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SPECIAL TONAL ALTERNATIONS IN DONGSHI HAKKA REDUPLICATION*

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ABSTRACT

This paper investigates the special tone sandhi phenomena in the reduplication patterns of AB(C)AB(C), AAA, and AAAA in Dongshi Hakka. These patterns are notable in that they involve tone sandhi patterns that are different from those found in non-reduplications. Within the constraint-based theory of OT, this paper shows that although the tonal alternations observed in the different reduplication patterns are distinct from one another, they are all accompanied with a floating high tone which contributes greatly to the special patterns associated with tone sandhi. In addition to the existence of a floating high tone, AAA reduplication and AAAA reduplication also surface with fixed tonal melodies. It is shown that the fixed tonal melodies in the two patterns of reduplication actually resemble the common phenomena of fixed segmentism in reduplication and are driven by markedness requirements.

Key words: Dongshi Hakka, reduplication, special tone sandhi, floating high tone,fixed tonal melody, Optimality Theory

1. INTRODUCTION

Reduplication refers to the phenomenon where all or part of a base is

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reduplicated to form a new word, and is one of the most common word formation processes observed in languages. Dongshi Hakka, which is a Hakka dialect spoken by residents of the Dongshi village in Taichung County (Tung 1994, M. Chiang 1998), is rich in reduplication patterns. According to M. Chiang (2002), there are as many as ten reduplication patterns in Dongshi Hakka. These reduplication patterns are AA reduplication, AAA reduplication, ABB reduplication, AAB reduplication, AAAA reduplication, ABAB reduplication, AABB reduplication, ABAC reduplication, ABCB reduplication, and ABCABC reduplication. Similar to other Chinese dialects, Dongshi Hakka includes abundant tonal changes when certain tones are in adjacent position (M. Chiang 1998, Chung 2008, Hsiao and Chiu 2006, Hsiao 2008, H. Lin 2011, Liu 2007 among others). Tone sandhi takes place not only in non-reduplicated forms, but also in forms that involve reduplication. Based on the different tone sandhi behaviors displayed in different reduplication patterns, the ten reduplication patterns can be categorized into two groups: those that involve all and only general tone sandhi (i.e., AA, ABB, AAB, AABB, ABAC, and ABCB) and those that do not (i.e., ABAB, ABCABC, AAA, and AAAA). Tone sandhi patterns that deviate from the general ones, as observed in the second group of reduplication patterns, can be further categorized into two types: those that involve fixed tonal melody (i.e., AAA, and AAAA) and those that do not (i.e., ABAB, and ABCABC). The purpose of this paper is to investigate the group involving special tone sandhi patterns including ABAB reduplication, ABCABC reduplication, AAA reduplication, and AAAA reduplication. Within the output-oriented framework of Optimality Theory (Prince and Smolensky 1993/2004, McCarthy and Prince 1993), this paper shows that the tonal alternations found in these reduplication patterns are the result of a combination of general tone sandhi and a floating high tone, which is docked on the right edge of the first reduplicant.[1] The phenomena are mainly captured by the interaction of

[1] Reduplication with a floating tone is found not only in Dongshi Hakka but also in other Chinese dialects such as Southern Min (Cheng 1973, C. Lin 2004, Myers & Tsay 2001, Wu 1996, Yip 1980, and Zhang and Lai 2007, 2008). Yip (1980) also notes that the reduplication of monosyllabic adjectives in Mandarin accompanies a floating high tone (e.g., *hao*L ‘good’ → *hao*L *haor*H (*de*)).

constraints such as WELLFORMEDNESS and ALLOTONE, which regulate general tone sandhi, and MAXFLOAT, *FLOAT, ALIGN-TW-L, and ALIGN-TR-R, which regulate the realization and the docking site of the floating high tone. As for the fixed tonal sequences found in AAA reduplication and AAAA reduplication, they will be shown to be an unmarkedness effect; they are mainly captured by context free (e.g., *CONTOUR) and context-sensitive (e.g., *HD/Lr and *NONHD/Hr) markedness constraints.

The remainder of this paper is organized as follows. Section 2 presents data and generalizations of tone sandhi found in Dongshi Hakka reduplication, with the focus on the special tone sandhi observed in the reduplication patterns of ABAB, ABCABC, AAA, and AAAA. In Section 3, we propose OT analyses to account for the special tonal alternations observed in the different patterns of reduplication. Finally, Section 4 concludes the paper.

2. TONE SANDHI IN REDUPLICATION

This section presents data and generalizations of tone sandhi in different patterns of reduplication in Dongshi Hakka. As knowledge of the general tone sandhi patterns in the language is prerequisite, we offer a brief introduction to the general tone sandhi patterns prior to the presentation of reduplication data in §2.2. All reduplication data presented in this paper are drawn from M. Chiang (2002).

2.1 General Tone Sandhi in Dongshi Hakka

There are four lexical tones in Dongshi Hakka. They are *yinping* 33, *yangping* 11, *yinshang* 31, and *yinqu* 53 (Chung 2008, H. Lin 2011).[2]

[2] Some scholars consider Dongshi Hakka to have six lexical tones (i.e., *yinping*, *yangping*, *yinshang*, *yinqu*, *yinru*, and *yangru*). Other researchers consider Dongshi Hakka to have an additional tonal category of *chaoyinping*. However, M. Chiang (1998, 2002) and Chung (2008) have convincingly argued against the lexical status of *chaoyinping* and claim that *chaoyinping*, whose value is 35, is the sandhi form of 33 and was triggered by a following diminutive affix that carried 31 and disappeared in the

Given the four tone system, there are 16 (4 x 4) bi-tonal combinations in Dongshi Hakka, among which five pairs undergo tone sandhi. These tone sandhi phenomena are illustrated by the bi-tonal examples from M. Chiang (1998) in (1).

(1) Tonal combinations that undergo tone sandhi

	Input	*Output*	*Example*
ai.	33.11	**35.**11	tʰien ʃi 'weather'
aii.	33.31	**35.**31	kie lon 'chicken egg'
b.	11.11	**33.**11	fuŋ ʒiun 'afterglow'
ci.	53.31	**55.**31	ʃu ʒiaŋ 'leafy shade'
cii.	53.53	**55.**53	tʰien fa 'telephone'

Key: tones are separated by '.'; T = citation tone; **T** = sandhi tone (i.e., tones that undergo general tone sandhi)

Tone sandhi as illustrated in (1) can be captured by the three derivational rules in (2).

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process of historical development. Further, based on phonetic and phonological evidences, Chung (2008) and H. Lin (2011) have argued that the two *ru* tones in Dongshi Hakka, i.e., *yinru* and *yangru*, are derived from *yinshang* and *yinqu*, respectively. For more detailed discussions of these viewpoints, please refer to Chung (2008) and H. Lin (2011). Notice also that the four lexical tones in Dongshi Hakka are not always represented in the same way in the literature. In particular, scholars disagree with respect to the way in which *yangping* is represented. *Yangping* is considered a contour tone and represented as 113 in J. Chiang (2003), M. Chiang (1998), and Hsiao and Chiu (2006), as 13 in Chung (2008), and as 313 in Liu (2007). On the other hand, M. Chiang (2002) and H. Lin (2011) consider *yangping* to be a low level tone 11 and regard the initial dipping or final rising in *yangping*, if any, as phonetic rather than phonological. As Yip (2002:22) points out, when producing a low tone, it takes time to lower the pitch to the lowest point; thus, a phonological 11 tone is usually transcribed as a 21 tone, but the initial small fall has no phonological significance. In phonological studies, phonetic details are often ignored (cf. Chen 2000, Hsu 1995, Chen et al. 2008, and H. Lin 2007, among others). For instance, the 53 tone in Pingyao is accompanied by a small rise in the word final position and sounds like a 423; however, such a phonetic detail is ignored in Chen (2000). As a consequence, the present paper transcribes *yangshang* as 11 (cf. discussion in H. Lin 2011).

(2) General tone sandhi (TS) rules
 a. Yinping TS rule: 33 → 35 / __ {11, 31}
 b. Yangping TS rule: 11 → 33/ __ 11
 c. Yinqu TS rule: 53 → 55/ __ {31, 53}

Rules (2a)-(2c) take care of the changes in (1a)-(1c), respectively. A schematic summary of the changes is given in (3).

(3) Bi-tonal combinations

$\sigma_1 \backslash \sigma_2$	33	11	31	53
33	33.33	**35.**11	**35.**31	33.53
11	11.33	**33.**11	11.31	11.53
31	31.33	31.11	31.31	31.53
53	53.33	53.11	**55.**31	**55.**53

Key: Shaded areas contain tonal combinations that do not change

When it comes to tri-tonal strings, tone sandhi operates consistently from left to right, irrespective of the morpho-syntactic structures (M. Chiang 1998, Hsiao 2008).[3] For example, as shown in (4), both the morpho-syntactically left branching (e.g., {{*tʰien fa*} *ʃien*}'telephone line') and right branching (e.g., {*kʰon* {*tʰien ʃi*}} 'watch television') utterances that are underlyingly /53.53.53/ derive the same tonal output **55**.**55**.53. As clearly illustrated in (5), to derive the correct output, tone sandhi must operate left-to-right.

[3] In trisyllabic strings, *yinping* and *yangping* tone sandhi actually involve alternative readings, one formal and the other casual (Hsiao 2006, 2008, Hsiao and Chiu 2006), as illustrated by the examples below. The present study focuses only on the casual reading.

	Input	*Casual reading*	*Formal Reading*
{*tʃʰim* {*nam nin*}} 'find a man'	11-11-11	**33**-**33**-11	11.**33**.11
{*hem* {*mun ʃiŋ*}} 'call the door god'	33-11-11	**35**-**33**-11	33-**33**-11

(4)

Morpho-syn. Structure	*Input*	*Output*
{{*t^hien fa*} *ʃien*} 'telephone line'	53.53.53	**55.55**.53
{*k^hon* {*t^hien ʃi*}} 'watch television'	53.53.53	**55.55**.53

(5)

	Left-to-right			*Right-to-left*	
a.	Input	<u>53.53</u>.53	b.	Input	53.<u>53.53</u>
	Yinqu TS rule	|		Yinqu TS rule	|
		55.<u>53.53</u>			<u>53.**55**</u>.53
	Yinqu TS rule	|			| (n/a)
	Output	**55.55**.53		Output	*53.**55**.53

Key: <u>T.T</u> = Current two-tone window scanned for possible rule application

2.2 Tone Sandhi in Dongshi Hakka Reduplication

M. Chiang (2002) provides a detailed description of Dongshi Hakka reduplication. According to M. Chiang (2002), Dongshi Hakka has ten reduplication patterns: AA reduplication, AAA reduplication, ABB reduplication, AAB reduplication, AAAA reduplication, ABAB reduplication, AABB reduplication, ABAC reduplication, ABCB reduplication, and ABCABC reduplication. Among these ten reduplication patterns, tone sandhi phenomena observed in AA reduplication, ABB reduplication, AAB reduplication AABB reduplication, ABAC reduplication and ABCB reduplication are not different from those in non-reduplicated forms and are derivable from the general tone sandhi rules in (2). On the contrary, the tonal changes observed in AAA reduplication, AAAA reduplication, ABAB reduplication, and ABCABC reduplication contain sandhi patterns that are different from the general ones and cannot be fully explained by the rules in (2).

