Article

Language & Linguistics 語言暨語言學

Language and Linguistics
16(6) 873–889

DOI: 10.1177/1606822X15602615
lin.sagepub.com
SAGE

Circular Tonal Chain Shifts in Jiaoxian Compound Words*

Wang-chen Ling

National Chengchi University

This study examines the tonal chain shifts in pre-neutral toned syllables of Jiaoxian compound words, using the framework of Optimality Theory. The tonal chain shifts are motivated by reducing articulatory effort according to the tonal markedness scale. When a tone shifts to a more marked one, it is because of the anti-neutralization nature, which can be captured by Preserving Contrasts (PC). PC keeps feature contrast in the output. The maintenance of PC comes from transderivational anti-faithfulness, and the output-to-output anti-faithfulness constraints evaluate a pair of related words and require dissimilarity between them.

Key words: Jiaoxian, Preserving Contrasts (PC), tonal chain shifts, tonal markedness scale, transderivational anti-faithfulness

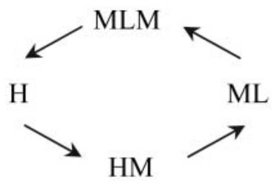
1. Introduction

Tonal chain shifts have been a challenge that many scholars have formalized within the framework of Optimality Theory (OT) (Barrie 2006; Hsieh 2005; Łubowicz 2003; Mortensen 2004, among others). In particular, this paper examines the tonal chain shifts in pre-neutral toned syllables in Jiaoxian, a dialect spoken in Shandong.

Hirayama (1998) observes that the tonal chain shifts taking place in pre-neutral toned syllables are common among Shandong dialects. Hirayama indicates that this kind of tonal chain shift results from diachronic change. The historical tones in Shandong dialects have undergone tone sandhi, which yields the present tones. Only the full tone in a pre-neutral toned syllable has escaped tone sandhi. One of the Shandong dialects Hirayama mentions is Dezhou. As shown in (1), Hirayama argues that the historical H (high level tone) changes to HM (high–mid falling tone) because the end pitch of a high level often drops, and this tonal shift pushes other tones to change.

* I am deeply grateful to Yuchau E. Hsiao and Lian-Hee Wee for their detailed and enlightening comments. I would also like to thank the two anonymous reviewers, whose valuable comments strengthened my paper. All errors are my own responsibility.

(1) Dezhou diachronic tonal chain shifts (Hirayama 1998:7)[1]

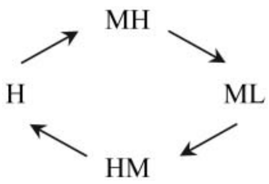


Hirayama further explains that the reason why the pre-neutral toned H does not undergo tone sandhi is because the neutral-toned syllable attaches to its preceding H so strongly that it prevents the end pitch of H from dropping.

However, I observe that a full-toned syllable can also attach strongly to its preceding H, but this does not prevent the end pitch of H from dropping.[2] In addition, the H-to-HM mapping is not common in Chinese dialects, either from the perspective of tone sandhi or language acquisition (Li & Thompson 1978; Yue-Hashimoto 1987). Moreover, Hirayama (1998) only points out the motivation for H-to-HM mapping without providing the motivation for the rest of the tonal shifts in the chain.

In contrast, the present study proposes that it is the tone in a pre-neutral toned syllable that exhibits chain shifts, diachronic or synchronic. The Jiaoxian tonal chain shifts are shown below in (2).

(2) Jiaoxian tonal chain shifts



I contend that the tonal chain shifts from MH (mid–high rising) to ML (mid–low falling), ML to HM (high–mid falling), and HM to H (high level) are motivated by minimizing articulatory effort according to the tonal markedness scale (Hyman & VanBik 2004; Yip 2001). H changes to a more marked tone because of Preserving Contrasts (PC; Łubowicz 2003:20) in the output.[3] The maintenance of PC is governed by a set of output-to-output (OO) anti-faithfulness constraints (Alderete 2001). The neutral tones of compound words tend to surface as low-registered tones (following de Lacy 2002, who says that non-heads disprefer high tones). However, when preceded by low-registered tones, they surface as high-register tones due to the obligatory contour principle (OCP) (Goldsmith 1976:63; Leben 1973:87–113).[4]

---

[1] MLM refers to mid-low-mid falling-rising tone. ML refers to mid-low falling tone.

[2] In modern Shandong dialects, in a sequence of two full-toned syllables, the second syllable can trigger tone sandhi of the first (see footnote 8 in §2).

[3] P is a potentially contrastive phonological property: e.g. a distinctive feature. PC constraint requires that pairs of inputs which have contrast underlyingly pertaining to P contrast on the surface (not necessarily pertaining to P). In this study, PC refers to OO correspondence.

