table> | <i>tan</i> | <i>bai</i> | ‘to confess’ | reveal | blank | | H | H | base tone | LM | | sandhi tone |
| <i>hao</i> | <i>jiu</i> | ‘good wine’ | | | | | | | | | | | | | | | | | | | | | | | |
| good | wine | | | | | | | | | | | | | | | | | | | | | | | | |
| L | L | base tone | | | | | | | | | | | | | | | | | | | | | | | |
| MH | | sandhi tone | | | | | | | | | | | | | | | | | | | | | | | |
| <i>tan</i> | <i>bai</i> | ‘to confess’ | | | | | | | | | | | | | | | | | | | | | | | |
| reveal | blank | | | | | | | | | | | | | | | | | | | | | | | | |
| H | H | base tone | | | | | | | | | | | | | | | | | | | | | | | |
| LM | | sandhi tone | | | | | | | | | | | | | | | | | | | | | | | |
| <p>(4) OCP-MH in Tianjin
(Chen 2000; Wee 2004)</p> <table border="0"> <tr> <td><i>mai</i></td> <td><i>mi</i></td> <td>‘to buy rice’</td> </tr> <tr> <td>buy</td> <td>rice</td> <td></td> </tr> <tr> <td>MH</td> <td>MH</td> <td>base tone</td> </tr> <tr> <td>H</td> <td></td> <td>sandhi tone</td> </tr> </table> | <i>mai</i> | <i>mi</i> | ‘to buy rice’ | buy | rice | | MH | MH | base tone | H | | sandhi tone | <p>(5) OCP-LM in Dongshi
(Hsiao & Chiu 2006)</p> <table border="0"> <tr> <td><i>vong</i></td> <td><i>shia</i></td> <td>‘yellow snake’</td> </tr> <tr> <td>yellow</td> <td>snake</td> <td></td> </tr> <tr> <td>LM</td> <td>LM</td> <td>base tone</td> </tr> <tr> <td>M</td> <td></td> <td>sandhi tone</td> </tr> </table> | <i>vong</i> | <i>shia</i> | ‘yellow snake’ | yellow | snake | | LM | LM | base tone | M | | sandhi tone |
| <i>mai</i> | <i>mi</i> | ‘to buy rice’ | | | | | | | | | | | | | | | | | | | | | | | |
| buy | rice | | | | | | | | | | | | | | | | | | | | | | | | |
| MH | MH | base tone | | | | | | | | | | | | | | | | | | | | | | | |
| H | | sandhi tone | | | | | | | | | | | | | | | | | | | | | | | |
| <i>vong</i> | <i>shia</i> | ‘yellow snake’ | | | | | | | | | | | | | | | | | | | | | | | |
| yellow | snake | | | | | | | | | | | | | | | | | | | | | | | | |
| LM | LM | base tone | | | | | | | | | | | | | | | | | | | | | | | |
| M | | sandhi tone | | | | | | | | | | | | | | | | | | | | | | | |
| <p>(6) OCP-HM in Huojia
(He 1979)</p> <table border="0"> <tr> <td><i>lao</i></td> <td><i>ban</i></td> <td>‘boss’</td> </tr> <tr> <td>Af.</td> <td>boss</td> <td></td> </tr> <tr> <td>HM</td> <td>HM</td> <td>base tone</td> </tr> <tr> <td>ML</td> <td></td> <td>sandhi tone</td> </tr> </table> | <i>lao</i> | <i>ban</i> | ‘boss’ | Af. | boss | | HM | HM | base tone | ML | | sandhi tone | <p>(7) OCP-ML in Shangxian
(Zhang 1989)</p> <table border="0"> <tr> <td><i>fa</i></td> <td><i>huang</i></td> <td>‘panic’</td> </tr> <tr> <td>get</td> <td>panic</td> <td></td> </tr> <tr> <td>ML</td> <td>ML</td> <td>base tone</td> </tr> <tr> <td>MH</td> <td></td> <td>sandhi tone</td> </tr> </table> | <i>fa</i> | <i>huang</i> | ‘panic’ | get | panic | | ML | ML | base tone | MH | | sandhi tone |
| <i>lao</i> | <i>ban</i> | ‘boss’ | | | | | | | | | | | | | | | | | | | | | | | |
| Af. | boss | | | | | | | | | | | | | | | | | | | | | | | | |
| HM | HM | base tone | | | | | | | | | | | | | | | | | | | | | | | |
| ML | | sandhi tone | | | | | | | | | | | | | | | | | | | | | | | |
| <i>fa</i> | <i>huang</i> | ‘panic’ | | | | | | | | | | | | | | | | | | | | | | | |
| get | panic | | | | | | | | | | | | | | | | | | | | | | | | |
| ML | ML | base tone | | | | | | | | | | | | | | | | | | | | | | | |
| MH | | sandhi tone | | | | | | | | | | | | | | | | | | | | | | | |

The OCP effect on tone root will force one of any pair of adjacent identical tones to alter at least one tone feature, contour or register (or both). If the target tone is followed by a different tone it may remain unchanged, as in Mandarin, Dongshi, and Huojia, while in some dialects, such as Boshan, Tianjin, and Shangxian, different tonal mutation may be independently motivated by grammar.

2.2 OCP effects on contour

OCP may scan the contour tier, and ban any pair of tones that have identical contours in the output. In Dongshi, a high-falling tone maps to a high tone before any falling tone, high-falling or low-falling, as in (8a) and (8b).

- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|----------|-------------|--|----|----|-----------|----------|----------|--|---|--|-------------|---------|--|--|---|----------|------|--|----|----|-----------|----------|----------|--|---|--|-------------|---------|--|--|
| (8) OCP-Fall in Dongshi (Hsiao 2008; Hsiao & Chiu 2006) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>a. <i>tai</i> <i>shu</i> ‘big tree’</p> <table border="0"> <tr> <td>big</td> <td>tree</td> <td></td> </tr> <tr> <td>HM</td> <td>HM</td> <td>base tone</td> </tr> <tr> <td>[Hr, hl]</td> <td>[Hr, hl]</td> <td></td> </tr> <tr> <td>H</td> <td></td> <td>sandhi tone</td> </tr> <tr> <td>[Hr, h]</td> <td></td> <td></td> </tr> </table> | big | tree | | HM | HM | base tone | [Hr, hl] | [Hr, hl] | | H | | sandhi tone | [Hr, h] | | | <p>b. <i>siong</i> <i>zeu</i> ‘elephants walk’</p> <table border="0"> <tr> <td>elephant</td> <td>walk</td> <td></td> </tr> <tr> <td>HM</td> <td>ML</td> <td>base tone</td> </tr> <tr> <td>[Hr, hl]</td> <td>[Hr, hl]</td> <td></td> </tr> <tr> <td>H</td> <td></td> <td>sandhi tone</td> </tr> <tr> <td>[Hr, h]</td> <td></td> <td></td> </tr> </table> | elephant | walk | | HM | ML | base tone | [Hr, hl] | [Hr, hl] | | H | | sandhi tone | [Hr, h] | | |
| big | tree | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HM | HM | base tone | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [Hr, hl] | [Hr, hl] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| H | | sandhi tone | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [Hr, h] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| elephant | walk | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HM | ML | base tone | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [Hr, hl] | [Hr, hl] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| H | | sandhi tone | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| [Hr, h] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

In Zhenjiang, a falling tone, high-falling or low-falling, maps to a high-rising tone before any falling tone, high-falling or low-falling, as in (9a–d).⁴

⁴ The register issue will be dealt with in §2.3.

(9) OCP-Fall in Zhenjiang (Cheung 1985)

- | | | | | | | | |
|----|------------|------------|--------------|----|------------|-----------|-------------------|
| a. | <i>ko</i> | <i>ing</i> | ‘high pitch’ | b. | <i>jao</i> | <i>io</i> | ‘to make friends’ |
| | high | pitch | | | make | friend | |
| | HM | HM | base tone | | HM | ML | base tone |
| | [Hr, hl] | [Hr, hl] | | | [Hr, hl] | [Lr, hl] | |
| | MH | | sandhi tone | | MH | | sandhi tone |
| | [Hr, lh] | | | | [Hr, lh] | | |
| | | | | | | | |
| c. | <i>jan</i> | <i>dan</i> | ‘simple’ | d. | <i>me</i> | <i>jo</i> | ‘to buy wine’ |
| | simple | single | | | buy | wine | |
| | ML | HM | base tone | | ML | ML | base tone |
| | [Lr, hl] | [Hr, hl] | | | [Lr, hl] | [Lr, hl] | |
| | MH | | sandhi tone | | MH | | sandhi tone |
| | [Hr, lh] | | | | [Hr, lh] | | |

The conversion of falling tones to level tones in (8a) and (8b) or to rising tones in (9a–d) indicates that adjacent falling contours are forbidden in these dialects. When a falling tone is followed by a non-falling tone, the falling tone may preserve its base form or undergo a different mutation. In Dongshi, HM remains unchanged before a rising or level tone (Hsiao & Chiu 2006:459–461), while in Zhenjiang, a falling tone maps to a level tone before a rising or level tone (Cheung 1985:192–196).

In contrast, adjacent rising contours are disallowed in Lianyun, as in (10a–c). (The superscript V^n represents a nasalized vowel.)

(10) OCP-Rise in Lianyun (Iwata 1982)

- | | | | | | | |
|----|--------------------|-----------------------|---------------|----|----------------|-----------------------|
| a. | <i>shu</i> | <i>zuo</i> | ‘desk’ | b. | <i>po - li</i> | ‘glass’ |
| | book | table | | | glass | |
| | MLM | LM | base tone | | MLM | MH |
| | [Lr, hlh] | [Lr, lh] | | | [Lr, hlh] | [Hr, lh] |
| | ML | | sandhi tone | | ML | |
| | [Lr, hl] | | | | [Lr, hl] | |
| | | | | | | |
| c. | <i>xiang - jao</i> | | ‘banana’ | d. | <i>sheng</i> | <i>saⁿ</i> |
| | banana | | | | produce | produce |
| | MLM | MLM | base tone | | MLM | ML |
| | [Lr, hlh] | [Lr, hlh] | | | [Lr, hlh] | [Lr, hl] |
| | ML | | sandhi tone | | MLM | |
| | [Lr, hl] | | | | [Lr, hlh] | |
| | | | | | | |
| e. | <i>ji</i> | <i>daⁿ</i> | ‘chicken egg’ | | | |
| | chicken | egg | | | | |
| | MLM | H | base tone | | | |
| | [Lr, hlh] | [Hr, h] | | | | |
| | MLM | | sandhi tone | | | |
| | [Lr, hlh] | | | | | |

The concave tone MLM^[Lr, hlh], as in (10), contains a step down (an hl falling contour) followed by a step up (an lh rising contour). ‘Tonally induced changes tend to minimize the number of ups and downs over a given stretch,’ as Hyman (1978:261) indicates. This is known as the principle of ups and downs (PUD). In this spirit, MLM is likely subject to PUD and levels out; hence, the contour [hlh] maps to [hl]. One could argue that the Lianyun data could be interpreted as a ban on [hlh] non-finally; in terms of J. Zhang (2001), this could just be a phonetic effect that non-final syllables do not have adequate length for complex tonal contours. However, this argument is unable to account for (10d) and (10e), where MLM is preserved when followed by a non-rising tone, ML or H. Accordingly, the Lianyun concave tone in fact illustrates a case of contour simplification due to a ban on adjacent rising contours. Specifically, MLM loses its rising contour and maps to ML before LM, as in (10a), before MH, as in (10b), or before another MLM, as in (10c). When this concave tone is followed by a falling or level tone, it remains unchanged, preserving its rising contour, as in (10d) and (10e).