2.2.1 Reduplication with general tone sandhi

The six patterns of reduplication that involve general tone sandhi are listed in (6). ("**T** $^{<T}$" in the examples refers to "sandhi tone $^{<\text{citation tone}}$")

(6)

a. AA Reduplication

- i. kiaŋ33 kiaŋ33 驚驚 'somewhat afraid'
- ii. ton31 ton31 短短 'somewhat short'
- iii. fuŋ**33**$^{<11}$ fuŋ11 紅紅 'somewhat red'
- iv. am**55**$^{<53}$ am53 暗暗 'somewhat dark'

b. ABB Reduplication

- i. kiaŋ31 vaŋ**33**$^{<11}$ vaŋ11 頸橫橫 'very arrogant'
- ii. ko**35**$^{<33}$ k^{h}ia**33**$^{<11}$ k^{h}ia11 高 k^{h}ia k^{h}ia 'very tall'
- iii. voŋ**33**$^{<11}$ kuŋ**33**$^{<11}$ kuŋ11 黃 kuŋ kuŋ 'very muddy'
- iv. ʒien**35**$^{<33}$ toŋ**33**$^{<11}$ toŋ11 煙 toŋ toŋ 'a lot of smoke'

c. AAB Reduplication

- i. fan33 fan**35**$^{<33}$ tʃion31 翻翻轉 'to vacillate'
- ii. k^{h}ioŋ**33**$^{<11}$ k^{h}ioŋ11 oi53 強強要 'to get something by force'

d. AABB Reduplication

- i. kiaŋ33 kiaŋ**35**$^{<33}$ hiam31 hiam31 驚驚險險 'dangerous'
- ii. ŋa**33**$^{<11}$ ŋa**33**$^{<11}$ ʃia**33**$^{<11}$ ʃia11 牙牙舌舌 'acting like a spoiled child'
- iii. se31 se31 t^{h}oŋ33 t^{h}oŋ33 洗洗湯湯 'cleaning things'

e. ABAC Reduplication

- i. k^{h}iaŋ**35**$^{<33}$ se31 k^{h}iaŋ**35**$^{<33}$ kiok<u>32</u>[4] 輕手輕腳 'walking gently'
- ii. t^{h}ai**55**$^{<53}$ tʃu31 t^{h}ai**55**$^{<53}$ ʒi53 大主大意 'making a decision without consulting with authorities'

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[4] <u>32</u> is a *yinru* tone that is the phonetic variant of *yinshang* 31 (cf. Chung 2008, H. Lin 2011).

f. ABCB Reduplication

i. p^{h}i11 ʒioŋ**35**$^{<33}$ kut32 ʒioŋ33 皮癢骨癢 ‘very audacious’

ii. ŋiak32 tsiu**55**$^{<53}$ p^{h}i**55**$^{<53}$ tsiu53 額縐鼻縐 ‘feeling very reluctant’

iii. fu11 tsok**55**$^{<53}$ lon**55**$^{<53}$ tsok53 胡作亂作 ‘doing things very carelessly’

Tone sandhi phenomena observed in these reduplication patterns are not different from tone sandhi observed in non-reduplicated forms. Take (6aiii) for example. The unreduplicated form *fuŋ* ‘red’ carries an 11 tone. After reduplication, the tonal sequence /11.11/ is formed. As a consequence, the Yangping tone sandhi rule (2b) takes effect and changes the sequence to [**33**.11].

Tonal alternations in longer strings of reduplicated forms are still consistent with non-reduplication. When more than two tones are adjacent as a result of reduplication, tone sandhi operation is always left-to-right. The reduplicated form *ʒien**35** toŋ**33** toŋ11* ‘a lot of smoke’ in (7 = 6biv) can help to illustrate this point. The resulting tonal output **35**.**33**.11 derived from /33.11.11/ suggests that the two tones on the left must have been scanned first for tone sandhi, followed by the two tones on the right, as illustrated in (7a). (7b) shows that if the two tones on the right were scanned first for tone sandhi, the unattested output would be derived.

(7) ʒien33 toŋ11 toŋ11 → ʒien**35** toŋ**33** toŋ11 ‘a lot of smoke’

<table>
<tr><td></td><td colspan="2">Left-to-right</td><td></td><td colspan="2">Right-to-left</td></tr>
<tr><td>a.</td><td>Input</td><td>33.11.11</td><td>b.</td><td>Input</td><td>33.11.11</td></tr>
<tr><td></td><td>Yinqu TS rule</td><td>|</td><td></td><td>Yinqu TS rule</td><td>|</td></tr>
<tr><td></td><td></td><td>35.11.11</td><td></td><td></td><td>33.33.11</td></tr>
<tr><td></td><td>Yinqu TS rule</td><td>|</td><td></td><td></td><td>| (n/a)</td></tr>
<tr><td></td><td>Output</td><td>35.33.11</td><td></td><td>Output</td><td>*33.33.11</td></tr>
</table>

2.2.2 Reduplication with special tone sandhi

We now turn to the reduplication patterns involving special tonal changes, which are the focus of this study.

2.2.2.1 ABAB reduplication

Consider ABAB reduplication first. ABAB reduplication refers to the total reduplication of a disyllabic root AB. ABAB reduplication denotes diminutive and is one of the most productive reduplication patterns in Dongshi Hakka. As M. Chiang (2002) points out, almost all disyllabic adjectives can undergo ABAB reduplication. Examples of ABAB reduplication are listed in (8).[5] (Syllables involving tonal alternations that deviate from general tone sandhi are double underlined.)

(8) ABAB reduplication

	Root	*Reduplicated Form*
ai.	xan11 liau53	xan11 liau55-xan11 liau53
	閒料 'at leisure'	閒料閒料 'somewhat at leisure'
aii.	si**55**$^{<53}$ tʃin53	si**55**$^{<53}$ tʃin55-si**55**$^{<53}$ tʃin53
	四正 'solid'	四正四正 'somewhat solid'
bi.	vu33 kim33	vu33 kim35-vu33 kim33
	烏金 'black'	烏金烏金 'somewhat black'
bii.	fun31 fuŋ11	fun31 fuŋ 35-fun31 fuŋ11
	粉紅 'pink'	粉紅粉紅 'somewhat pink'
biii.	pien31 tu31	pien31 tu35 -pien31 tu31
	扁肚 'having butterflies in one's stomach'	扁肚扁肚 'somewhat feel like having butterflies in one's stomach'
biv.	fuŋ**35**$^{<33}$ ʃin11	fuŋ **35**$^{<33}$ ʃin35-fuŋ **35**$^{<33}$ ʃin11
	風神 'awe-inspiring'	風神風神 'somewhat awe-inspiring'
bv.	xa**33**$^{<11}$ fin11	xa**33**$^{<11}$ fin35-xa**33**$^{<11}$ fin 11
	霞痕 'rosy'	霞痕霞痕 'somewhat rosy'

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[5] We leave the discussion with regard to which repeated portion is the base and which is the reduplicant until §3.2.1, and therefore the reduplicants in the examples presented before §3.2.1 are not marked.

ABAB reduplication involves tonal alternations that are different from the general tone sandhi patterns. As illustrated in (8ai), when the input tone of the second syllable is 53, it will surface with a high level 55 regardless of the tonal value of the following tone;[6] further, as illustrated in (8bi), (8bii) and (8biii), when the input tone is 33, 11 or 31, it will surface with a rising tone 35, again regardless of the tonal value of the following tone. The tonal alternations described can be summarized by the derivational rules in (9).

(9) Special TS rule I for reduplication
$\{33, 11, 31\} \rightarrow 35 /\ _{word}[\sigma\_\_$
$53 \rightarrow 55/\ _{word}[\sigma\_\_$

It is worth noting that while the tonal change on the second syllable in ABAB reduplication is different from that of general tone sandhi, the tonal alternations on the rest of the syllables, if any, follow the general tone sandhi patterns in (2). For instance, the tonal change on the third syllable of the reduplicated form in (8biv) is derivable by the Yinping tone sandhi rule in (2a), and the tonal alternation on the first syllable can be derived by applying the Yinping rule before the application of the special tone sandhi rule I (9).

2.2.2.2 ABCABC reduplication

Consider next ABCABC reduplication. ABCABC reduplication refers to the total reduplication of a trisyllabic root ABC. Like ABAB reduplication, ABCABC reduplication also denotes a diminutive sense, as exemplified in (10).

(10) ABCABC reduplication

a.	kie**35**$^{<33}$ lon31 mien53 雞卵面 'beautiful in face'	kie**35**$^{<33}$ lon31 mien55- kie**35**$^{<33}$ lon31 mien53 雞卵面-雞卵面 'somewhat beautiful in face'

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[6] According to the Yinqu TS rule (2c), a 53 tone will change to a **55** tone only before 53 and 31.

bi.	la**33**$^{<11}$ lun11 ʃieu33 la lun 燒 'warm'	la**33**$^{<11}$ lun11 ʃieu35- la**33**$^{<11}$ lun11 ʃieu33 la lun 燒-la lun 燒 'somewhat warm'
bii.	tʰiam**33**$^{<11}$ tsi**33**$^{<11}$ ko11 甜 tsi ko 'sweet and fat'	tʰiam**33**$^{<11}$ tsi**33**$^{<11}$ ko35- tʰiam**33**$^{<11}$ tsi**33**$^{<11}$ ko11 甜 tsi ko-甜 tsi ko 'somewhat sweet and fat'
biii.	tʃʰiu**55**$^{<53}$ pʰi**55**$^{<53}$ lon31 臭屁卵 'bragging'	tʃʰiu**55**$^{<53}$ pʰi**55**$^{<53}$ lon35- tʃʰiu**55**$^{<53}$ pʰi**55**$^{<53}$ lon31 臭屁卵-臭屁卵 'somewhat bragging'

The tonal patterns observed in ABCABC reduplication are very similar to those in ABAB reduplication. Just as in ABAB reduplication, the tonal change observed on the third syllable is also different from the general tone sandhi patterns in (2). In addition, when the input tone of the third syllable is 53, it will surface with a high level 55 (e.g., 10a), but when the input tone is 33, 11 or 31, it will surface with a rising tone 35 (e.g., 10bi, 10bii, 10biii). The tonal alternations can be captured by the derivational rules in (11).

(11) Special TS rule II for reduplication
$\{33, 11, 31\} \rightarrow 35 /\ _{word}[\sigma\sigma\_\_$
$53 \rightarrow 55 /\ _{word}[\sigma\sigma\_\_$

On the other hand, tonal alternations on the rest of the syllables, if any, are derivable from the general tone sandhi rules. For instance, the tonal alternation on the first and fourth syllables of the reduplicated form in (10a) can be derived by applying the Yinping tone sandhi rule in (2a).

Despite the fact that ABAB reduplication and ABCABC reduplication have been categorized into two different types in M. Chiang (2002), they should be considered as a single reduplication pattern for two reasons. First, in terms of function, both ABAB reduplication and ABCABC reduplication denote dimunity. Second, in terms of tone sandhi, regardless of whether it is the second syllable in

ABAB reduplication or the third syllable in ABCABC reduplication that undergoes special tone sandhi, the last syllable of the first repeated portion is the one that undergoes special tone sandhi.[7] Further, not only does the syllable undergoing special tone sandhi stand in the same position, but the alternation of the tone is also the same: the syllable will surface with a 55 tone when the input tone is 53, and with a 35 tone when the input tone is 33, 11 or 31. As a matter of fact, the only difference between ABAB reduplication and ABCABC reduplication is the size of the root undergoing reduplication--the former being disyllabic and the latter being trisyllabic. Even so, the roots in both types undergo total reduplication. Due to the nature of the similarities in ABAB reduplication and ABCABC reduplication, they are considered to be a single pattern of reduplication and are referred to as AB(C)AB(C) reduplication in the rest of this paper.

2.2.2.3 AAA reduplication

Consider next AAA reduplication. AAA reduplication refers to the double reduplication of a monosyllabic root A. Unlike AB(C)AB(C) reduplication, the function of AAA reduplication is to denote intensity. Examples of AAA reduplication are listed below.

(12) AAA reduplication

a.	son33 酸 ‘sour’	son35-son11-son33 酸酸酸 ‘very sour’
b.	si31 死 ‘tight’	si35-si11-si31 死死死‘very tight’
c.	ts^{h}eu53 瘦 ‘thin’	ts^{h}eu35-ts^{h}eu11-ts^{h}eu53 瘦瘦瘦‘very thin’
d.	ts^{h}ia11 斜 ‘sloping’	ts^{h}ia35-ts^{h}ia**33**$^{<11}$-ts^{h}ia11 斜斜斜 ‘very sloping’

In terms of tonal changes, AAA reduplication is also different from AB(C)AB(C) reduplication. As can be seen in (12a-c), the tones on the

[7] It will become clear which of the repeated portions is the base and which is the reduplicant in §3.2.1.

first disyllabic sequence in AAA reduplication are replaced by the fixed tonal sequence 35.11, no matter what the input tone of the root is; the tone on the third syllable, on the other hand, is identical to its root tone. As such, the tone sandhi phenomenon deviates from the general tone sandhi patterns and can be captured by the derivational rule in (13).