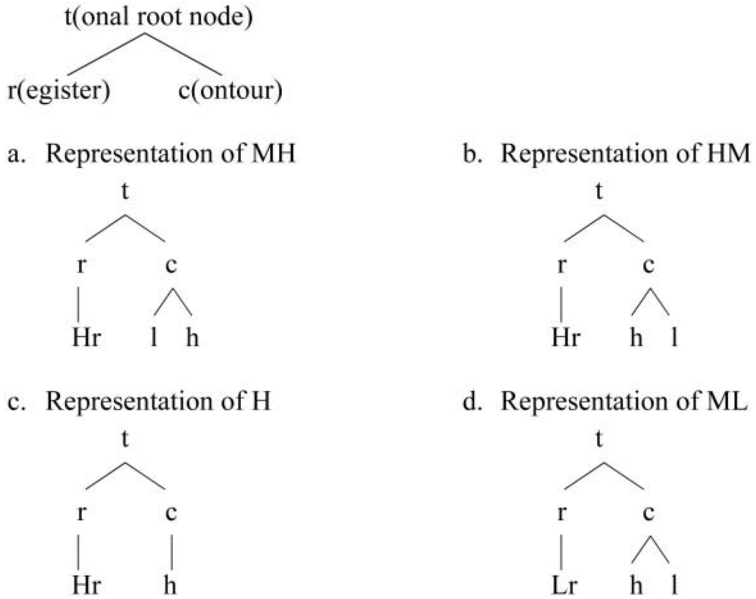
[4] See (4) in §2.

The rest of the paper is organized as follows. Section 2 introduces Jiaoxian tones and tone sandhi patterns. Section 3 provides an OT analysis of the tonal chain shifts in Jiaoxian, and offers cross-linguistic evidence. Section 4 concludes this paper.

2. Jiaoxian tones and rudimentary tone sandhi patterns[5]

There are four base tones in Jiaoxian: namely, MH (mid–high rising, known as *yinping* in traditional terminology), HM (high–mid falling, *yangping*), H (high level, *shang*), and ML (mid–low falling, *qu*).[6] Following Bao's (1999:46) model, Jiaoxian's tones may be represented as in (3a–d).[7]

(3) The geometry of tone



[5] Data were collected from a female speaker, aged 38, who had lived in Jiaoxian for 25 years before moving to Taiwan. She returns to Jiaoxian at least once a year. Her highest education level is elementary school.

[6] To be precise, the *qu* tone is really MLM. Evidence for treating it as ML comes from Rizhao, a sister variety of Jiaoxian, in which ML tone undergoes sandhi in the same manner as Jiaoxian's *qu* tone.

[7] The data from Jiaoxian are transcribed according to Chao's (1930) numeric tonal notation where 1 is the lowest pitch and 5 is the highest. Hsiao (2015) adapts Chao's (1930) system into the alphabetic system as follows. The range from 3 to 5 belongs to high register, Hr, while that from 3 to 1 belongs to the low register, Lr. A high melody, h, and a low melody, l, represent contours. This paper then adopts Hsiao's (2015) adaptation.

Tone notations:

Tones	Alphabetical values	Numerical values
High:	H [Hr, h]	(5, 4)
High-rising	MH [Hr, lh]	(35, 24)
High-falling	HM [Hr, hl]	(53, 42)
Low-falling	ML [Lr, hl]	(31, 32)

Jiaoxian tonal chain shifts are found on the full-toned syllable that is followed by a neutral-toned syllable.[8] A paradigm of the tone shifts is given in (4).[9]

(4)

Neutral-toned syllable / Full-toned syllable	*yinping* /Hr, lh/ MH	*yangping* /Hr, hl/ HM	*shang* /Hr, h/ H	*qu* /Lr, hl/ ML
yinping /Hr, lh/ MH	[Lr, hl][Hr] ML H_N 東 西 toŋ ɕi 'thing'	[Lr, hl][Hr] ML H_N 櫻 桃 jin tʰao 'cherry'	[Lr, hl][Hr] ML H_N 孫 女 sun ny 'granddaughter'	[Lr, hl][Hr] ML H_N 機 器 tɕi tʰɕi 'machine'
yangping /Hr, hl/ HM	[Hr, h][Lr] H L_N 娘 家 njaŋ tɕa 'family of a married woman's parents'	[Hr, h][Lr] H L_N 葡 萄 pʰu tʰao 'grape'	[Hr, h][Lr] H L_N 姪 女 tʂɨ ny 'niece'	[Hr, h][Lr] H L_N 床 上 tʂʰaŋ ʂaŋ 'on the bed'
shang /Hr, H/ H	[Hr, lh][Lr] MH L_N 棗 山 tθao ʂan 'steamed bread with red jujube'	[Hr, lh][Lr] MH L_N 碼 頭 ma tʰou 'wharf'	[Hr, hl][Lr] HM L_N[10] 水 果 ʂwei kwo 'fruit'	[Hr, lh][Lr] MH L_N 馬 上 ma ʂaŋ 'immediately'
qu /Lr, hl/ ML	[Hr, hl][Lr] HM L_N 地 方 ti faŋ 'place'	[Hr, hl][Lr] HM L_N 罐 頭 kwan tʰou 'can'	[Hr, hl][Lr] HM L_N 地 裡 ti li 'in the field'	[Hr, hl][Lr] HM L_N 漂 亮 pjau ljaŋ 'pretty'