2.3 OCP effects on register

OCP effects can be observed on the register tier as well; in that case, any pair of tones that have identical registers is banned in the output. Tiantou shows another case of leveling in terms of PUD, but the contour simplification is sensitive to a neighboring register; a low-register concave tone, in a non-VO structure, maps to a high-falling tone before any low-register tone, as in (11a) and (11b).⁵ In Xuzhou, a sub-dialect of Cangshan, a low-register concave tone maps to a high-rising tone before any low-register tone, as in (12a) and (12b). (L^o represents a neutral low tone.)

(11) OCP-Lr in Tiantou (Huang 2010)

a.	<i>xiao</i>	<i>ci</i>	‘lady’	b.	<i>fo</i>	<i>jian</i>	‘rocket’
	small	girl			fire	jet	
	MLM	MLM	base tone		MLM	ML	base tone
	[Lr, hlh]	[Lr, hlh]			[Lr, hlh]	[Lr, hl]	
	HM		sandhi tone		HM		sandhi tone
	[Hr, hl]	[Hr, hl]					

(12) OCP-Lr in Xuzhou (Li 1996; Liu 2003)

a.	<i>jang</i>	<i>bei</i>	‘North of the river’	b.	<i>dong</i>	<i>gua</i>	‘melon’
	river	North			winter	melon	
	MLM	MLM	base tone		MLM	L ^o	base tone
	[Lr, hlh]	[Lr, hlh]			[Lr, hlh]	[Lr, l]	
	MH		sandhi tone		MH		sandhi tone
	[Hr, lh]				[Hr, lh]		

⁵ In Tiantou, this OCP effect on low register is morphosyntactically conditioned, particularly found in non-VO structures; in VO structures, this concave is neutralized as a high tone before any tone (Huang 2010:247–248).

Whereas adjacent low registers are prohibited in Tiantou and Xuzhou, adjacent high registers are banned in Leling and Sixian. A high-falling tone in Leling maps to a low-falling tone before any high-register tone, as in (13a) and (13b). In Sixian, a high-rising tone maps to a low tone before any high-register tone, as in (14a) and (14b).

(13) OCP-Hr in Leling (Cao 2007)

a.	<i>iu</i>	<i>lan</i>	‘to travel’	b.	<i>zih</i>	<i>da</i>	‘express’
	tour	browse			direct	arrive	
	HM	H	base tone		HM	HM	base tone
	[Hr, hl]	[Hr, h]			[Hr, hl]	[Hr, hl]	
	ML		sandhi tone		ML		sandhi tone
	[Lr, hl]				[Lr, hl]		

(14) OCP-Hr in Sixian (data from Hsiao 2008; Hsu 1996)

a.	<i>song</i>	<i>ko</i>	‘go to the class’	b.	<i>zu</i>	<i>gon</i>	‘pig liver’
	go	class			pig	liver	
	MH	H	base tone		MH	MH	base tone
	[Hr, lh]	[Hr, h]			[Hr, lh]	[Hr, lh]	
	L		sandhi tone		L		sandhi tone
	[Lr, l]				[Lr, l]		

As OCP places restrictions between identical registers, the question arises then as to what happens between different registers. Two patterns are in order. First, the target tone may retain its base form. The high-register HM in Leling (Cao 2007:56) and the high-register MH in Sixian (Hsiao 2008:81) remain unchanged before a low-register tone. Second, the target tone may alter its contour without changing its register. The low-register MLM in Tiantou non-VO structures (Huang 2010:247) and that in Xuzhou (Liu 2003:15–21) map to ML before any high-register tone.⁶

A more complex case can be observed in Zhuolan Raoping, where OCP is active both between high registers and between low registers. Some examples are given in (15).⁷

(15) OCP-Hr/OCP-Lr in Zhuolan Raoping

a.	<i>lang</i>	<i>kian</i>	‘parts’	b.	<i>kim</i>	<i>ngian</i>	‘this year’
	separate	part			this	year	
	HM	H	base tone		H	HM	base tone
	[Hr, hl]	[Hr, h]			[Hr, h]	[Hr, hl]	
	L		sandhi tone		L		sandhi tone
	[Lr, l]				[Lr, l]		

⁶ In Xuzhou, the low-register MLM also maps to ML before a high-register neutral tone (Liu 2003:21).