(13) Special TS rule III for reduplication
 Ta.Tb → 35.11/___Tc

When the tone on the third syllable is 11, the general rule of Yangping tone sandhi will take place and change the 2nd tone to **33**, as illustrated in (12d).

2.2.2.4 AAAA reduplication

Finally, consider AAAA reduplication. AAAA reduplication is a type of reduplication that involves four identical elements *segmentally* speaking. But in terms of *tone*, none of the four syllables share the same tone. Like AAA reduplication, AAAA reduplication involves a fixed tonal melody. The tonal melody which surfaces on the string is the fixed tonal sequence 33.11.55.53. As M. Chiang (2002) points out, AAAA reduplication in Dongshi Hakka pertains to either onomatopoeic sounds or repeated and trivial actions. Examples of AAAA reduplication are listed in (14).

(14) AAAA reduplication

a.	ɲiam33 ɲiam11 ɲiam55 ɲiam53	'to chatter endlessly'
b.	kia33 kia11 kia55 kia53	'to make a racket'
c.	te33 te11 te55 te53	'to talk endlessly after getting drunk'
d.	a33 a11 a55 a53	'babbling sound of baby'
e.	tsi33 tsi11 tsi55 tsi53	'the sound of a bug'
f.	kiu33 kiu11 kiu55 kiu53	'the sound of a bird'
g.	ku33 ku11 ku55 ku53	'gurgling sound in abdomen'

The tone sandhi phenomenon is different from the general tone sandhi patterns and can be captured by the derivational rule in (15).

(15) Special TS rule IV for reduplication
     Ta.Tb.Tc.Td → 33.11.55.53

As mentioned, though the four syllables in this pattern of reduplication are identical in terms of segment, none of the tones in the four syllables are the same. Thus, it might not be appropriate to use the term AAAA reduplication to describe the reduplication pattern in terms of tone. As a matter of fact, though none of the four tones are the same, the 33.11.55.53 sequence can actually be grouped into two pairs, **33**.11 and **55**.53, with the former member of each pair derivable from the latter by the general tone sandhi rules in (2). Thus, in terms of tone, the so called AAAA reduplication can be considered as a kind of AABB reduplication (cf. M. Chiang 2002:558). However, it is different from the AABB reduplication (e.g., *se31 se31 tʰoŋ33 tʰoŋ33* 洗洗湯湯 'cleaning things') examined in §2.2.1, because in those examples, both the segments and tones form the AABB pattern. The so-called AAAA reduplication, on the other hand, is a hybrid of AAAA and AABB reduplication. It is in the form of AAAA segmentally, but in the form of AABB tonally. Thus, it can actually be referred to as $A^AA^AA^BA^B$ reduplication, and can be considered as being derived from the disyllabic root A^AA^B.[8] In fact, M. Chiang points out that one way of interpreting the tonal output of 33.11.55.53 is to consider it as being derived from the disyllabic root $A^{11}.A^{53}$ through AABB reduplication. Thus, the tonal output is the result of applying general tone sandhi on the reduplicated form. That is, 11.53 → 11.11.53.53 → **33**.11.**55**.53. Nonetheless, M. Chiang also points out that the number of AAAA reduplications with an $A^{11}.A^{53}$ root correspondent is very low. Of the 20 samples she collected,

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[8] As a matter of fact, M. Chiang (2002:558) points out that treating AAAA reduplication as derived from reduplicating a disyllabic sequence has the advantage of making AAAA reduplication in Dongshi Hakka parallel to the AAAA reduplication in Meinong Hakka. That is because the AAAA reduplication in Meinong Hakka also has a fixed melody (i.e., 33.33.55.55), and according to Chung (2001:126), the tonal output of such a pattern is derived from a disyllabic AA sequence.

only three (illustrated in (16)) have corresponding 11.53 roots that are meaningful.[9] Thus, it is questionable as to whether AAAA reduplication may be regarded as being derived from an $A^{11}.A^{53}$ root. Further, M. Chiang mentions that onomatopoeic words formed by AAAA reduplication can have disyllabic roots with the fixed tonal melody 55.55 and a *kun*[31] ending, as exemplified in (17).

(16) AAAA reduplication that has a corresponding $A^{11}.A^{53}$ root

	Root	*Reduplicated form*
a.	ɲiam11 ɲiam53	ɲiam**33** ɲiam11 ɲiam**55** ɲiam53 'to chatter endlessly'
b.	kia11 kia53	kia**33** kia11 kia**55** kia53 'to make a racket'
c.	te11 te53	te**33** te11 te**55** te53 'to talk endlessly after getting drunk'

(17) AAAA reduplication that has a corresponding $A^{55}.A^{55}$ *kun*[31] root

	Root	*Reduplicated form*
a.	a55 a55 kun31	a33 a11 a55 a53 'babbling sound of a baby'
b.	tsi55 tsi55 kun31	tsi33 tsi11 tsi55 tsi53 'the sound of a bug'
c.	kiu55 kiu55 kun31	kiu33 kiu11 kiu55 kiu53 'the sound of a bird'
d.	ku55 ku55 kun31	ku33 ku11 ku55 ku53 'gurgling sound in the abdomen'

AAAA reduplication is clearly derived from a disyllabic root. However, given that the exact tones of the roots remain unclear, and given that the tonal output of AAAA reduplication is the fixed 33.11.55.53 irrespective of the tones of the root, in the OT analysis proposed in §3.3.3, we do not indicate the tones of the root.[10]

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[9] The meanings denoted by the disyllabic roots are similar to their corresponding quadrasyllabic words (M. Chiang 2002).

[10] As will be shown in (103), the IO faithfulness constraint is lowest ranked in AAAA reduplication. Therefore, whether the root tones are specified or not will not affect the

3. OPTIMALITY THEORETIC ANALYSES

In this section, OT analyses are proposed to account for the three reduplication patterns that involve special tone sandhi, i.e., AB(C)AB(C) reduplication, AAA reduplication and AAAA reduplication. Before presenting OT analyses to reduplication-related tone sandhi in §3.3, a simplified OT analysis for tone sandhi in non-reduplication is given in §3.1; moreover, issues regarding which part in the reduplicated form is the base and which part is the reduplicant, as well as issues about reduplicant size are addressed and analyzed in §3.2.

3.1 A Simplified Optimality Theoretic Analysis of General Tone Sandhi

Dongshi Hakka tone sandhi in non-reduplication has been examined in-depth in Chung (2008), in Hsiao (2008)[11], and in H. Lin (2011) within Optimality Theory[12], and readers are referred to those works for in-depth analysis of general tone sandhi in the dialect. To account for general tone sandhi in Dongshi Hakka in the present paper, we will simply rely on two markedness constraints, WELLFORMEDNESS and ALLOTONE, which respectively penalizes marked tonal sequences and regulates the input-output tone mapping.

(18) WELLFORMEDNESS CONDITION (abbr. WFC): Disallow marked tonal sequence (i.e., *o33.11, *33.31, *11.11, *53.31, and *53.53).

analysis proposed in the present paper since none of the surface tones are determined by the root tones.

[11] Hsiao (2008) only focuses on Yinping tone sandhi.

[12] For derivational analyses of Dongshi Hakka general tone sandhi, please refer to M. Chiang (1998) and Hsiao and Chiu (2006).

(19) ALLOTONE: An input tone is mapped to its corresponding allotones.
  a. /33/: [33~35]
  b. /11/: [11~33]
  c. /31/: [31]
  d. /53/: [53~55]

As shown in (1), sequences of 33.31, 11.11, 53.31, and 53.53 are illegal; tone sandhi would thus take place to repair WFC violations. Notice that WFC also penalizes the output sequence 33.11 that is *inherited* from the input (i.e., 33.11 ← /33.11/) but not the sequence **33**.11 that is *non-inherited* from the input (i.e., **33**.11 ← /11.11/); that is because while an input /33.11/ is illicit and must change to **35**.11 (cf. 1ai), an output **33**.11 derived from /11.11/ (cf., 1b) is well-formed and will not change further to **35**.11. The distinction between inherited and non-inherited markedness is based on the theory of Comparative Markedness proposed in McCarthy (2003). In the Comparative Markedness Theory, markedness constraints compare the output candidate under evaluation with another candidate that is fully faithful to the input. Thus, *$_{\text{O}}$M penalizes a marked structure that is also present in the fully faithful candidate (and is, therefore, inherited from the input), and *$_{\text{N}}$M penalizes a marked structure that is not present in the fully faithful candidate (and is, therefore, non-inherited from the input). Thus, in Dongshi Hakka, the mapping of /33.11/ → [33.11] violates *$_{\text{O}}$33.11, while the mapping of /11.11/ → [**33**.11] does not. The second constraint ALLOTONE regulates the mapping between an underlying tone and its allotones. The ALLOTONE constraint requires, for instance, that for an input /11/ tone, the output can only be [11] or [33]. Together, the two constraints predict, for instance, that before 11, an 11 tone will change to a **33** tone.[13]

[13] WELLFORMEDNESS and ALLOTONE that are simplified in the form of a single constraint in the present paper should actually be perceived as some well-ranked hierarchies of constraints. For instance, WFC proposed in the present paper is equivalent to the ranked hierarchy of ||OCP-T(11), OCP-C(𝕙𝕝), [OCP-C(𝕝) & *HD/𝕃𝕣]$_{\text{ADJ}}$ » [NOJUMP-t & *HD/𝕃𝕣]$_{\text{ADJ}}$|| in H. Lin (2011), in which OCP-T(11) predicts the 11.11 → **33**.11 change, OCP-C(𝕙𝕝) regulates the 53.53 → **55**.53 change and the 53.31 → **55**.31 change, [OCP-C(𝕝) & *HD/𝕃𝕣]$_{\text{ADJ}}$ triggers 33.11 → **35**.11, and [NOJUMP-t & *HD/𝕃𝕣]$_{\text{ADJ}}$ accounts for the 33.31 → **35**.31 change. ALLOTONE, on the other hand, is similar to the ranked hierarchy

(20) /11.11/ → [**33.**11]

/11.11/	WFC	ALLOTONE
a. 11.11	*!	
b. **31**.11		*!
☞ c. **33.**11		

In addition to the two markedness constraints, two faithfulness constraints, IDENT-IO-T and IDENT-IO-T-HD, that govern both how many tones and which tones are allowed to change are also necessary.

(21) IDENT-IO-T: Input-Output corresponding tones (at the tonal level) are identical.

(22) IDENT-IO-T-HD: The tone standing at the head position (right edge) of a tonal sequence (at the tonal level) cannot be different from its corresponding tone in the output.

Certainly, WFC must dominate the faithfulness constraint IDENT-IO-T to ensure the occurrence of tone sandhi. In addition, Dongshi Hakka is a right-headed language—when tone sandhi takes place, it is the tone on the right that preserves the underlying tone and the tone on the left that undergoes tonal alternation;[14] as such, the positional faithfulness constraint IDENT-IO-T-HD is necessary to make the correct prediction of the sandhi site, as illustrated in (23).

of ||[IDENT-IO-REG & IDENT-IO-CON]$_{SEG}$, IDENT-IO-t-L, [OCP-REG & *RISE]$_{ADJ}$ » *NONHD/ℍr|| in H. Lin (2011). For instance, [IDENT-IO-REG & IDENT-IO-CON]$_{SEG}$ predicts that 11(Lr, l) can change to **33(Hr, l)** (which involves a change of register only) but not to **35(Hr, lh)** (which involves a change of both contour and register), and IDENT-IO-t-L predicts that 11 will change to **33** (without altering the left toneme) but not to **31(Lr, hl)** (whose left toneme is different from that of 11).