Jiaoxian shows a chain shift effect whereby full tones change to other tones from the basic inventory, summarized in (5). Note also that neutral tones undergo shifts as well, to ensure

---

[8] The tone sandhi patterns in the sequence of two full-toned syllables are shown below (UR = underlying representation; TS = tone sandhi; PR = phonetic representation).

lau	ʂɨ	'teacher'	y	θan	'umbrella'	xai	pʰa	'afraid'
H	MH	UR	H	H	UR	ML	ML	UR
HM	MH	TS/PR	**HM**	H	TS/PR	**MH**	ML	TS/PR

[9] The words selected in (4) are mono-morphemic compounds, such as *pʰu tʰao* 'grape'; words with suffixes, such as *kwan tʰou* 'can'; and highly lexicalized compounds, such as *ma ʂaŋ* 'immediately'. According to the survey in this study, the second syllables in the above words are neutral-toned. Whatever the word structures are, the tones of full syllables in pre-neutral toned syllables undergo chain shifts.

[10] Note that the tone of *ʂwei kwo* 'fruit' should be MH-L_N, but it surfaces as HM-L_N. This special case is assumed to be affected by other dialects in Shandong.

difference in register with the preceding full tones (attributable to the OCP; see §1 earlier). Our attention, however, will be on the full tones.

(5) Tonal chain shifts in Jiaoxian (see (2))

MH [Hr, lh]

H [Hr, h] **ML** [Lr, hl]

HM [Hr, hl]

Notably, from MH to ML, ML to HM, and HM to H, the shifts move along the tonal markedness scale (Hyman & VanBik 2004; Yip 2001), as shown in (6).

(6) *rise » *fall » *level

The tonal markedness scale is a scale of markedness grounded in the decreasing difficulty of production and perception of tones. Level tones are less marked than contour tones. Yue-Hashimoto (1987) surveys 83 dialects of Chinese, and finds that leveling is the most common change that takes place in tone sandhi. Li & Thompson (1978) also observe the tendency to level off contour tones in language acquisition. Falling tones are less marked than rising tones. This is also supported, first, by the fact that falling tones are more common in Chinese tonal inventories (Cheng 1973); and second, through the studies of Ohala & Ewan (1973) and Sundberg (1973), which show rising tones taking longer to produce (and perceive; Ohala 1978) than falling ones.

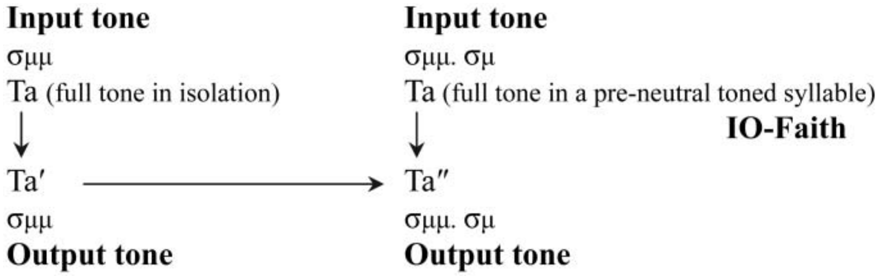
The tonal markedness scale only penalizes those that increase articulatory effort, so the ML-to-HM mapping is accepted. Nevertheless, (7b) is not preferred because the full-toned syllables are heads that prefer high-registered tones (de Lacy 2002). Example (7b) also suggests that low-registered tones are not allowed when falling contours are maintained in the output.

(7) a. ML [Lr, hl] → HM [Hr, hl]
*b. HM [Hr, hl] → ML [Lr, hl]

Closing the loop is the alternation from H to MH, in violation of the tonal markedness scale, but nonetheless to be expected following Kiparsky's (1985) idea of structure preservation that prevents H (high level) from becoming M (mid level) or L (low level), both unavailable in the Jiaoxian tonal inventory. Thus in order to maintain contrast (recall PC), the only recourse is for H to surface as MH.

Tone sandhi triggered by the tonal markedness scale results in neutralization, which violates PC. The maintenance of PC is governed by a set of OO anti-faithfulness constraints (Alderete 2001). The overall effect is therefore to move along the tonal markedness scale, resulting in a chain shift of all the tones in the inventory without increase in markedness. How this works for Jiaoxian is schematically illustrated next in (8).

(8) OO anti-faithfulness in Jiaoxian



3. An Optimality Theory analysis

3.1 Constraint rankings in Jiaoxian

From MH to ML, ML to HM, and HM to H, the shifts move stepwise along the tonal markedness scale (Hyman & VanBik 2004; Yip 2001). In terms of this scalar feature, this paper adopts constraints from Mortensen (2004), who indicates that a lot of chain shifts are also scalar in character.[11] The scale is formalized in (9).