⁷ The data of Zhuolan Raoping are collected in my ongoing two-year research project supported by the Ministry of Science and Technology #MOST-103-2410-H-004-086-MY2, with the help of five native speakers, three males and two females, aged from 66 to 74.

c.	<i>mun</i>	<i>heu</i>	‘behind the door’	d.	<i>lu</i>	<i>bian</i>	‘roadside’
	door	behind			road	side	
	HM	ML	base tone		H	L	base tone
	[Hr, hl]	[Lr, hl]			[Hr, h]	[Lr, l]	
	M		sandhi tone		M		sandhi tone
	[Hr, l]				[Hr, l]		
e.	<i>coi</i>	<i>to</i>	‘kitchen knife’	f.	<i>sui</i>	<i>tong</i>	‘pond’
	kitchen	knife			water	pond	
	ML	L	base tone		ML	HM	base tone
	[Lr, hl]	[Lr, l]			[Lr, hl]	[Hr, hl]	
	M		sandhi tone		L		sandhi tone
	[Hr, l]				[Lr, l]		

The high-register tones in (15a) and (15b) map to L before another high-register tone, while those in (15c–d) map to high-register M before any low-register tone. The low-register ML in (15e) maps to high-register M before another low-register tone, but to L in (15f) before a high-register tone.

To sum up, OCP prohibits tone roots, contours, or registers that are identical from being adjacent. However, OCP does not indicate the target tone for mutation. A closely related problem is the locus of tone retention. A recent treatment of the tone retention lies in positional faithfulness, which often falls into a paradox of typology, as will be discussed in the following section.

3. Rethinking OCP effects

OCP does not place a locus restriction on tone sandhi or tone preservation. It has hitherto been necessary to invoke positional faithfulness so that tonal alternation would apply discriminately to the locus of sandhi. In the following discussions, I propose an analysis that dispenses with positional faithfulness by direct specification of violation locus. I distinguish between old and new markedness violations in pairs of bitonal sequences.

3.1 Locus of violation

Under the effect of OCP- α , an $[\alpha_i \alpha_j]$ bitonal sequence maps to $[\beta_i \alpha_j]$ in many Chinese dialects, and to $[\alpha_i \beta_j]$ in others. The literature has attributed the right/left retention of α to either prosodic headship (Lin 2011) or domain-edge effect (Hsiao 2008, 2013; Shih 1986). Mandarin illustrates a case of right tone retention, as in (16), while Zhoushan shows retention of the left tone, as in (17).

- (16) Right retention in Mandarin
(Shih 1986)
- | | | |
|------------|------------|-------------|
| <i>hao</i> | <i>jiu</i> | ‘good wine’ |
| good | wine | |
| L | L | base tone |
| MH | | sandhi tone |

- (17) Left retention in Zhoushan
(Fang 1987)
- | | | |
|------------|-------------|--------------|
| <i>mai</i> | <i>ning</i> | ‘matchmaker’ |
| medium | person | |
| L | L | base tone |
| ML | | sandhi tone |

One possible analysis for the disyllabic expressions is to assume prominence privilege. It could be suggested that the right syllable of the Mandarin phrase in (16) is stressed, serving as a prosodic head, while the left syllable of the Zhoushan word in (17) is the prosodic head. The head syllables retain their base tones, while the non-head ones are subject to tone sandhi. An alternative analysis could be to consider edge privilege. Assuming that the disyllabic strings in (16) and (17) form a disyllabic foot, the suggestion is that tone retention is required at the right edge of the Mandarin foot but at the left edge of the Zhoushan foot.

The headship/edge analyses would be based on assumptions of language typology: Mandarin would be prosodically right-headed or require right-edge faithfulness, while Zhoushan would be prosodically left-headed or require left-edge faithfulness. These two analyses encounter problems in dialects like Huojia. Consider (18a–d):

(18) Disyllabic tone sandhi in Huojia (He 1979)

a.	<i>ci</i>	<i>huo</i>	‘to set fire’	b.	<i>ci</i> - <i>huo</i>	‘a kind of rising fireworks’
	set	fire			rising fire	
	HM	HM	base tone		HM HM	base tone
	ML		sandhi tone		LM	sandhi tone
c.	<i>zui</i>	<i>lian</i>	‘mouth and face’	d.	<i>zui</i> - <i>lian</i>	‘outlook’
	mouth	face			outlook	
	HM	HM	base tone		HM HM	base tone
	ML		sandhi tone		ML LM	sandhi tone

He (1979:124) distinguishes three patterns of HM sandhi in Huojia, which I term here HM_{s1} , HM_{s2} and HM_{s3} , for convenience of discussion. HM_{s1} preserves the base tone of the right syllable and allows tone sandhi of the left syllable, as in (18a) and (18c). Conversely, HM_{s2} preserves the base tone of the left syllable and allows tone sandhi of the right syllable, as in (18b). In HM_{s3} , both syllables undergo tone sandhi, as in (18d). HM_{s1} is the most common, and it expresses the meaning of a word or phrase literally: in (18a) the verb phrase that consists of *ci* ‘to set’ and *huo* ‘fire’ means ‘to set fire’, and in (18c) the noun phrase that is conjoined by *zui* ‘mouth’ and *lian* ‘face’ means exactly ‘mouth and face’. HM_{s2} is limited to special terms; in (18b) the term *ci-huo* indicates a particular kind of ‘rising fireworks’. HM_{s3} is usually found in compounds that develop extended meaning; in (18d) *zui* and *lian* are compounded to indicate ‘outlook’ in general. Given these facts, the headship/edge analyses would be inconsistent in Huojia. It would be unfounded to claim that (18c) is prosodically right-headed but (18d) has no head, since stress is not intuitively motivated in this dialect. It would also be baseless to say that (18a) has right-edge privilege but (18b) has left-edge privilege. In terms of Optimality Theory (OT, Prince & Smolensky 2004), the headship/edge analyses have led to positional faithfulness (Beckman 1998; Itô et al. 1996; Lombardi 1999; Nelson 2003; Yip 2002). The first disadvantage for positional faithfulness, then, is to fall inevitably into a paradox of typology, as in the case of Huojia.⁸

⁸ A possible argument in support of the headship analysis could appeal to Duanmu’s (1990) ‘non-head stress’, which suggests that a morphosyntactic non-head is stressed. In other words, a morphosyntactic non-head is a

In reaction to this problem, I propose that a simpler, and more plausible, analysis would be to specify locus of violation (McCarthy 2003). Specifically, the universal constraint component CON includes the constraints defined in (19a) and (19b).