[14] In addition to the stability of tone at the right edge, the right-headedness of Dongshi Hakka is also supported by the right-edge lengthening in emphasis. (cf. H. Lin 2011).

(23) /11.11/ → [**33.**11]

/11.11/	IDENT-IO-T-HD	WFC	ALLOTONE	IDENT-IO-T
☞ a. **33.**11				*
b. 11.**33**	*!			*

Although the constraint ranking proposed can account for tone sandhi in a disyllabic sequence, it falls short when dealing with tri-syllabic strings. (24) illustrates that the current constraint ranking will wrongly predict a right-to-left reading (i.e., 24b) because compared with the left-to-right reading (i.e., 24a), it is more faithful to the input.

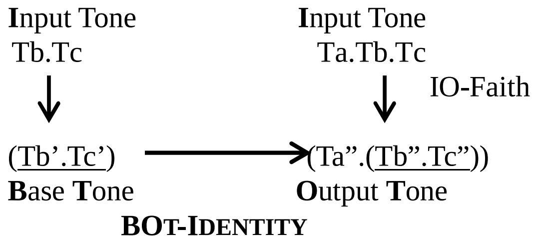
(24) /53.53.53/ → [**55.55.**53]

/53.53.53/	IDENT-IO-T-HD	WFC	ALLOTONE	IDENT-IO-T
a. **55.55.**53 (=5a)				**!
💣 b. 53.**55**.53 (= 5b)				*

As mentioned above, the operation of tone sandhi in Dongshi Hakka is consistently left-to-right irrespective of morpho-syntactic structures (ref. (4)). Thus, tone sandhi in trisyllabic strings cannot be governed by morpho-syntactic structures. However, as shown below, the tonal output derived by left-to-right directionality can be predicted if the Prosodic Correspondence model proposed in H. Lin (2005a) is adopted and if it is assumed that the tone sandhi domain on which tri-tonal strings operate is the left branching ((σσ)σ).

The Prosodic Correspondence model (H. Lin 2005a), unlike the Transderivational Correspondence model (Benua 1997), evaluates outputs that are related by prosodic structure rather than morpho-syntactic structure. Further, the corresponding outputs that are evaluated are the tonal outputs; the segmental information is of no importance. In this model the bases are tones that share the input with the tonal outputs to which they prosodically relate. Thus, in the correspondence relationship illustrated in (25), the tonal sequence Tb”.Tc” within the inner prosodic constituent of (Ta”.(<u>Tb”.Tc”</u>)) is evaluated with Tb’.Tc’ that shares the input with Ta”.Tb”.Tc”. The correspondence between them is evaluated by the constraint IDENT-BOT.

(25) IDENT-BOT: Corresponding tones in the prosodically related bases and outputs must be identical. (H. Lin 2005a)



The Prosodic Correspondence model has been shown to play an important role in accounting for tone sandhi of a number of languages such as Beijing Mandarin and Sixian-Hakka (H. Lin 2005a), Boshan (H. Lin 2004), Tianjin (H. Lin 2008), Chengdu (H. Lin 2006), and Hakha-Lai (H. Lin 2005b).

In the present paper, the IDENT-BOT constraint is adopted. However, as the term ‘base’ is also used in the Base-Reduplicant correspondence relationship, to avoid confusion, the IDENT-BOT constraint in (25) is slightly modified in the present study to IDENT-OO-T in (26); since tonal *bases* are essentially tonal *outputs*, the modification does not alter the function of the constraint.

(26) IDENT-OO-T: Corresponding tones in the prosodically related outputs must be identical.

As for the left branching ((σσ)σ) domain proposed for Dongshi Hakka, it is supported by both language internal and language external evidence. The language internal support comes from syllable contraction in Dongshi Hakka. The contraction data in (27) drawn from Hsiao (2004) and Wei (2006, 2007) show that the first and the second syllables are always affected in contraction, no matter whether the tri-syllabic strings are left branching (27a) or right branching (27b) morpho-syntactically. The phenomenon shows that the first two syllables are closer when contraction takes place. This in turn suggests that the domain for contraction should be ((σσ)σ).

(27)

a. {{σσ}σ}	b. {σ{σσ}}
'tomorrow' (Wei 2006:39)	'on that night' (Wei 2007:67)
tʰien koŋ ŋit → tʰioŋ ŋit	kai am pu → kam pu
sky light day	that dark night
'come out and play' (Wei 2006:39)	'rain heavily' (Hsiao 2004:13)
tʃut loi liau → tʃoi liau	lok tʰai ʒi → loai ʒi
out come play	fall big rain

Language externally, H. Lin (2004, 2005a, 2005b, 2006, 2008) has examined a number of languages whose tone sandhi application directionalities are insensitive to morpho-syntactic structures (e.g., Sixian-Hakka, Boshan, Tianjin, Chengdu, and Hakha-Lai) similar to Dongshi Hakka and has observed a correlation between the prosodic domains and the position of prominence. The domains are found to be aligned to the *non-prominent* edge. Thus, for *left* prominent languages, the domain is *right* aligned (i.e., (σ(σσ))); but for *right* prominent languages, the domain is *left* aligned (i.e., ((σσ)σ)).

The tonal domain ((σσ)σ) of Dongshi Hakka, which has been supported by evidence within the language and crosslinguistically, can be accounted for by the prosodic constraints below:

(28) ALLFTL: Every foot stands at the left edge of the utterance.
(29) PARSESYLL: Parse every syllable into higher prosodic levels.
(30) BINBRAN: Phonological structures are binary branching.

(31) and (32) illustrate how the constraints predict the ((σσ)σ) domain regardless of the morpho-syntactic bracketing of the input string.

(31)

{σ{σσ}}	PARSESYLL	ALLFTL	BINBRAN
a. σ(σσ)	*!	*	
b. σσσ	*!**		
c. (σσ(σ))		*!*	*
d. (σ(σσ))		*!	
e. (σσ)(σ)		*!*	*
f. (σσσ)			*!
☞ g. ((σσ)σ)			

(32)

{{σσ}σ}	PARSESYLL	ALLFTL	BINBRAN
a. σ(σσ)	*!	*	
b. σσσ	*!**		
c. (σσ(σ))		*!*	*
d. (σ(σσ))		*!	
e. (σσ)(σ)		*!*	*
f. (σσσ)			*!
☞ g. ((σσ)σ)			

(33) illustrates how the assumption of the ((σσ)σ) domain and the IDENT-OO-T constraint account for general tone sandhi in trisyllabic strings.

(33) /53.53.31/ → [**55.55.**31] Reference Output: **55**.53 (← /53.53/)[15]

/53.53.31/	IDENT-IO-T-HD	WFC	ALLO TONE	IDENT-OO-T	IDENT-IO-T
☞ a. ((**55.55**).31)				*	**
b. ((53.**55**).31)				**!	*

[15] The reference output [**55.**53] can be derived from the same constraint ranking, as illustrated below:

/53.53/ → [**55.**53]

/53.53/	IDENT-IO-T-R	WFC	ALLOTONE	IDENT-OO-T	IDENT-IO-T
☞ a. **55.**53					*
b. 53.**55**	*!				*
c. 53.53		*!			
d. **31.**53			*!		*

In (33), given the left-branching prosodic domain, the bitonal sequence at the left edge has to be evaluated with the reference output **55**.53. As the tonal sequence within the inner prosodic constituent in (a) (i.e., **55**.**55**) is different from the reference output for only one tone, and as that in (b) is different from the reference output for both tones, (a) is correctly selected as the optimal output.

3.2 Reduplicant Placement and Reduplicant Size

3.2.1 Reduplicant placement

With regard to the reduplicant placement, as all forms of AB(C)AB(C) reduplication, AAA reduplication and AAAA reduplication involve total reduplication, it is hard to justify which part of the reduplicated form is the base and which is the reduplicant. M. Chiang (2002), for instance, considers that the reduplicant is the second repeated portion in AB(C)AB(C) reduplication: in other words, the base is considered to be the initial repeated portion in AB(C)AB(C) reduplication (i.e., AB(C)-RED).[16] The present paper, on the contrary, considers that the base in AB(C)AB(C) reduplication and in AAA reduplication is the last repeated portion (i.e., RED-AB(C), RED-RED-A). The reasoning behind this position is that the last repeated portion is more faithful to the input. In phonological studies on reduplication, it is usually agreed that bases are more faithful to the input than their reduplicant counterparts. Since in the reduplication patterns of interest it is the last tone of the last repeated portion that tends to preserve its underlying tone, rather than that of the other repeated portion(s), it is better to consider that the base is the last repeated portion. As such, the prefixal status of the reduplicant (underlined here after) can be predicted by ranking ALIGN-RED-L (35) above ALIGN-ROOT-L (34), as illustrated in (36).

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[16] M. Chiang (2002) points out that it is the last syllable of the *base* that changes to 35/55 in ABAB and ABCABC reduplication, suggesting that the base is the first repeated portion in the reduplicated form.

(34) ALIGN-ROOT-L: Align the left edge of the root with the left edge of the word.

(35) ALIGN-RED-L: Align the left edge of a RED with the left edge of the word.

(36) ALIGN-RED-L » ALIGN-ROOT-L

a. /RED, AB/

$\underline{\text{AB}}\text{-AB} > \text{AB-}\underline{\text{AB}}$

b. /RED, RED, A/

$\underline{\text{A-A}}\text{-A} > \text{A-}\underline{\text{A-A}}$

The reduplicant placement of AAAA reduplication is different from the other two reduplication patterns. Recall that in terms of tone, the so-called AAAA reduplication should be regarded as a kind of AABB reduplication. For clarity, in this subsection, AAAA reduplication is referred to as $A^AA^AA^BA^B$. Thus, the reduplicant in $A^AA^AA^BA^B$ reduplication cannot be a prefix to the root as it can for AB(C)AB(C) and AAA reduplication, because if the reduplicant is placed before the base (i.e., RED-A^AA^B), the unattested sequence *$\underline{A^AA^B}$-A^AA^B would be derived. There are four different ways to derive $A^AA^AA^BA^B$ from A^AA^B, as listed below:

(37) Possible reduplicant placements

a. $\underline{A^A}\text{-}A^A.A^B\text{-}\underline{A^B}$

b. $A^A\text{-}\underline{A^A}\text{-}A^B\text{-}\underline{A^B}$

c. $A^A\text{-}\underline{\ A^A.A^B}\text{-}A^B$

d. $\underline{A^{A1}}\text{-}A^{A2}\text{-}\underline{A^{B1}}\text{-}A^{B2}$

Just as in AB(C)AB(C) and AAA reduplication, it is the tone in the final position of an $A^AA^AA^BA^B$ reduplicated form that remains intact when tone sandhi takes place. This suggests that the final syllable of $A^AA^AA^BA^B$ reduplication should also be considered as the base. Thus, (37a) and (37b), where the RED is placed to the right of the base, can be ruled out immediately. As for the third and fourth options, they differ only in terms of discerning the intervening part. In the third option, the base is intervened by the reduplicant, while in the fourth option, not only is the reduplicant intervened by part of the base (i.e., A^{A2}), but the base is also intervened by part of the reduplicant (i.e., A^{B2}). Thus, in terms of CONTIGUITY, the third option will only violate CONTIG-IB, which requires the portion of the base standing in correspondence to the input to form a contiguous string. On the other hand, the fourth option, in addition to violating CONTIG-IB, also violates CONTIG-IR, which requires the portion of the reduplicant standing in correspondence to the input to form a contiguous string.[17] Thus, the third option, where the reduplicant appears as an infix to the root, is adopted in the present study.

As a matter of fact, the infixation of a reduplicant in the base is by no means uncommon (cf. Broselow and McCarthy 1983). The placement of (37c) can be derived by the ranking ||ALIGN-ROOT-L » ALIGN-RED-L|| (Crowhurst 2004, H. Lin 2010).