(9) If scale **S** is a scale of type *t*, then all possible representations of type *t* are associated with some level on scale **S**. **S** = 〈 {a, b, c}, {d, e},…, {x, y, z} 〉

The following are the constraints adopted in this paper (Mortensen 2004:13):

(10) Stymie (**S**): If **S**[12] is a scale of type *t*, α is a representation of type t, and β is an output correspondent of α, then $|S(\alpha) - S(\beta)| \leq 1$.

(11) Retain (**S**): If **S** is a scale of *t*, α is a representation of type t, and β is an output correspondent of α, then $S(\alpha) \leq S(\beta)$.

In (12), Stymie (**S**) is violated when elements of input–output pairs are not adjacent on the relevant scale. In (12), Retain (**S**) forbids descents on a scale of an input–output pair. Take the scale **S** = 〈 {A}, {B, C}, {D} 〉, for example. The interaction of the above constraints is shown in tableau (12), which is simplified from Mortensen's tableau (2004:15).

[11] He uses the example that Karok V:: changes to V:, which in turn changes to V involving quantity reduction.
[12] Please note that Mortensen uses a boldface **S** to refer to a scale as a sequence and a corresponding italic *S* to refer to the scale as a function.

(12) The evaluation of scalar input–output constraints:

	RETAIN (**S**)	STYMIE (**S**)
a. B→B		
b. B→C		
c. B→A	*	
d. B→D		
e. A→D		*
f. D→A	*	*

(12b) obeys RETAIN (**S**) because *B* and *C* are on the same level of scale **S**. (12c) violates RETAIN (**S**) since *B* descends to *A*. However, STYMIE (**S**) is obeyed by (12c), for *B* is adjacent to *A* on scale **S**. (12e) violates STYMIE (**S**) because *A* and *D* are distanced by *B* and *C*. However, RETAIN (**S**) is satisfied in (12e) since descent does not occur from *D* to *A*.

The present study adapts Mortensen's (2004) constraints into OO mapping: namely, the mapping between the output of full tone in isolation and the output of full tone in a pre-neutral toned syllable. The tonal markedness scale is referred to as scale **C** since it is employed at the contour level.

(13) Scale **C** (contour)
*rise » *fall » *level

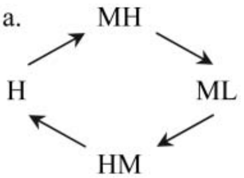
The relevant constraints are formalized below in (14) and (15).

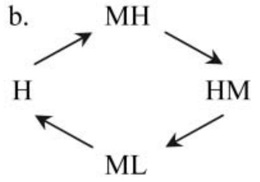
(14) STYMIE (**C**): **C** is the tonal markedness scale, α is a representation of tonal markedness, and β is an output correspondent of α. Assign one violation mark when $|S(\alpha) - S(\beta)| \geq 1$.

(15) RETAIN (**C**): **C** is the tonal markedness scale, α is a representation of tonal markedness, and β is an output correspondent of α. Assign one violation mark when $S(\alpha) \geq S(\beta)$.

The interaction between STYMIE (**C**) and RETAIN (**C**) is illustrated in (16). This paper examines sets of OO mappings called scenarios, as in Łubowicz (2003:7), instead of individual OO mapping.

(16) RETAIN (**C**) » STYMIE (**C**)

Scenarios	RETAIN (**C**)	STYMIE (**C**)
☞ a. 	* (H→MH)	* (H→MH)

💣[13] b. 	* (H→MH)	* (H→MH)
c. MH ⇄ ML H ⇄ HM	* (ML→MH) *! (H→HM)	

In (16c), MH and ML, as well as H and HM, are in adjacent positions on the tonal markedness scale. Therefore, all of the tonal shifts in (16c) satisfy Stymie (**C**). However, (16c) violates Retain (**C**) because ML surfaces as a more marked tone, MH. H changing to HM also incurs one violation mark in Retain (**C**). The violations of Retain (**C**) result in the elimination of (16c). (16a) violates Retain (**C**) once because the level tone, H, descends to MH on the tonal markedness scale. The change from H to MH also violates Stymie (**C**) since the two tones are not adjacent on the tonal markedness scale. However, as shown in tableau (16), (16a) ties with (16b). Therefore, an additional constraint is needed to break the tie.

As mentioned in §2, when falling contours are maintained in the output, low-registered tones are forbidden. This can be captured by constraint conjunction, as proposed in (17).

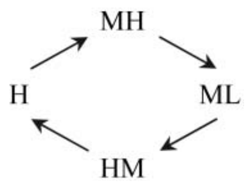
(17) [OO¬Ident-Fall & *Hd/Lr]$_{Ft}$: Assign one violation mark when the following constraints are violated simultaneously within the foot domain:

a. OO¬Ident-Fall: Assign one violation mark for every output of falling tone in isolation that has a corresponding output of falling tone in a pre-neutral toned syllable.

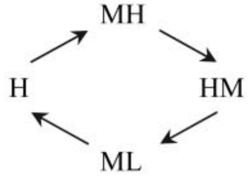
b. *Hd/Lr: Assign one violation mark for low-registered tones in the head position.