- (19) a. $\text{OCP-}\alpha_{[\text{Loc1}]} \equiv$ for every α , do not return α if followed by an α tone.
 b. $\text{OCP-}\alpha_{[\text{Loc2}]} \equiv$ for every α , do not return α if preceded by an α tone.

- (20) Illustrations of (19a and b)

	$\text{OCP-}\alpha_{[\text{Loc1}]} = (19a)$	$\text{OCP-}\alpha_{[\text{Loc2}]} = (19b)$
$\alpha_i \alpha_j \alpha_k$	$*\alpha_i * \alpha_j$	$*\alpha_j * \alpha_k$

As McCarthy (2003:7) indicates, every markedness constraint, M_i , 'is defined by some locus function Loc_i . The result of applying M_i to *cand* is a number of violation-marks equal to the cardinality of the set obtained by applying Loc_i to *cand*.' Loc_i are not strings, but individual tones. Accordingly, $\text{OCP-}\alpha$ specifies locus of violation in its definition in addition to the number of violation marks. As illustrated in (20), α_i is followed by α_j and α_j by α_k , so both α_i and α_j are loci of violation in terms of (19a); in terms of (19b), both α_j and α_k are loci of violation, since α_j is preceded by α_i and α_k by α_j .

In this sense, the violation locus in Huojia is morphosemantically conditioned: the Loc function of (19a) is specified commonly in literal speech, as in (18a) and (18c), but that of (19b) is limited only to special terms, as in (18b); in compounds with special semantic extension, as in (18d), both Loc functions of (19a) and (19b) are specified. In other words, the specifications of violation locus pertain to subgrammars of different structures, which account for the patterns of HM sandhi with no prosodic headship or edge typology stipulated.

A second disadvantage for the positional faithfulness analyses arises from the $[\alpha_i \alpha_j \gamma_k] \rightarrow [\beta_i \alpha_j \gamma_k]$ mapping, where the medial α_j is neither a prosodic head nor at the domain edge, but retains its base form. One could suggest that there can be recursive prosodic structures. For example, $[\alpha_i \alpha_j \alpha_k]$ can be prosodically parsed into recursive feet, such as $((\alpha_i \alpha_j) \alpha_k)$ or $(\alpha_i (\alpha_j \alpha_k))$. However, the interim foot boundaries do not bar tone sandhi, as shown in (21) and (22).

(21)	<i>lao</i>	<i>hu</i>	<i>dan</i>	'tiger gall' (Shih 1986)	
	Af.	tiger	gall	(Mandarin)	
	L	L	L	base tones	$\text{OCP-L}_{[\text{Loc1}]}$
*a.	((L	L)	L)	sandhi tones	violated
b.	((MH	MH)	L)	sandhi tones	not violated
*c.	((MH	L)	L)	sandhi tones	not violated
*d.	((L	MH)	L)	sandhi tones	not violated

prosodic head. In this sense, stress falls on *huo* in (18a), but on *ci* in (18b). For (18c and d), one would have to assume that stress is assigned to the left node of a coordinate structure, such as the noun phrase in (18c), and that a compound like (18d) receives no stress. In any case, various stipulations of morphosyntactic interface would be necessary. In contrast, the proposed analysis in this paper, which incorporates locus of violation, is more direct, needing no stipulation of the above.

(22)	<i>zhi</i> paper L	<i>lao</i> Af. L	<i>hu</i> tiger L	‘paper tiger’ (Shih 1986) (Mandarin) base tones	OCP-L _[Loc1]
*a.	(L	(L	L))	sandhi tones	violated
*b.	(MH	(MH	L))	sandhi tones	not violated
*c.	(MH	(L	L))	sandhi tones	violated
d.	(L	(MH	L))	sandhi tones	not violated

Regardless of the fact that the medial syllable *hu* in (21) is at the right edge of the interim left foot, and the medial syllable *lao* in (22) is at the left edge of the interim right foot, both syllables undergo tone sandhi such that (21b) and (22d) can be derived. In that case, the interim foot boundaries do not block the tone sandhi of the medial syllables, *hu* in (21) and *lao* in (22). The question then is how to avoid the mapping from $[\alpha_i \alpha_j \gamma_k]$ to $[\alpha_i \beta_j \gamma_k]$ or $[\beta_i \beta_j \gamma_k]$, where the medial α_j maps to β_j . The solution is again linked to locus of violation. In terms of the Loc function of (19a), the medial α_j in $[\beta_i \alpha_j \gamma_k]$ is not followed by any α tone and thus does not violate OCP- α . Consider (23)–(25):