(38) ALIGN-ROOT-L » ALIGN-RED-L
/RED, $A^{A}.A^{B}$/
$A^{A}\text{-}\underline{A^{A}.A^{B}}\text{-}A^{B} > \underline{A^{A}}\text{-}A^{A}\text{-}\underline{A^{B}}\text{-}A^{B}$

Notice that ALIGN-RED-L must dominate CONTIG-IB to ensure that the reduplicant will be as close to the left edge of the word as possible, even at the expense of violating CONTIG-IB.

(39) ALIGN-RED-L » CONTIG-IB
/RED, $A^{A}.A^{B}$/
$A^{A}\text{-}\underline{A^{A}.A^{B}}\text{-}A^{B} > A^{A}.A^{A}\text{-}\underline{A^{B}.A^{B}}$

Notice also that in AB(C)AB(C) reduplication and AAA reduplication, ALIGN-ROOT-L must be outranked by CONTIG-IR to make sure that the reduplicant will not be intervened by the root just to better satisfy ALIGN-ROOT-L.

The final constraint rankings for the reduplicant placement in the three patterns of reduplication are given in (40) and (41).

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[17] The CONTIG-IR constraint is adopted from Fitzgerald (2000).

(40) AB(C)AB(C) reduplication and AAA reduplication
ALIGN-RED-L, CONTIG-IR » ALIGN-ROOT-L

(41) $A^A A^A A^B A^B$ reduplication
ALIGN-ROOT-L » ALIGN-RED-L » CONTIG-IB

3.2.2 Reduplicant size

Consider next the size of the reduplicant. As all AB(C)AB(C) reduplication, AAA reduplication or AAAA reduplication involve total reduplication, the reduplicant size always equals that of the base. Thus, the reduplicant of a disyllabic AB root or AA (i.e., $A^A A^B$) root is disyllabic, and that of a trisyllabic ABC root is trisyllabic. The reduplicant of a monosyllabic root A in AAA reduplication is also monosyllabic, but the root is reduplicated twice (i.e., RED-RED-A). In the literature, total reduplication is usually predicted by MAX-BR, which requires a total copy of the elements of the base.

(42) MAX-BR: Every element (segment and tone) in the base has a correspondent in the reduplicant.

(43) MAX-BR
/RED-AB/
AB-AB > A-AB

3.3 Optimality Theoretic Analyses of Special Tone Sandhi in Reduplication

This section proposes Optimality Theoretic analyses of tone sandhi observed in AB(C)AB(C) reduplication, in AAA reduplication, and in AAAA reduplication.

3.3.1 AB(C)AB(C) reduplication

The tonal pattern of AB(C)AB(C) reduplication can be summarized below:

(44) The tonal pattern of AB(C)AB(C) reduplication

a. The tone on the reduplicant final syllable is 55 when its corresponding tone in the base (= the input) is 53, and 35 when its corresponding tone in the base (= the input) is 33, 11 or 31.[18]

b. The tone on the non-reduplicant final syllable is derivable by the general tone sandhi rules.

Consider the initial characteristics of AB(C)AB(C) reduplication first. Why does the reduplicant final syllable surface with 55 when the corresponding tone in the base is 53? And why does it surface with 35 when the corresponding tone in the base is 33, 11 or 31? As M. Chiang (2002:560) points out, the 35 tone observed in AB(C)AB(C) reduplication might be an influence from Southern Min tone sandhi.

In Southern Min/ Taiwanese, a mono-syllabic adjective can undergo either single reduplication to denote dimunity or double reduplication to denote intensity, as illustrated below:

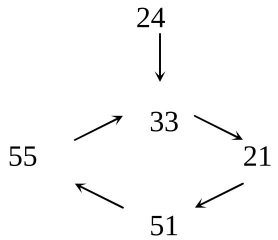
(45)

Mono-syllabic adjective	*Single reduplication ‘somewhat adj.’*	*Double reduplication ‘very adj.’*	*Examples*
21	**51**-21	51-**51**-21	e.g., se ‘small’
51	**55**-51	55-**55**-51	e.g., kin ‘fast’
55	**33**-55	35-**33**-55	e.g., tĩ ‘sweet’
33	**21**-33	35-**21**-33	e.g., tua ‘big’
24	**33**-24	35-**33**-24	e.g., aŋ ‘red’

[18] The tone of the base that corresponds to the reduplicant final syllable is identical to that of the input. As it is commonly agreed that the correspondence between the input and the reduplicant (i.e., IR correspondence) is less clear than that between the base and the reduplicant (i.e., BR correspondence), the first characteristic is better described as “The tone on the reduplicant final syllable is 55 when its corresponding tone in the *base* is 53, and 35 when its corresponding tone in the *base* is 33, 11 or 31.”

When the mono-syllabic adjective undergoes single reduplication, the derived tonal output follows the general tone sandhi pattern in the language summarized in (46).

(46) Southern Min/Taiwanese tone sandhi:



However, when the mono-syllabic adjective undergoes double reduplication, while the tonal output of the second syllable still follows the general tone sandhi pattern, the first syllable undergoes a special tonal change, as shown in (45): when the input tone is 21 or 51, the tonal output still follows the general tone sandhi pattern; but when the input tone is 55, 33, or 24, the tonal output is a rising 35 tone.

Zhang and Lai (2007, 2008) propose that the special tonal alternation found on the first syllable of double reduplication in Taiwanese is the result of general tone sandhi plus a floating high tone association (cf. also Cheng 1973, Yip 1980, Wu 1996, Myers & Tsay 2001, and C. Lin 2004). The floating high tone is realized on the left edge of a **51** tone (derived from a 21 input tone) and a **55** tone (derived from a 51 input tone) (vacuously). However, it is realized on the right edge of a **33** tone (derived from a 55 and a 24 input tone) and a **21** tone (derived from a 33 input tone) in order to preserve the tonal identity of the two reduplicants at the left edges. Zhang and Lai (2007:35-36) propose the following constraints to account for the tonal patterns of Taiwanese double reduplication:

(47) REALIZE(Float): A floating tone must be realized in the output.

(48) ALIGN(Float, Left, Word, Left) (abbr. ALIGN-L): The left edge of a floating tone must be aligned with the left edge of a word.

(49) IDENT-RR(Tone, Left) (abbr. ID-RR(T, L)): The left edges of the tones of two reduplicants derived from the same base must be identical.

(50) APPROPRIATE-ALLOMORPH (abbr. ALLMPH): For an existing syllable, select its surface tonal allomorph as follows:

UR	Surface allomorph	
	XP-final	Non-XP-final
21	21	**51**
51	51	**55**
55	55	**33**
33	33	**21**
24	24	**33**

In Zhang and Lai's analysis, the tonal alternation on the first syllable of double reduplication, which deviates from general tone sandhi and is the result of a floating high tone docking, can be predicted by the domination of REALIZE(Float) over ALLMPH, as illustrated in (51). As for the docking site of the floating tone, it can be predicted by the interaction of ALIGN-L and IDENT-RR(T, L). The domination of IDENT-RR(T, L) over ALIGN-L predicts that the floating high tone will dock on the left edge of the word, unless the placement of the floating high tone generates forms that fail to have the left edge of a reduplicant correspond to the left edge of a base, as illustrated in (52). (In the tableaux below, the floating high tone is marked by [x].)

(51) REALIZE(Float) » ALLMPH

/RED-RED-55/	REALIZE(Float)	ALLMPH
☞ a. 3[5]-**33**-55		*
b. **33**-**33**-55	*!	

(52) IDENT-RR(T, L) » ALIGN-L

/RED-RED-55/	IDENT-RR(T, L)	ALIGN-L
☞ a. 3[5]-**33**-55		*
b. [5]3-**33**-55	*!	

The special tone sandhi found in AB(C)AB(C) reduplication in Dongshi Hakka is very similar to that in Southern Min/ Taiwanese. By assuming that there is a floating high tone accompanying AB(C)AB(C) reduplication, the change of the tone on the reduplicant final syllable to 55 when the corresponding tone in the base is 53, and to 35 when the corresponding tone in the base is 33, 11 or 31 can be naturally explained: the 55 tone and the 35 tone can simply be regarded as having been right aligned with a floating high tone.[19] As such, AB(C)AB(C) reduplication in Dongshi Hakka can be analyzed in a way similar to Southern Min/ Taiwanese. However, though the REALIZE(Float) constraint and the alignment constraint that aligns an edge of a floating tone with some edge of a PCat/GCat as proposed in Zhang and Lai (i.e., ALIGN-L) are quite straightforward, they encounter some problems.

First, REALIZE(Float), which requires a floating tone to be realized in the output, is similar to MAX(SUBSEG) proposed in Zoll (1996:85), which requires an input floating autosegment to stand in correspondence with output bearing units such as root nodes and TBU. However, MAX(SUBSEG) is criticized to have a number of conceptual and empirical problems (cf. Wolf 2007). Myers (1997) and Wolf (2007) propose that constraints like MAX(SUBSEG) can be replaced by a combination of two constraints, one prohibits floating tones and the other requires tonal correspondence. Thus, the present paper adopts the two constraints *FLOAT (defined in 53) and MAXFLOAT (defined in 54) from Wolf (2007). *FLOAT is violated if an underlying floating tone remains floating in the output; MAXFLOAT is violated if an underlying floating tone is deleted. Thus, an unrealized input floating tone will violate either *FLOAT or MAXFLOAT.

Second, the alignment constraint proposed in Zhang and Lai (2007) (i.e., ALIGN-L) is also problematic because once a floating tone is realized in the output, its status as a floating tone no longer exists. Carleton and Myers (1994) propose a general alignment constraint ALIGN(H, L, Domain, L) which requires a high tone to be associated with the leftmost tone bearer in the smallest domain containing that tone. According to Carleton and Myers (1994:fn 4), when dominated by

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[19] Notice that the association of a floating high tone to the right of a 11 tone would have generated 15. The present paper assumes that new tones that are not present in non-reduplicated forms will not be generated under reduplication. Thus, 15 surfaces as the only rising tone that exists in the non-reduplication, i.e., 35.

PARSE(T) and PARSE(A), which respectively require input tones and association lines to be parsed, the alignment constraint will only have effect on floating tones. This is because for tones that are underlyingly associated, any movement or deletion of high tones that are not aligned with the bearer of the domain initial tone to satisfy ALIGN(H, L, Domain, L) will violate either PARSE(A) or PARSE(T). On the other hand, a floating high tone is not associated to any tone bearer in the underlying representation; thus, the floating high tone is free to move without violating PARSE(T) or PARSE(A). Following Carleton and Myers, to account for the realization of a floating high tone at the right edge of the reduplicant in Dongshi Hakka, the present paper proposes a general alignment constraint, ALIGN(TONE, R, RED, R), which requires tones to be associated to the rightmost TBU of the reduplicant, and assumes it to be dominated by MAX-t and MAX-A, which respectively prohibit the deletion of tonemes[20] and association lines; as such ALIGN(TONE, R, RED, R) will only have effect on floating tones.[21]

(53) *FLOAT: No floating tones.
(54) MAXFLOAT: All autosegments that are floating in the input have output correspondents.
(55) ALIGN (TONE, R, RED, R) (abbr. ALIGN-TR-R): The right edge of a tone must be aligned with the right edge of a reduplicant.

---

[20] Toneme refers to the tone segment dominated by the contour node, which is a sister of the register node and is dominated by a toal node (cf. 64 below).

[21] Notice that when the tone on which the floating tone docks is a contour tone (e.g., 53), the obligatory realization of an input floating tone (as predicted by *FLOAT and MAXFLOAT) will result in the replacement of its right toneme (assuming concaves and convexes are disallowed in Dongshi Hakka) (e.g., 53 → 5[5]). In such a case, the right toneme of the original tone is deleted (violating MAX-t). The replacement suggests the domination of MAXFLOAT and *FLOAT over MAX-t. If, on the other hand, the tone standing in the RED final position is a level tone, the docking of the floating tone will not result in toneme deletion but addition of association line, violating DEP-A. The association of the floating tone to some tone bearer suggests the domination of MAXFLOAT and *FLOAT over DEP-A. Notice also that allotonic variations (e.g., the change of 11 → **33** in general tone sandhi) are considered as involving tonal changes (violating IDENT-IO) rather than tonal replacements and thus are free from MAX and DEP violations.