[OO¬Ident-Fall & *Hd/Lr]$_{Ft}$ is a local conjunction (Smolensky 1993, 1995) of two constraints that rule out 'the worst of the worst' output forms, which implies that the markedness constraint *Hd/Lr is active only in a faithful structure of falling contour.

(18) [OO¬Ident-Fall & *Hd/Lr]$_{Ft}$; Retain (**C**) » Stymie (**C**)

Scenarios	[OO¬Ident-Fall & *Hd/Lr]$_{Ft}$	Retain (**C**)	Stymie (**C**)
☞ a. 		* (H→MH)	* (H→MH)

[13] 💣= unattested output wrongly selected by the constraint sets.

b. 	*! (HM→ML)	* (H→MH)	* (H→MH)

(18b), which is identical to (16b), is now ruled out by [OO¬Ident-Fall & *Hd/Lr]$_{Ft}$, which is an undominated constraint. In other words, when the falling contour is maintained, the low-registered tone is not preferred. There is no ranking argument between [OO¬Ident-Fall & *Hd/Lr]$_{Ft}$ and Retain (**C**), Stymie (**C**), so tableau (18) is drawn separately.

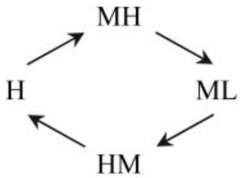
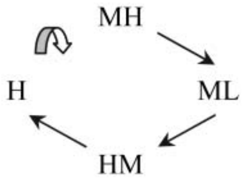
As mentioned in §2, the H-to-MH mapping is in violation of the tonal markedness scale but observes OO anti-faithfulness (Alderete 2001), as formalized in (19).

(19) OO¬Ident-T: Assign one violation mark for every full tone in isolation that has a corresponding output of full tone in a pre-neutral toned syllable.

This constraint also interacts with OO-Ident-T, as formalized in (20).

(20) OO-Ident-T: Assign one violation mark for every full tone in isolation that is different from its corresponding output of full tone in a pre-neutral toned syllable.

(21) OO¬Ident-T » Retain (**C**) » Stymie (**C**);
OO¬Ident-T » OO-Ident-T

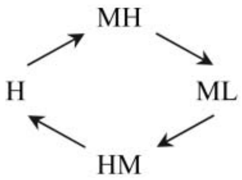
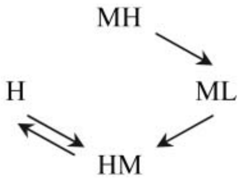
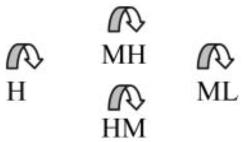
Scenarios	OO¬Ident-T	Retain (**C**)	Stymie (**C**)	OO¬Ident-T	OO-Ident-T
☞ a. 		* (H→MH)	* (H→MH)		* (MH→ML) * (ML→HM) * (HM→H) * (H→MH)
b. 	*! (H→H)			*! (H→H)	* (MH→ML) * (ML→HM) * (HM→H)

[OO¬Ident-Fall & *Hd/Lr]$_{Ft}$ is removed here since it is inactive in (21). Tableau (21) is split into two parts because there is no downward-path relationship between Retain (**C**), Stymie (**C**), and OO-Ident-T. As shown in (21b), all of the shifts conform to the tonal markedness scale. However, (21b) is eliminated because of the fatal violation of OO¬Ident-T.

The constraints proposed here still cannot exclude candidate (23b) below. Thus, PC$_{OUT}$ (Tone) is introduced to avoid tonal neutralization.[14]

(22) PC$_{OUT}$ (Tone): Assign one violation mark for each output of the tone in a pre-neutral toned syllable that corresponds to two or more outputs of tones in isolation in a scenario.

(23) PC$_{OUT}$ (Tone), OO¬Ident-T » Stymie (**C**)

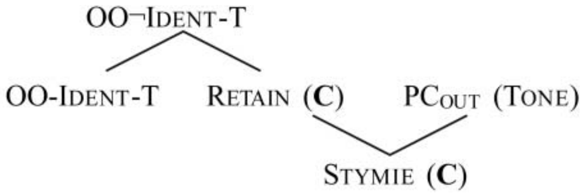
Scenarios	PC$_{OUT}$ (Tone)	OO¬Ident-T	Stymie (**C**)
☞ a. 			* (H→MH)
b. 	*!(H→HM) (ML→HM)		
c. 		*!(MH→MH) *(ML→ML) *(HM→HM) *(H→H)	

PC$_{OUT}$ (Tone) does not interact with Retain (**C**), so Retain (**C**) is eliminated in (23). In (23b), both ML and H surface as HM, which is ruled out by PC$_{OUT}$ (Tone). PC$_{OUT}$ (Tone) seems to replace OO¬Ident-T in (21), since PC$_{OUT}$ (Tone) can also rule out (21b). Nonetheless, PC$_{OUT}$ cannot eliminate (23c), which can only be removed by OO¬Ident-T.

The Hasse diagram (McCarthy 2008:48) in (24) is provided as a summary of the constraint ranking for the full tone in a pre-neutral toned syllable.