(23)	<i>kao</i> barbecue L	<i>ru</i> baby L	<i>zhu</i> pig H	‘barbecue piglet’ (Hsiao 1991) (Mandarin) base tones	OCP-L _[Loc1]
*a.	L	L	H	sandhi tones	violated
b.	MH	L	H	sandhi tones	not violated
*c.	L	MH	H	sandhi tones	not violated
*d.	MH	MH	H	sandhi tones	not violated
(24)	<i>hau</i> like HM	<i>chiong</i> plant HM	<i>ca</i> tea LM	‘love to plant tea’ (Hsiao & Chiu 2006) (Dongshi) base tones	OCP-Fall _[Loc1]
*a.	HM	HM	LM	sandhi tones	violated
b.	H	HM	LM	sandhi tones	not violated
*c.	HM	H	LM	sandhi tones	not violated
*d.	H	H	LM	sandhi tones	not violated
(25)	<i>koi</i> drive MH	<i>ca</i> car MH	<i>loi</i> come L	‘to drive the car over’ (Hsiao 2008) (Sixian) base tones	OCP-Hr _[Loc1]
*a.	MH	MH	L	sandhi tones	violated
b.	L	MH	L	sandhi tones	not violated
*c.	MH	L	L	sandhi tones	not violated
*d.	L	L	L	sandhi tones	not violated

The Loc function of (19a) is specified in these three dialects. OCP-L_[Loc1] scans tone roots in Mandarin. The L of *ru* in (23) is not followed by another L, and thus remains unchanged. OCP-Fall_[Loc1] scans contours in Dongshi. The HM of *chiong* in (24) is not followed by any falling tone, and thus does not mutate. In Sixian, OCP-Hr_[Loc1] scans registers. The MH of *ca* in (25) precedes no high-register tone, and thus is not subject to tone sandhi.

One might argue that the emergence of (24b) in Dongshi, or even that of (22d) in Mandarin, follows from edge faithfulness; namely, tones at both edges of a local domain are preserved. While this argument predicts the reading of (24b), it fails to account for the exclusion of (26d) and the surfacing of (26e).

(26)	<i>hao</i> love HM	<i>chiong</i> plant HM	<i>shu</i> tree HM	‘love to plant tree’ (Hsiao & Chiu 2006) (Dongshi) base tones OCP-Fall _[Loc1]	
*a.	HM	HM	HM	sandhi tones	violated
*b.	H	HM	HM	sandhi tones	not violated
*c.	HM	H	HM	sandhi tones	not violated
*d.	HM	H	HM	sandhi tones	not violated
e.	H	H	HM	sandhi tones	not violated

In a similar fashion, the faithfulness of both edges derives the reading of (22d), but is unable to account for the reading of (21b). More seriously, faithfulness of both edges would erroneously predict that disyllabic tonal changes, like those in §2, could never occur. The present proposal for the inclusion of violation locus in CON provides a more direct and accurate analysis.

3.2 Grandfathering effects

The avoidance of the $[\alpha_i \alpha_j \alpha_k \alpha_l] \rightarrow [\alpha_i \beta_j \beta_k \alpha_l]$ mapping raises another problem: $[\alpha_i \beta_j \beta_k \alpha_l]$ is an illegal output but it does not violate OCP- α . Edge faithfulness would wrongly allow $[\alpha_i \beta_j \beta_k \alpha_l]$ in the output. The locus of violation appears inconsistent here as well: the $[\alpha_i \beta_j \dots]$ pair refers to the Loc function of (19b), the $[\dots \beta_k \alpha_l]$ pair to the Loc function of (19a), and the $[\dots \beta_j \beta_k \dots]$ pair to both Loc functions of (19a) and (19b).

(27)	<i>xiang</i> intend L	<i>mai</i> buy L	<i>hao</i> good L	<i>jiu</i> wine L	‘intend to buy good wine’ (Hsiao 1991) (Mandarin) base tones OCP-L _[Loc1]	
*a.	L	L	L	L	sandhi tones	violated
b.	MH	L	MH	L	sandhi tones	not violated
*c.	L	MH	MH	L	sandhi tones	not violated
d.	MH	MH	MH	L	sandhi tones	not violated

The Mandarin tetrasyllabic line in (27) consists of two disyllabic feet, *xiang mai* and *hao jiu*, as proposed by Chen (2000), Hung (1987), Hsiao (1991), and Shih (1986), among others. Mandarin takes the foot as the L sandhi domain in normal speech, where the Loc function of (19a) is specified. As OCP-L_[Loc1] applies to each foot, the reading of (27b) is derived, where *xiang* and *hao* mutate but *mai* and *jiu* retain their base tones. Alternatively, the intonational phrase (i.e. the whole line) serves as the L sandhi domain in fast speech. As OCP-L_[Loc1] applies to the intonational phrase, either (27c) or (27d) can be derived, but the former is a bad reading.

(28)	<i>hao</i>	<i>chiong</i>	<i>tai</i>	<i>shu</i>	‘love to plant big tree’ (Hsiao & Chiu 2006)	
	HM	HM	HM	HM	base tones	OCP-Fall _[Loc1] (Dongshi)
*a.	HM	HM	HM	HM	sandhi tones	violated
*b.	H	HM	H	HM	sandhi tones	not violated
*c.	HM	H	H	HM	sandhi tones	not violated
d.	H	H	H	HM	sandhi tones	not violated

Dongshi does not take the foot as the HM sandhi domain, but the intonational phrase (i.e. the whole line) functions as the sole domain, where the Loc function of (19a) is specified as well. In this domain, only (28a) violates OCP-Fall_[Loc1], but the remaining three readings do not. However, (28b) and (28c) are bad readings.