(56) and (57) show that MAXFLOAT, *FLOAT and ALIGN-TR-R together predict the realization of the floating high tone on the right edge of the reduplicant. As mentioned, the lack of the realization of an input floating tone in the output would violate either *FLOAT or MAXFLOAT. For simplicity, we do not make a distinction between the two in the tableaux that follow.

(56) AB^{35}-AB & without general tone sandhi
vu33 kim33 → vu33 kim35-vu33 kim33 'black/ somewhat black'

/RED-33.33/	*FLOAT, MAXFLOAT	ALIGN-TR-R
a. 33.33-33.33	*!	
b. 35.33-33.33		*!*
c. 33.33-35.33		*!*
☞ d. 33.35-33.33		

(57) AB^{55}-AB & without general tone sandhi
xan11 liau53 → xan11 liau55-xan11 liau53 'at leisure/ a bit at leisure'

/RED-11.53/	*FLOAT, MAXFLOAT	ALIGN-TR-R
a. 11.53-11.53	*!	
b. 11.53-35.53		*!*
c. 35.53-11.53		*!*
☞ d. 11.55-11.53		

The constraints proposed so far, however, are not sufficient to account for the tonal patterns in AB(C)AB(C) reduplication in at least two respects. First, a constraint regulating the correspondence between the reduplicant and the base is essential because, except for the syllable on which the floating high tone docks (i.e., the RED final syllable), the corresponding syllables in the reduplicant and the base share the same tonal value.[22] (59) illustrates how IDENT-BR-T (defined in 58) serves to capture this characteristic of AB(C)AB(C) reduplication.

[22] Following Hogoboom (2004), the base of a reduplicant is regarded as all of the segments in the output without the reduplicant.

(58) IDENT-BR-T: Base-Reduplicant corresponding tones (at the tonal level) are identical.

(59) IDENT-BR-T
/RED-11.11/
33.35-**33**.11 > 11.35-**33**.11

IDENT-BR-T must be dominated by MAXFLOAT and *FLOAT to ensure the realization of the floating high tone even at the expense of violating IDENT-BR-T, as illustrated in (60). Further, it must be outranked by ALIGN-TR-R to ensure the docking of the floating high tone on the right edge of the reduplicant, even through this might cause the reduplicant and the base to become more different, as illustrated in (61).

(60) MAXFLOAT, *FLOAT » IDENT-BR-T
/RED-11.11/
33.35-**33**.11 > **33**.11-**33**.11

(61) ALIGN-TR-R » IDENT-BR-T
/RED-33.11/
35.35-**35**.11 > 35.11-**35**.11

Second, there must also be constraints regulating the correspondence between the syllable in the reduplicant on which the floating high tone is realized and its base correspondent. In particular, there should be constraints regulating the realization of 55, but not 35, for a base 53 tone and the realization of 35, but not for instance 55, for a base 33, 11 or 31 tone. Thus, the present paper proposes that in addition to IDENT-BR-T, which evaluates Base-Reduplicant corresponding tones *as a whole*, there must also be constraints that evaluate Base-Reduplicant corresponding tones not as a whole, but at edges.[23] Nelson (2003) shows that typologically left edge preservation of the base in the process of reduplication is notably more prevalent; therefore, a positional faithfulness constraint, IDENT-BR-T-L, that regulates the identity of the

[23] Positional faithfulness constraints that target tone constituents can be found in Yip (2002), Luo (2004), and H. Lin (2008, 2011), among others.

left edges of individual Base-Reduplicant corresponding tones is proposed in (62).

(62) IDENT-BR-T-L: The left edge of a reduplicant tone must be identical to its base correspondent.

The IDENT-BR-T-L constraint correctly predicts that 53 will be realized as 55, but not 35, in the reduplicant final position because while the left edges of 53 and 55 are the same (i.e., both begin with 5), those of 53 and 35 are different.[24] Though the IDENT-BR-T-L constraint plays the decisive role in selecting a 55 tone for a 53 base and 35 for a base 31 or 33, it fails to select a 35 tone when the corresponding base is 11 because 35, just as 55, is not identical to 11 at the left edge, as illustrated in (63). (63) also shows that IDENT-BR-T-L must be outranked by MAXFLOAT and *FLOAT to predict the realization of the floating high tone.

(63)

/RED-33.11/	MAXFLOAT, *FLOAT	ALIGN-TR-R	IDENT-BR-T-L
💣a. 33.55-33.11			*
☞ b. 33.35-33.11			*
c. 33.11-33.11	*!		

Though neither 35 nor 55 are identical to 11 at the left edge of the tone, 35 is more like 11, because both 35 and 11 begin with a low toneme while 55 begins with a high toneme. Bao (1999) argues that each tone should have an internal representation in which the tone features are dominated by a node called Contour, which is a sister of the Register feature; moreover, both Contour and Register are dominated by a Tonal Node. Based on Bao's model, the four lexical tones (i.e., 33, 11, 31, 53) and the two derived tones (i.e., **35**, **55**) have the following internal structures (cf. H. Lin 2011).

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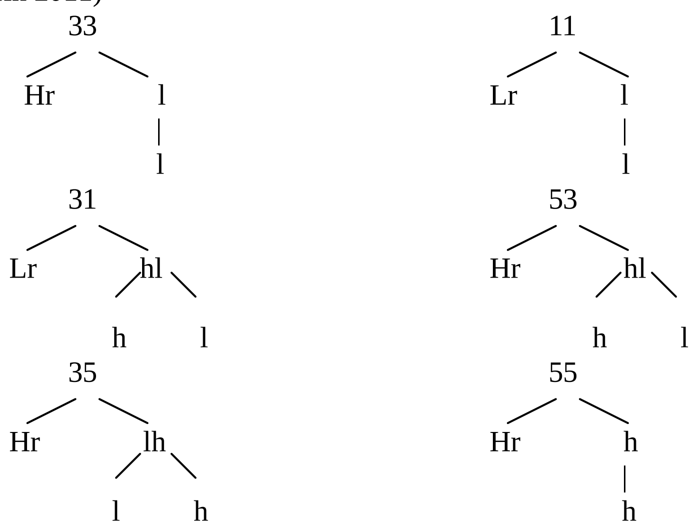
[24] Since non-RED final syllables in AB(C)AB(C) reduplication share the same tonal value with their base correspondents, they automatically satisfy the IDENT-BR-T-L constraint.

(64) The internal structure of Dongshi Hakka tones
(H. Lin 2011)



Key : Hr＝high register, Lr＝low register

Thus, to rule out (63a), the present paper proposes further that in addition to IDENT-BR-T and IDENT-BR-T-L,which require Base-Reduplicant corresponding elements at the *tonal* level to be identical, there must also be a constraint that requires Base-Reduplicant corresponding elements at the *tonemic* level to be identical. With this knowledge of the internal structure in mind, the IDENT-BR-t-L constraint is proposed.

(65) IDENT-BR-t-L: The left toneme of a reduplicant tone cannot be different from its corresponding toneme in the base.

IDENT-BR-t-L can now help select 35(Hr, lh), but not 55(Hr, h), for a base 11(Lr, l) tone. Notice that IDENT-BR-t-L must be dominated by

IDENT-BR-T-L to ensure the selection of 35(Hr, lh) for a base 31(Lr, hl) tone as the left tonemes of 35 and 31 are different.[25]

(66) IDENT-BR-T-L » IDENT-BR-t-L
/RED-11.31/
11.35-11.31 > 11.55-11.31
l.lh-l.hl l.h-l.hl

We shall now consider the second characteristic of AB(C)AB(C) reduplication: the tonal changes in the non-reduplicant-final position are not different from those in the general tone sandhi patterns. As shown in §3.1, general tone sandhi can be accounted for by the constraint ranking: ||IDENT-IO-T-HD, WFC, ALLOTONE » IDENT-IO-T||. We shall see how they account for general tone sandhi within the context of reduplication. (67) illustrates that WFC and ALLOTONE play a crucial role in predicting the tonal changes in AB(C)AB(C) reduplication that involve the general tone sandhi.

[25] Alternatively, the 53~55 and 33/31/11~35 alternations can be accounted for without resorting to IDENT-BR-t-L if we assume the evaluation of IDENT-BR-T-L is able to distinguish between different degrees. For instance, the IDENT-BR-T-L constraint can be considered violated once when the left edges of the Base-Reduplicant correspondents are 50% of the pitch range apart (i.e., when the difference is between 1 and 3 or 3 and 5), and violated twice when the left edges of the Base-Reduplicant correspondents are 100% of the pitch range apart (i.e., when the difference is between 1 and 5).

/RED-33.11/	IDENT-BR-T-L
a. 33.55-33.11	**!
☞ b. 33.35-33.11	*

(67) AB[35]-AB & with general tone sandhi

/RED-11.11/	WFC	ALLOTONE[26]	IDENT-BR-T
a. **33**.35-11.11	*!		**
b. **33**.35-**35**.11		*!	**
c. 11.35-**33**.11			**
☞ d. **33**.35-**33**.11			*

In AB(C)AB(C) reduplication, which involves tri-tonal roots, the IDENT-OO-T constraint introduced in §3.1 is essential, as illustrated in (68).

(68) ABC[35]-ABC & with general tone sandhi

RO: **55**.53 (← /53.53/)

/RED-53.53.31/	WFC	IDENT-OO-T	IDENT-IO-T
a. **55.**53.35-((**55.** 53).31)	*!		*
b. 53.**55**.35-((53.**55**).31)		**!	*
☞ c. **55.55**.35-((**55.55**).31)		*	**

Finally, IDENT-IO-T-HD must dominate IDENT-BR-T to ensure that the base preserves its rightmost input tone, even though this causes the base and the reduplicant to become more different.

(69) IDENT-IO-T-HD » IDENT-BR-T
/RED-11.33/
11.35-11.33 > 11.35-11.35

The final constraint ranking for AB(C)AB(C) reduplication is summarized in (70).

[26] Notice that reduplicants have no input correspondents and, therefore, are not subject to ALLOTONE evaluation.

(70) Constraint ranking for AB(C)AB(C) reduplication
MAXFLOAT, *FLOAT, ALIGN-TR-R, IDENT-IO-T-HD,
WFC, ALLOTONE
» IDENT-BR-T-L
» IDENT-BR-t-L, IDENT-OO-T, IDENT-BR-T
» IDENT-IO-T

(71)-(73) illustrate how (70) accounts for AB(C)AB(C) reduplication with and without general tone sandhi.