[14] PC$_{OUT}$ (Tone) is adapted from Łubowicz (2003:20) into OO correspondence.

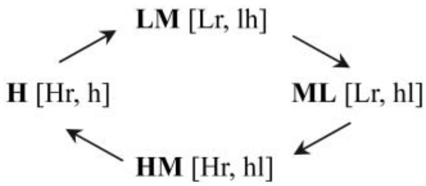
(24) [OO¬Ident-Fall & *Hd/Lr]Ft



3.2 Constraint rankings in other Chinese dialects

The constraint set in Jiaoxian tonal chain shifts is also viable in other Chinese dialects. In Leling, a dialect in Shandong, tonal chain shifts also appear in pre-neutral toned syllables (Cao 2007), as shown in (25).

(25) Tonal chain shifts in Leling



From LM to ML, ML to HM, and HM to H, the tones move stepwise along with the tonal markedness scale, which conforms to Retain (**C**). H changes to LM instead of staying intact as H, which shows that OO¬Ident-T outranks Retain (**C**). Retain (**C**) favors the attested output, as in (26a), while Stymie (**C**) favors the unattested output, as in (26b). Therefore, Retain (**C**) should rank higher than Stymie (**C**).

(26) Constraints: OO¬Ident-T, Retain (**C**), Stymie (**C**)

Scenarios	Retain (**C**)	Stymie (**C**)
☞ a. H → LM → ML → HM → H	* (H→LM)	* (H→LM)
b. LM ⇄ ML H ⇄ HM	* (ML→LM) *! (H→HM)	

The ranking of OO¬Ident-T, Retain (**C**), and Stymie (**C**) in Leling is shown in (27).[15]

[15] The complete constraint rankings in Leling and Chaoyang are not the focus of this paper. This paper only proposes the constraints of Jiaoxian and discusses their rankings in Leling and Chaoyang.

(27) Constraints: OO¬Ident-T, Retain (**C**), Stymie (**C**)

Dialects	**Rankings**
Leling	OO¬Ident-T » Retain (**C**) » Stymie (**C**)
Jiaoxian	OO¬Ident-T » Retain (**C**) » Stymie (**C**)

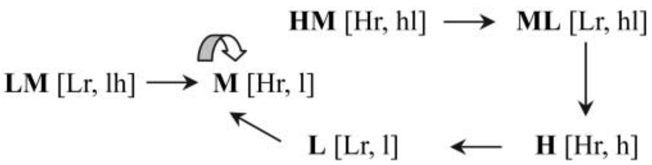
In Leling, H shifts to LM instead of HM, which demonstrates that PC_{OUT} (Tone) outranks Stymie (**C**), as shown in (28).

(28) Constraints: PC_{OUT}, Stymie (**C**)

Dialects	**Rankings**
Leling	PC_{OUT} (Tone) » Stymie (**C**)
Jiaoxian	PC_{OUT} (Tone) » Stymie (**C**)

In both Leling and Jiaoxian, tonal neutralization is prohibited in the output. However, in Chaoyang, a Min dialect (Yip 2001; Zhang 1979), tonal neutralization is permitted to prevent tones from shifting to more marked tones. The tonal chain shifts in Chaoyang take place in non-final positions, as shown in (29).

(29) Chaoyang tone circle



In (29), none of the tones matches more marked tones, but neutralization is commonly observed in Chaoyang, which yields the constraint ranking in (30).

(30) Constraints: PC_{OUT} (Tone), OO¬Ident-T, Retain (**C**)

Dialects	**Rankings**
Chaoyang	Retain (**C**) » PC_{OUT} (Tone), OO¬Ident-T
Leling	OO¬Ident-T » Retain (**C**)
Jiaoxian	OO¬Ident-T » Retain (**C**)

Moreover, $[$OO¬Ident-Fall & *Hd/Lr$]_{Ft}$, which is undominated in both Jiaoxian and Leling, ranks low in Chaoyang where ML shifts to HM.

The cross-linguistic evidence supports the premise that the constraint set in Jiaoxian can predict different kinds of tonal chain shifts through constraint reranking.

3.3 Evaluation of the present analysis

The present set of constraints in Jiaoxian can solve problems that alternative analysis cannot deal with. The tonal chain shifts in Jiaoxian result in surface forms that do not improve on markedness. Therefore, they cannot be explained by such markedness constraints as *rise, *fall, or *level, which will erroneously eliminate the attested outputs. On the other hand, this paper adopts Mortensen's (2004) constraints, which can account for the motivation of tonal chain shifts as follows: RETAIN (**C**) examines the OO correspondence between two tones and prevents the surface from becoming more marked. The stepwise movement of the tones that aligns with the tonal markedness scale can only be captured by STYMIE (**C**).