(29)	<i>tian</i>	<i>teu</i>	<i>tong - moi</i>		‘my farmer cousin’	
	farm	head	cousin		(Zhuolan Raoping)	
	HM	HM	HM	H	base tones	OCP-Hr _[Loc1]
*a.	HM	HM	HM	H	sandhi tones	violated
b.	L	HM	L	H	sandhi tones	not violated
*c.	HM	L	L	H	sandhi tones	not violated
*d.	L	L	L	H	sandhi tones	not violated

(30)	<i>nan</i>	<i>jim</i>	<i>teu - lu</i>		‘hard to find a job’	
	hard	find	job		(Zhuolan Raoping)	
	HM	HM	HM	H	base tones	OCP-Hr _[Loc1]
*a.	HM	HM	HM	H	sandhi tones	violated
*b.	L	HM	L	H	sandhi tones	not violated
*c.	HM	L	L	H	sandhi tones	not violated
d.	L	L	L	H	sandhi tones	not violated

The HM sandhi in Zhuolan Raoping is subject to OCP-Hr_[Loc1]. The tone sandhi domain is syntactically determined. The NP in (29) consists of two feet, *tian teu* and *tong moi*. OCP-Hr_[Loc1] operates on each foot and derives the reading of (29b), where *tian* and *tong* surface with L but *teu* and *moi* retain their base tones. The readings of (29c) and (29d) are not acceptable, but they incur no violation of OCP-Hr_[Loc1]. The VP in (30) constitutes a single domain to which OCP-Hr_[Loc1] applies. The only good reading is (30d), where all the three HMs map to Ls, but the readings in (30b) and (30c) are grammatically ill-formed. However, neither (30b) nor (30c) violates OCP-Hr_[Loc1].

The solution to these problems does not follow from the collaboration of OCP and positional faithfulness, but I would like to argue here that it in fact lies in the grandfathering effect, in terms of comparative markedness (McCarthy 2003). This theory distinguishes two kinds of markedness violations: old-markedness violation, M_O , which is shared with the fully faithful candidate (FFC), and new-markedness violation, M_N , which is not shared with the FFC. As McCarthy indicates, a language may tolerate marked structures that are inherited from the input, but prohibit the same structures that are created in the output. This is referred to as the grandfathering effect. Essentially, ‘ $*M_N \gg \text{FAITH} \gg *M_O$ ’ requires that derived markedness be blocked while non-derived markedness be tolerated. In the present analysis, I examine comparative markedness in tonal sequences, and

posit that a language may tolerate an $[\alpha \beta]$ sequence inherited from the input, but ban the same sequence newly created in the output. In the case of Mandarin, an old [L MH] sequence, as in (31a), is a possible surface form, while a new [L MH] sequence, as in (31b), is not allowed to surface. This fact can be achieved through the ‘ $[L_O T_N] \gg \text{Faith} \gg [L_O T_O]$ ’ ranking (T = full tone).

- (31) $[L_O T_N] \gg \text{Faith} \gg [L_O T_O]$ (Mandarin) (Hsiao 1991)
- | | | | | | | | |
|----|-----------|------------|---------|-----|------------|-----------|---------|
| a. | <i>nu</i> | <i>ren</i> | ‘woman’ | *b. | <i>lao</i> | <i>hu</i> | ‘tiger’ |
| | L | MH | input | | L | L | input |
| | L | MH | output | | L | MH | output |

Similarly, the ‘ $[HM_O H_N] \gg \text{Faith} \gg [HM_O H_O]$ ’ ranking predicts that an old [HM H] sequence in Dongshi, as in (32a), is grammatically acceptable, while a new [HM H] sequence, as in (32b), is not a feasible output.

- (32) $[HM_O H_N] \gg \text{Faith} \gg [HM_O H_O]$ (Dongshi) (Hsiao & Chiu 2006)
- | | | | | | | | |
|----|------------|------------|--------------|-----|-------------|------------|--------------|
| a. | <i>tai</i> | <i>hok</i> | ‘university’ | *b. | <i>tian</i> | <i>shi</i> | ‘television’ |
| | big | school | | | electric | view | |
| | HM | H | input | | HM | HM | input |
| | HM | H | output | | HM | H | output |

Zhuolan Raoping permits an old [HM Lr] sequence on the surface, as in (33a), but prohibits a new [HM Lr] sequence, as in (33b). This can be governed by the ‘ $[HM_O Lr_N] \gg \text{Faith} \gg [HM_O Lr_O]$ ’ ranking.

- (33) $[HM_O Lr_N] \gg \text{Faith} \gg [HM_O Lr_O]$ – Zhuolan Raoping
- | | | | | | | | |
|----|------------|------------|----------------|-----|-------------|------------|--------------|
| a. | <i>jim</i> | <i>kim</i> | ‘to find gold’ | *b. | <i>tian</i> | <i>shi</i> | ‘television’ |
| | find | gold | | | electric | view | |
| | HM | L | input | | HM | HM | input |
| | HM | L | output | | HM | L | output |

The point is that the OCP effect on tone sandhi must be supplemented with comparative markedness. Further evidence for the distinction between old- and new-tonal-markedness violations can be observed in Tianjin, where an old [L L] pair maps to [MH L] but a derived new [L L] pair does not trigger sandhi (see also Chen 2000; Lin 2004; Wee 2004). This pattern in Tianjin suggests a case of an anti-grandfathering effect: a newly created [L L] pair is tolerated, but an old [L L] pair is forced to mutate (see also Hsiao 2015). The following section will show how OCP constraints interact with old-/new-markedness constraints.

3.3 Constraint interactions

As the OCP effect places restrictions on adjacent tones, the locus of violation indicates the target tone for mutation, and the grandfathering effect governs tone retention. In this spirit, stipulations of positional faithfulness (head/edge privilege) can be dispensed with. In terms of comparative

markedness, OCP constraints work with new-markedness constraints in Chinese dialects to eliminate undesirable tonal outputs. In Dongshi, OCP-Fall_[Loc1] and *[HM_O H_N] dominate Ident-T. The tetrasyllabic line in (34) constitutes a single domain for the HM sandhi; these two top-ranked constraints together favor candidate (f) over the other candidates. The parenthesized !-marks indicate that either violation is fatal.