(71) AB^{35}-AB & without general tone sandhi

/RED-53.11/	MAXFLOAT, *FLOAT	ALIGN-TR-R	IDENT-IO-T-HD	WFC	ALLOTONE	IDENT-BR-T-L	IDENT-BR-t-L	IDENT-OO-T	IDENT-BR-T	IDENT-IO-T
a.53.11-53.11 hl.l-hl.l	*!									
b.53.11-53.11 hl.l-hl.l		*!*								
c.53.35-53.**33** hl.lh-hl.**l**			*!						*	*
d.53.55-53.11 hl.h-hl.l						*	*		*!	
☞ e.53.35-53.11 hl.lh-hl.l						*			*	

(72) AB[55]-AB & with general tone sandhi

/RED-53.53/	MAXFLOAT, *FLOAT	ALIGN-TR-R	IDENT-IO-T-HD	WFC	ALLOTONE	IDENT-BR-T-L	IDENT-BR-t-L	IDENT-OO-T	IDENT-BR-T	IDENT-IO-T
a. **55**.53-**55**.53 **h**.hl-**h**.hl	*!									*
b. **55**.53-**55**.53 **h**.hl-**h**.hl		*!								*
c. **55**.55-**55**.**55** **h**.h-**h**.**h**			*!							**
d. **55**.55-53.53 **h**.h-hl.hl				*!					**	
e. **55**.35-**55**.53 **h**.lh-**h**.hl						*!	*		*	*
☞ f. **55**.55-**55**.53 **h**.h-**h**.hl									*	*

(73) ABC^{55}-ABC & with general tone sandhi (RO: **55**.53 ← /53.53/)

/RED-53.53.53/	MAXFLOAT, *FLOAT	ALIGN-TR-R	IDENT-IO-T-HD	WFC	ALLOTONE	IDENT-BR-T-L	IDENT-BR-t-L	IDENT-OO-T	IDENT-BR-T	IDENT-IO-T
a. **55.55**.53-((**55.55)**.53**)** **h.h.**hl-**h.h.**hl	*!							*		**
b. **55.55.**53-((**55.55)**.53**)** **h.h.**hl-**h.h.**hl		*!						*		**
c. **55.55**.55-((**55.55)**.**55)** **h.h.**h-**h.h.h**			*!					*		***
d. **55.55**.55-((**55**.53**)**.53**)** **h.h.**h-**h**.hl.hl				*!					**	*
e. **55.55**.35-((**55.55)**.53**)** **h.h.**lh-**h.h.**hl						*!	*	*	*	**
f. 53.**55**.55-((53.**55)**.53**)** hl.**h.**h-hl.**h**.hl								**	*!	*
☞ g. **55.55**.55-((**55.55)**.53) **h.h.**h-**h.h**.hl								*	*	**

In sum, it has been argued that the special tonal alternations in AB(C)AB(C) reduplication is the result of general tone sandhi plus a floating high tone association. In particular, the alternation of 53~55 and 33/31/11~35 found in the RED final syllable is the consequence of the docking of a floating high tone on the right edge of the reduplicant and is predicted by MAXFLOAT, *FLOAT, and ALIGN-TR-R.

3.3.2 AAA reduplication

We shall now turn to AAA reduplication. The characteristics of tone sandhi in AAA reduplication are summarized in (74):

(74) The tonal pattern of AAA reduplication
a. The tones on the first two syllables in AAA reduplication are the fixed tonal sequence 35.11 (i.e., 35.11.X) and the tone on the final syllable is identical to its input correspondence.
b. Yangping tone sandhi takes place on the rightmost disyllabic sequence when the last tone is 11 (i.e., 35.**33**.11 ← 35.11.11).

Consider the first property of AAA reduplication. The phenomenon of reduplication with fixed elements as observed in Dongshi Hakka reduplication is not new. For instance, in terms of segments, the so called Ca- reduplication, which involves a fixed segment *a*, is very common in Formosan languages.[27] Segments that surface as the fixed elements in reduplication are usually unmarked (Alderete et al. 1999). Universally, pharyngeal or coronal segments are less marked than labial or dorsal consonant (75). As a consequence, the fixed segments in reduplication are often found to be the less marked pharyngeal or coronal consonants/vowels such as *ʔ*, *t* and *i*, *a*, *e*, but not the more marked labial or dorsal consonants/vowels like *k*, *p* and *u*, *y*.

(75) Place-markedness Hierarchy (de Lacy 2006:2)
*PL/DORS » *PL/LAB » *PL/COR » *PL/PHAR

As Alderete et al. (1999) point out, the surfacing of fixed segments in reduplication is a kind of the Emergence of the Unmarked (TETU; McCarthy and Prince 1994) effect and is accounted for by the TETU ranking schema below:

(76) Skeletal Ranking for the Emergence-of-the-Unmarked (TETU)
IO-Faithfulness » Phono-Constraint » BR-Identity

The ranking in (76) predicts that in reduplication, a structural constraint,

[27] Examples of Formosan languages that have Ca- reduplications are: Amis, Bunun, Paiwan and Pazih. Please refer to Zeitoun and Wu (2006) for a summary of Formosan languages that involve Ca- reduplication.

which generally has no effect in the language because it is lower ranked than the IO-faithfulness constraint, emerges in the reduplicant because I-O Correspondence is not relevant in the reduplicant and because the structural constraint outranks the constraint on BR-Identity. In the present study, we will show that the fixed tonal sequence in AAA reduplication is also unmarked and is a TETU effect as well.

De Lacy (1999, 2002) examines the interaction between tone and prominence, and observes that different prosodic positions have different tonal preferences. In a prosodic head position, H is the least marked. It is preferred over M, which in turn is preferred over L. On the other hand, in a prosodic non-head position, the tonal preference is the reverse: L is the least marked and is preferred over M, which in turn is preferred over H.

H. Lin (2011), based on de Lacy, proposes that in Dongshi Hakka, high register (Hr) tones are preferred to low register (Lr) tones in the head position and that low register tones are preferred to high register tones in the non-head position. The two constraints in (77) and (78) are proposed in H. Lin.

(77) *HD/Lr: No Lr tones in the head position.
(78) *NONHD/Hr: No Hr tones in the non-head position.

The evaluation of tonal markedness in terms of register, as proposed in H. Lin, is consistent with de Lacy's (2002) basic proposal as high register tones are higher in pitch than low register tones.

Dongshi Hakka is a right prominent language. Thus, in AAA reduplication, the fixed tonal sequence occurs in the non-head (left) position. Given *NONHD/Hr, the realization of 11(Lr, l), which is an Lr tone, as the second member in the fixed 35.11 sequence falls naturally. Notice that 31(Lr, hl) is also an Lr tone and should be as good as 11 in the non-head position. However, because contour tones are more marked than level tones universally, 31 can be ruled out by resorting to the markedness constraint *CONTOUR. (80) illustrates how the selection of 11 is explained by the TETU ranking below.

(79) *CONTOUR: No contour tones.

(80) /RED-RED-X/, where X is non-11

/RED-RED-53/	IDENT-IO-T	*NONHD/Hr	*CONTOUR	IDENT-BR-T
a. RED-11.**33** Lr.**Hr**	*!			*
b. RED-33.53 Hr.Hr		*	*!	*
c. RED-35.53 Hr.Hr		*	*!*	*
d. RED-53.53 Hr.Hr		*	*!*	
e. RED-55.53 Hr.Hr		*	*!	*
f. RED-31.53 Lr.Hr			**!	*
☞ g. RED-11.53 Lr.Hr			*	*

While it is quite natural for 11 to surface as the fixed tone in the non-head position, the reason why 35 surfaces as a fixed tone before 11 requires further explanation. 35(Hr, lh) is a rising tone that is usually considered marked according to the context-free tonal markedness constraint *CONTOUR. In addition, it is also an Hr tone, violating *NONHD/Hr. In other words, 35 is in no way unmarked. The puzzle regarding why 35 is realized can be explained if we assume that just as in AB(C)AB(C) reduplication, there is a floating high tone docking on the right edge of the reduplicant, making it end with a high tone. This suggests that MAXFLOAT and *FLOAT must dominate *NONHD/Hr and *CONTOUR.

(81) MAXFLOAT, *FLOAT » *CONTOUR
/RED-RED-X/ (X = non-11)
35-11-X > 33-11-X

(82) MAXFLOAT, *FLOAT » *NONHD/Hr
/RED-RED-X/ (X = non-11)
35-11-X > 31-11-X
Hr-Lr Lr-Lr

As there are two reduplicants in AAA reduplication (i.e., RED-RED-A), another question that remains to be answered is why the floating high tone docks on the right edge of the first reduplicant, but not that of the second reduplicant. The fact that the floating high tone is docked onto the right edge of the first but not the second reduplicant is consistent with AB(C)AB(C) reduplication. In both AAA reduplication and AB(C)AB(C) reduplication, the floating high tone, in addition to trying to be realized at the rightmost edge of the reduplicant, is also trying to be realized as close to the left edge of the word as possible. As a result, it surfaces at the right edge of the first reduplicant. This is predicted by the interaction of ALIGN-TR-R (55) and ALIGN-TW-L (defined in 83); in particular, ALIGN-TR-R must dominate ALIGN-TW-L to ensure that the reduplicant will be aligned to the right edge, rather than the left edge, of the first reduplicant, as illustrated in (84).

(83) ALIGN(Tone, Left, Word, Left) (abbr. ALIGN-TW-L): The left edge of a tone must be aligned with the left edge of a word.[28]

(84) /RED-RED-X/, where X is non-11

/RED-RED-X/	ALIGN-TR-R	ALIGN-TW-L
a. 53-11-X	*!	
b. 11-53-X	*!	**
c. 11-35-X		**!*
☞ d. 35-11-X		*

Notice that the analysis proposed thus far cannot exclude the possibility of the first syllable surfacing with a 55 tone (i.e., 55.11.X). As the tonal value of the reduplicant is fixed regardless of the tones of the base, the unattested 55 cannot be ruled out by resorting to the BR correspondence constraint. To rule it out, the RR correspondence concept (Zhang and Lai 2007, 2008; Urbanczyk 2001; C. Lin 2004) is adopted. Recall that Zhang and Lai (2007) propose an IDENT-RR(T, L)

[28] Just as ALIGN-TR-R, ALIGN-TW-L is also assumed to be dominated by MAX-t and MAX-A. As a consequence, ALIGN-TW-L only has effect on floating tones.

constraint that regulates the correspondence between the reduplicants derived from the same base at the left edge of the tone. If we compare the attested 35 tone and the unattested 55 tone with the tone of the other reduplicant, i.e., 11, at the left edge, we can see that 35 is more similar to 11 at the left edge in that both 35(Hr, lh) and 11(Lr, l) begin with a low toneme, while 55(Hr, h) begins with a high toneme. Thus, the constraint IDENT-RR-t-L that regulates the correspondence of the left edge of the reduplicants at the tonemic level is proposed. (86) illustrates how it functions to rule out 55.11.X.

(85) IDENT-RR-t-L: The left tonemes of two reduplicants derived from the same base must be identical.

(86) IDENT-RR-t-L
/RED-RED-X/ (X = non-11)
35-11-X > 55-11-X
lh-l h-l

Now we consider the second property of AAA reduplication. Yangping tone sandhi takes place on the rightmost disyllabic sequence when the tone of the base is 11 (i.e., 35-11-11 → 35-**33**-11). If not undergoing Yangping tone sandhi, the resulting output would be 35-11-11, thereby violating WFC. Thus, tone sandhi observed on the rightmost disyllabic string is consistent with the general tone sandhi patterns and can be naturally predicted by WFC.

(87) WFC
/RED-RED-X/ (X = 11)
35-33-11 > 35-11-11

Notice, however, that the resultant output of Yangping tone sandhi 35-**33**-11 actually contains two Hr tones in the non-head positions and violates *NONHD/Hr twice. Thus, a possible candidate 55-31-11, which is equally well-formed with respect to the higher ranked constraints such as IDENT-IO-T, MAXFLOAT, *FLOAT, ALIGN-TR-R, IDENT-RR-t-L and

WFC will beat the attested candidate 35-**33**-11 because it contains fewer high register tones in the non-head position, as illustrated in (88).[29]

(88) /RED-RED-X/, where X is 11

/RED-RED-11/	IDENT-IO-T	MAXFLOAT, *FLOAT	ALIGN-TR-R	IDENT-RR-t-L	WFC	ALIGN-TW-L	*CONTOUR	*NONHD/Hr	IDENT-BR-T
💣 a. 55-31-11 Hr-Lr-Lr h-hl-l						*	*	*	**
b. 35-**33**-11 Hr-**Hr**-Lr lh-**l**-l						*	*	**!	**

The suboptimal candidate can be ruled out if we adopt the *NONHD/H from de Lacy (1999, 2002). That is because while both 35 and 55 violate *NONHD/Hr, only 55 violates *NONHD/H, as illustrated in (90).

(89) *NONHD/H: No high tones in the non-head position.
(90) *NONHD/H
/RED-RED-X/ (X = 11)
35-**33**-11 > 55-31-11

The final constraint ranking for AAA reduplication is summarized in (91):

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29 The easiest way to rule out the candidate is to assume that the output must be referred to a reference output 35.11 for correspondence, as illustrated below. However, given the unclear nature of the derivation of the 35.11 output, we do not proceed with such an analysis.