This paper also implements OO anti-faithfulness constraints (Alderete 2001) that forbid tones from staying intact. The constraint conjunction of an anti-faithfulness and a markedness constraint, which is $[\text{OO}\neg\text{IDENT-FALL} \ \& \ {*}\text{HD/LR}]_{\text{Ft}}$, explains the change from ML to HM.[16]

The theory of comparative markedness (McCarthy 2003) that is not applied in this paper seems to offer an alternative motivation for the tonal chain shifts in Jiaoxian. This approach differentiates markedness violation into two types: old markedness violation ($_{\text{O}}$M) and new markedness violations ($_{\text{N}}$M). $_{\text{O}}$M refers to violations that are inherited from the input, while $_{\text{N}}$M refers to violations that are made in the output. If comparative markedness is considered an OO correspondence here, it can explain the fact that Jiaoxian tonal chain shifts prohibit non-derived outputs. For example, ML is sanctioned only when it is derived from a different tone, which satisfies $_{\text{O}}$*ML. However, comparative markedness cannot explain the shift from MH to ML. One may argue that the unattested H-to-ML mapping can be ruled out by constraint conjunction, $[\text{OO-}_{\text{N}}{*}\text{ML} \ \& \ \text{OO-IDENT-R}]_{\text{Ft}}$, in (31).

(31) $[\text{OO-}_{\text{N}}{*}\text{ML} \ \& \ \text{OO-IDENT-R}]_{\text{Ft}}$
Assign one violation mark when the following constraints are violated simultaneously within the foot domain:
a. Assign one violation mark for each derived ML.
b. Assign one violation mark for every output of full tone in isolation that has a different register from its correspondent, which is in a pre-neutral toned syllable.

However, this constraint will also erroneously rule out the correct output, namely the MH-to-ML mapping.

Another unattested mapping, the HM-to-ML mapping, may be eliminated by $[\text{OO-}_{\text{N}}{*}\text{ML} \ \& \ \text{OO-IDENT-C}]_{\text{Ft}}$ in (32).

(32) $[\text{OO-}_{\text{N}}{*}\text{ML} \ \& \ \text{OO-IDENT-C}]_{\text{Ft}}$
Assign one violation mark when the following constraints are violated simultaneously within the foot domain:
a. Assign one violation mark for each derived ML.
b. Assign one violation mark for every output of full tone in isolation that has the same contour as its correspondent, which is in a pre-neutral toned syllable.

However, McCarthy (2003:50) points out the essential difference between comparative markedness constraints and anti-faithfulness constraints. The former focuses on the theory of markedness, while

[16] See (17) and (18) in §3.1.

the latter is based on the theory of faithfulness. Therefore, it is not appropriate to combine a comparative markedness constraint and an anti-faithfulness constraint as [OO-$_{N}$*ML & OO-IDENT-C]$_{Ft}$.

This paper also employs PC (Łubowicz 2003) and examines sets of OO mappings: namely, scenarios. PC admits push shifts (Łubowicz 2003:133), which indicates that A → B → C is a push shift when B → C has no independent motivation. In other words, B → C is a result of A → B. I propose that Jiaoxian tonal chain shifts reveal push shifts and need to be examined as scenarios. For example, the shift from H to MH is a result of the other tonal shifts in the chain. However, if H is examined individually, H will surface as HM or ML to avoid violating STYMIE (**C**).[17] The problem of PC is that it cannot rule out the fully faithful candidate. However, this is supplemented by an OO anti-faithfulness constraint (Alderete 2001), which helps eliminate the fully faithful candidate.[18]

4. Conclusion

Moreton (1999) proposes that circular tonal chain shifts cannot be computed in Classical OT (Prince & Smolensky 1993/2004. In contrast, this paper argues that the non-terminal circular tonal chain shifts in Jiaoxian exhibit stepwise shifts that move along the tonal markedness scale. RETAIN (**C**) and STYMIE (**C**) are adapted from Mortensen (2004) to capture this scalar feature. The former prevents outputs from becoming more marked tones; the latter demands that the two output tones be adjacent on the tonal markedness scale. The stepwise chain shifts also suggest that low-registered tones are not preferred when the falling contour is maintained onto the surface ([OO¬IDENT-FALL & *HD/Lr]$_{Ft}$). The shift from H to a more marked tone, MH, is in violation of the tonal markedness scale but observes PC that comes from OO anti-faithfulness. The tones of the neutral-toned syllables are then determined by the full tones preceding them, which shows the OCP effect (Goldsmith 1976:63; Leben 1973:87–113).

References

Alderete, John. 2001. Dominance effects as transderivational anti-faithfulness. *Phonology* 18.2: 201–253.

Bao, Zhiming. 1999. *The Structure of Tone*. Oxford & New York: Oxford University Press.

Barrie, Michael. 2006. Tone circles and contrast preservation. *Linguistic Inquiry* 37.1:131–141.

Cao, Yanjie. 2007. Shandong Lelinghua de liandu biandiao [Pitch shifting and neutral tones of Shandong Leling dialect]. *Dezhou Xueyuan Xuebao* [*Journal of Dezhou University*] 2007.5: 55–60.

Chao, Yuen Ren. 1930. A system of tone letters. *Le Maître Phonétique* 45:24–27.