(34) Dongshi HM sandhi, (28)

Input: HM HM HM HM Output: H H H HM

	OCP-Fall _[Loc1]	*[HM _O H _N]	Ident-T	*[HM _O H _O]
a. (HM HM HM HM)	*!*			
b. (HM HM H HM)	*(!)	*(!)	*	
c. (H HM HM HM)	*!*		*	
d. (H HM H HM)		*!	**	
e. (HM H H HM)		*!	**	
☞ f. (H H H HM)			***	

In Zhuolan Raoping, NP and VP refer to different domains for the HM sandhi; NP is parsed into feet, while VP forms an intonational phrase. In both cases, OCP-Hr_[Loc1] and *[HM_O Lr_N] dominate Ident-T. In (35a), candidate (a) incurs two violations of OCP-Hr_[Loc1], one per foot; the left foot of candidate (b) and the right foot of candidate (c) violate this constraint once. Hence, these three candidates are ruled out. In candidate (e), the left foot incurs a fatal violation of *[HM_O Lr_N], which disallows an old HM to precede a new low-register tone. Finally, candidate (d) wins over candidate (f) by one less violation of Ident-T.

(35) Zhuolan Raoping HM sandhi

a. Foot: NP, (29b)

Input: HM HM HM H Output: L HM L H

	OCP-Hr _[Loc1]	*[HM _O Lr _N]	Ident-T	*[HM _O Lr _O]
a. (HM HM)(HM H)	*!*			
b. (HM HM)(L H)	*!		*	
c. (L HM)(HM H)	*!		*	
☞ d. (L HM)(L H)			**	
e. (HM L)(L H)		*!	**	
f. (L L)(L H)			***!	

b. Intonational phrase: VP, (30d)

Input: HM HM HM H Output: L L L H

	OCP-Hr _[Loc1]	*[HM _O Lr _N]	Ident-T	*[HM _O Lr _O]
a. (HM HM HM H)	*!*			
b. (HM HM L H)	*(!)	*(!)	*	
c. (L HM HM H)	*!*		*	
d. (L HM L H)		*!	**	
e. (HM L L H)		*!	**	
☞ f. (L L L H)			***	

In (35b), OCP-Hr_[Loc1] and *[HM_O Lr_N] operate in the entire tetrasyllabic domain; the former is violated three times by candidate (a) and twice by candidate (c), while the latter is violated once by candidate (d) and candidate (e). Candidate (b) violates both of the top-ranked constraints. Consequently, candidate (f) emerges.

(36) Mandarin L sandhi

a. Foot: normal speech, (27b)

Input: L L L L Output: MH L MH L

	OCP-L _[Loc1]	*[L _O T _N]	Ident-T	*[L _O T _O]
a. (L L)(L L)	*!*			**
b. (L L)(MH L)	*!		*	*
c. (MH L)(L L)	*!		*	*
☞ d. (MH L)(MH L)			**	
e. (L MH)(MH L)		*!	**	
f. (MH MH)(MH L)			***!	

b. Intonational phrase: fast speech, (27d)

Input: L L L L Output: MH MH MH L

	OCP-L _[Loc1]	*[L _O T _N]	Ident-T	*[L _O T _O]
a. (L L L L)	*!*			***
b. (L L MH L)	*(!)	*(!)		*
c. (MH L L L)	*!*			**
d. (MH L MH L)		*!	**	
e. (L MH MH L)		*!	**	
☞ f. (MH MH MH L)			***	

The domain for the Mandarin L sandhi varies according to speech tempo: the foot in *moderato*, and the intonational phrase in *presto*. OCP- $L_{[Loc]}$ and $*[L_O T_N]$ dominate Ident-T, a constraint ranking that correctly selects candidate (d) in (36a) and candidate (f) in (36b) as the optimal outputs.

4. Conclusion

The OCP effect is usually considered a motivation for contextual tone sandhi; the relevant OCP constraints may scan tone roots, contours, or registers. In the literature, tone retention has been attributed to positional faithfulness, which often refers to prosodic headship or edge privilege. I have shown that stipulations of prosodic headship or edge privilege appear baseless in dialects such as Huojia, where tone retention may be found on the left or right syllable, or both. I have also argued that faithfulness of both edges may lead to incorrect predictions of tone sandhi, as in Dongshi and Mandarin. In reaction to these problems, I have posited an analysis that dispenses with the headship/edge privilege, but specifies locus of violation in relation to OCP- α . As OCP restricts contextual surface tones, violation locus specifies the target tone for mutation. I distinguish between old- and new-markedness violations in pairs of bi-tonal sequences. Precisely, in terms of comparative markedness, OCP constraints work with new-markedness constraints in Chinese dialects to eliminate undesirable tonal outputs.

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再思連讀變調之 OCP 效應

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「必要差異原則」(OCP) 不允許相同的成分彼此毗鄰，這個限制最早是從非洲聲調語言中的聲調異化現象所觀察得。在漢語方言中，語境連讀變調對於相鄰的聲調具敏感性，往往是由 OCP 效應所導致。本文調查了漢語方言變調的文獻，並觀察在調根、調弧及調域各個層次的 OCP 效應。本人提出，OCP 必須輔予「違反落標」的限制，並且主張，聲調保留並非取決於韻律首或邊端位置之特殊性，而是藉由「祖父效應」所成就。

關鍵詞：比較性標記，祖父效應，OCP，違反落標，連讀變調