Cheng, Chin-Chuan. 1973. A quantitative study of Chinese tones. *Journal of Chinese Linguistics* 1.1:93–110.

[17] See (23) in §3.1.

[18] See (23) in §3.1.

de Lacy, Paul. 2002. The interaction of tone and stress in Optimality Theory. *Phonology* 19.1:1–32.

Goldsmith, John A. 1976. *Autosegmental Phonology*. Cambridge: MIT dissertation.

Hirayama, Hisao. 1998. Cong shengdiao diaozhi yanbianshi de guandian lun Shandong fangyan de qingsheng qian biandiao [On the pre-neutral tone sandhi in Shandong from the perspective of diachronic change]. *Fangyan* [*Dialect*] 1998.1:7–13.

Hsiao, Yuchau E. 2015. Rethinking OCP effects on tone sandhi. *Language and Linguistics* 16.6: 927–945.

Hsieh, Feng-fan. 2005. Tonal chain-shifts as anti-neutralization-induced tone sandhi. *University of Pennsylvania Working Papers in Linguistics* 11.1:99–112.

Hyman, Larry M., & Kenneth VanBik. 2004. Directional rule application and output problems in Hakha Lai tone. *Language and Linguistics* 5.4:821–861.

Kiparsky, Paul. 1985. Some consequences of lexical phonology. *Phonology Yearbook* 2:85–138.

Leben, William Ronald. 1973. *Suprasegmental Phonology*. Cambridge: MIT dissertation.

Li, Charles N., & Sandra A. Thompson. 1978. The acquisition of tone. *Tone: A Linguistic Survey*, ed. by Victoria A. Fromkin, 271–284. New York: Academic Press.

Łubowicz, Anna. 2003. *Contrast Preservation in Phonological Mappings*. Amherst: University of Massachusetts at Amherst dissertation.

McCarthy, John J. 2003. Comparative markedness. *Theoretical Linguistics* 29.1–2:1–51.

McCarthy, John J. 2008. *Doing Optimality Theory: Applying Theory to Data*. Oxford: Blackwell.

Moreton, Elliott. 1999. Non-computable functions in Optimality Theory. *Rutgers Optimality Archive* (ROA#364). http://roa.rutgers.edu/article/view/374

Mortensen, David R. 2004. Abstract scales in phonology. *Rutgers Optimality Archive* (ROA#667-0604). http://roa.rutgers.edu/article/view/677

Ohala, John J. 1978. Production of tone. *Tone: A Linguistic Survey*, ed. by Victoria A. Fromkin, 5–39. New York: Academic Press.

Ohala, John J., & William G. Ewan. 1973. Speed of pitch change. *Journal of the Acoustical Society of America* 53.1:345.

Prince, Alan S., & Paul Smolensky. 1993/2004. *Optimality Theory: Constraint Interaction in Generative Grammar*. Revision of 1993 technical report. *Rutgers Optimality Archive* (ROA#537). Malden & Oxford: Blackwell.

Smolensky, Paul. 1993. Harmony, markedness, and phonological activity. Paper presented at Rutgers Optimality Workshop-1. *Rutgers Optimality Archive* (ROA#87). http://roa.rutgers.edu/article/view/88

Smolensky, Paul. 1995. On the internal structure of Con, the constraint component of UG. *Rutgers Optimality Archive* (ROA#86). http://roa.rutgers.edu/article/view/87

Sundberg, Johan. 1973. Data on maximum speed of pitch changes. *Quarterly Progress and Status Reports*, *Speech Transmission Laboratory* 4:39–47.

Yip, Moira. 2001. Tonal features, tonal inventories and phonetic targets. *UCL Working Papers in Linguistics* 13:161–188.

Yue-Hashimoto, Anne O. 1987. Tone sandhi across Chinese dialects. *Wang Li Memorial Volumes: English Volume*, ed. by Chinese Language Society of Hong Kong, 445–474. Hong Kong: Joint Publishing (H.K.).

Zhang, Shengyu. 1979. Chaoyang fangyan de liandu biandiao [Tone sandhi in Chaoyang dialect]. *Fangyan* [*Dialect*] 1979.2:93–121.

[Received 15 October 2014; revised 31 January 2015; accepted 31 January 2015]

Graduate Institute of Linguistics
National Chengchi University
64, Sec. 2, ZhiNan Road
Taipei 116, Taiwan
100555501@nccu.edu.tw

膠縣方言輕聲前連鎖音變

凌旺楨

國立政治大學

本文以優選理論分析膠縣方言輕聲前連鎖音變現象。本研究認爲連鎖變調的動機是爲了減少發音上的困難，而各聲調的難易程度可由「聲調有標刻度」(tonal markedness scale) 得知。當聲調變爲較爲有標的形式時，是因爲「保留差異性」(PC) 不允許兩不同聲調具相同的輸出值。「保留差異性」則是由「反信實制約」(OO anti-faithfulness constraints) 所得來，其要求兩相關字詞表現不同的特徵。

關鍵詞：聲調連鎖音變，聲調有標刻度，保留差異性，反信實制約，膠縣方言