IDENT-OO-T
/RED-RED-X/ (X = 11) (RO: **35.11** ← ??)
((35-**33**)-11) > ((55-31)-11)

(91) Constraint ranking for AAA reduplication
IDENT-IO-T
» MAXFLOAT, *FLOAT, ALIGN-TR-R, IDENT-RR-t-L,
WFC, *NONHD/H
» ALIGN-TW-L, *CONTOUR, *NONHD/Hr
» IDENT-BR-T

(92) and (93) illustrate how the full constraint set predicts AAA reduplication with and without Yangping tone sandhi.

(92) /RED-RED-X/, where X is non-11

/RED-RED-53/	IDENT-IO-T	MAXFLOAT, *FLOAT	ALIGN-TR-R	IDENT-RR-t-L	WFC	*NONHD/H	ALIGN-TW-L	*CONTOUR	*NONHD/Hr	IDENT-BR-T
a. 35.-11-**31** Hr-Lr-**Lr** lh-l-**hl**	*!						*	**	*	**
b. 11-33-53 Lr-Hr-Hr l-l-hl		*!						*	*	**
c. 55-55-53 Hr-Hr-Hr h-h-hl			*!			**		*	**	**
d. 55-11-53 Hr-Lr-Hr h-l-hl				*!		*	*	*	*	**
e. 55-55-53 Hr-Hr-Hr h-h-hl						*!*	*	*	**	**
f. 35-35-53 Hr-Hr-Hr lh-lh-hl							*	***	*!*	**
g. 35-33-53 Hr-Hr-Hr lh-l-hl							*	**	**!	**
☞ h. 35-11-53 Hr-Lr-Hr lh-l-hl							*	**	*	**

(93) /RED-RED-X/, where X = 11

/RED-RED-11/	IDENT-IO-T	MAXFLOAT, *FLOAT	ALIGN-TR-R	IDENT-RR-t-L	WFC	*NONHD/H	ALIGN-TW-L	*CONTOUR	*NONHD/Hr	IDENT-BR-T
a. 35-11-**33** Hr-Lr-**Lr** lh-l-**l**	*!						*	*	*	**
b. 11-**33**-11 Lr-**Hr**-Lr l-**l**-l		*!							*	*
c. 55-55-11 Hr-Hr-Lr h-h-l			*!			**			**	**
d. 55-33-11 Hr-Hr-Lr h-l-l				*!		*	*		**	**
e. 35-11-11 Hr-Lr-Lr lh-l-l					*!		*	*	*	*
f. 55-31-11 Hr-Lr-Lr h-hl-l						*!	*	*	*	**
g. 35-35-11 Hr-Hr-Lr lh-lh-l							*	**	**!	**
☞ h. 35-**33**-11 Hr-**Hr**-Lr lh-**l**-l							*	*	**	**

In sum, it has been shown that the fixed tonal sequence found in AAA reduplication is a TETU effect, which is reflected by the sandwich of the markedness constraints that favor the 35.11 sequence, including

*NONHD/H, *CONTOUR and *NONHD/Hr, between the IO-faithfulness and BR-identity constraints. The 35 tone in the fixed sequence, though it appears to be marked at first glance, is the result of the mandatory docking of the floating high tone on the right edge and is predicted by the dominant constraint MAXFLOAT and *FLOAT. Finally, it has also been shown that despite the fact that AAA reduplication involves special tonal alternation, the change of 11 (in the fixed sequence 35.11) to **33** before another 11 (i.e., 35.**33**.11) conforms to general tone sandhi (i.e., Yangping tone sandhi) and is predicted by WFC.

3.3.3 AAAA reduplication

The tonal pattern of AAAA reduplication can be summarized below:

(94) The tonal pattern of AAAA reduplication
  a. The tonal output of an AAAA reduplication is the fixed tonal sequence 33.11.55.53.
  b. The AAAA reduplicated form is derived from a disyllabic root.

Consider the first fact of AAAA reduplication. Similar to AAA reduplication, AAAA reduplication involves a fixed tonal sequence. As mentioned above, the fixed tonal sequence in AAA reduplication is a TETU effect and can be accounted for by the TETU ranking (i.e., IO-Faithfulness » Phono-Constraint » BR-Identity). However, the fixed tonal sequence in AAAA reduplication cannot be considered a TETU effect, because while the underlying tone of the root is preserved in AAA reduplication (i.e., the last syllable), this is not the case in AAAA reduplication. AAAA reduplication surfaces with the fixed sequence 33.11.55.53, irrespective of the nature of the underlying tones. In other words, the IDENT-IO-T constraint must be dominated by the constraints encouraging the 33.11.55.53 sequence. As shown below, the fixed tonal sequence in AAAA reduplication, like that in AAA reduplication, is also driven out of markedness requirements. In other words, in AAAA reduplication, the IDENT-IO-T constraint must be dominated by the markedness constraints that predicts the 33.11.55.53 melody (i.e., Phono-Constraint » IO-Faithfulness), generating a total unmarkedness effect.[30]

Here below we will start from the right edge of the fixed string. Why is 53 realized in the final position? Being a right prominent language, the right edge in Dongshi Hakka is the prominent head position. Thus, the realization of a 53(Hr, hl) tone in the head position is readily predicted by *HD/Lr (77). But 33(Hr, l), 35(Hr, lh), 55(Hr, h) and 53(Hr, hl) are all Hr tones in Dongshi Hakka, so it remains unclear as to why 53 is chosen. In Dongshi Hakka, the head position happens to be the utterance final position. As it is common for an utterance final position to accompany a falling contour, the selection of 53 in the utterance final position can be accounted for by the constraint in (95).[31]

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[30] As will be shown below, BR-identity plays a crucial role (and is ranked high) in AAAA reduplication. Nonetheless, the ||Phono-Constraint » IO-Faithfulness|| ranking will produce a total unmarkedness effect regardless of where BR-identity is ranked. This is because BR-identity requires identity between the base and the reduplicant. Therefore, if the base is unmarked (due to ||Phono-Constraint » IO-Faithfulness||), the reduplicant will be unmarked as well.

[31] An anonymous reviewer points out that the prediction of the falling tone 53 in the fixed 33.11.55.53 appears to be the result of a preference for high tone in the prominent position, coupled with a need to carry a low boundary tone in the utterance final position. If so, all unspecified element in utterance final position in the language would be predicted to surface with a low boundary tone. This prediction may be tested by investigations of the tonal realizations of neutral toned syllables, which are usually assumed to be underlyingly toneless (Duanmu 2000, J. Wang 2002, Yip 1980). The realization of the neutral tone in Beijing Mandarin, for instance, is affected by the boundary tone. Zhang (2007:266-67), based on Y. Wang's (1996) study of the Mandarin neutral tone (given below), claims that neutral tone realization in Mandarin involves "(a) rightward extension from the preceding lexical tone and (b) a boundary low tone at the right edge of the word." Take the trisyllabic word with 213 as the initial syllable followed by two neutral toned syllables for example. Zhang claims that the mid fall tone realized on the last syllable is the result of a boundary low tone.

(Zhang 2007:267)

σ	σ-neut.	σ-neut.-neut.
55	55-41	55-42-21
35	35-52	35-53-32
213	21-33	21-33-32
51	51-21	51-21-11

(95) FALL$\}_{utter}$: Align the right edge of an utterance with a falling contour.[32]

Tableau (96) shows that *HD/Lr and FALL$\}_{utter}$ together predict the occurrence of 53 in the head position.

(96)

/A-RED-A/	FALL$\}_{utter}$	*HD/Lr
a. T-T.T-33 Hr	*!	
b. T-T.T-11 Lr	*!	*
c. T-T.T-55 Hr	*!	
d. T-T.T-35 Hr	*!	
e. T-T.T-31 Lr		*!
☞ f. T-T.T-53 Hr		

Notice in passing that while FALL$\}_{utter}$ is effective in AAAA reduplication, it is not in the reduplication patterns of AB(C)AB(C) and AAA. In all of the three reduplication patterns, the base is situated in the

Nonetheless, in Dongshi Hakka, whether an utterance final neutral toned syllable will also surface with a boundary low tone, as observed in Beijing Mandarin, would still depend on how constraints that encourage the surface of such a tone interact with other constraints in neutral tone sandhi and would require a study that is much bigger in scope than can be afforded in the present paper. Therefore, I would like to leave this issue for further research.

[32] Universally, it is common for pitch contour to fall across an utterance (Yip 2002:12). Liu's (2008) acoustic study of the tonal system in Dongshi Hakka also shows that the utterance final pitch is generally lower than that of the utterance beginning pitch, suggesting that there is a falling contour toward the end of an utterance.

utterance final position. In AAAA reduplication, as the IO faithfulness constraint is lowest ranked, FALL}$_{utter}$ will predict a falling tone in the utterance final syllable irrespective of the tonal value of the root tone. On the other hand, in AB(C)AB(C) reduplication and AAA reduplication, the utterance final tone is always identical to its root correspondent, as predicted by the dominant IDENT-IO-T-HD and IDENT-IO-T in AB(C)AB(C) reduplication and AAA reduplication, respectively. Thus, to avoid the realization of a falling tone in the utterance position in the two reduplication patterns, FALL}$_{utter}$ must also be dominated by IDENT-IO-T-HD in the former and IDENT-IO-T in the latter.

Now let us consider the tone to the left of 53. As mentioned in §3.3, 11(Lr, l) is the least marked tone in the non-head position, so the surfacing of 55(Hr, h) in the non-head position is puzzling. Recall that in terms of tone, AAAA reduplication is a kind of AABB reduplication, with its reduplicant inserted in the base (i.e., A^{A}-$\underline{A^{A}A^{B}}$-A^{B}). In other words, the first tone and the second tone, as well as the fourth tone and the third tone form B-R correspondences with each other, respectively. It is argued that the reason why 55 is surfaced is that it is the most harmonic reduplicant of the 53 tone. According to IDENT-BR-t-L (ref. 65), the left toneme of a reduplicant tone should be identical to the left toneme of its base correspondent, such that the reduplicant that corresponds to 53(Hr, hl) must be left aligned with a high toneme (i.e., 31(Lr, hl), 53(Hr, hl) or 55(Hr, h)). Even so, we may still wonder why 31 and 53 are not selected. Both 31 and 53 can be ruled out if we assume that, as in AB(C)AB(C) reduplication and in AAA reduplication, there is a floating high tone that needs to be realized on the right edge of the reduplicant. As neither 31 nor 53 ends with a high tone, they are ruled out. This is readily captured by MAXFLOAT, *FLOAT and ALIGN-TR-R.[33]

[33] There are other ways to rule out 31 and 53 before the final 53. For instance, 53 can be easily ruled out by WFC because 53.53 is not a licit sequence. Also, 31 can be ruled out if we propose the constraint IDENT-BR-REG, which requires the base and the reduplicant to be identical in register. However, IDENT-BR-REG would encounter difficulty explaining why the first and the second tone in the fixed sequence, i.e., 33(Hr. l) and 11(Lr, l), do not agree in register. The analysis proposed in the current study, with its utilization of MAXFLOAT and *FLOAT, has the additional advantage of making the analysis of AAAA reduplication more consistent with those of AB(C)AB(C) and AAA reduplication, as all of the special tonal alternations found in the three reduplication

(97) illustrates how MAXFLOAT, *FLOAT, ALIGN-TR-R and IDENT-BR-t-L together predict the occurrence of 55 before the final 53.

(97)

/A-RED-A/	IDENT-BR-t-L	MAXFLOAT, *FLOAT	ALIGN-TR-R
a. T-T.11-53 l-hl	*!	*	
b. T-T.33-53 l-hl	*!	*	
c. T-T.35-53 lh-hl	*!		
d. T-T.31-53 hl-hl		*!	
e. T-T.53-53 hl-hl		*!	
f. T-T.53-53 hl-hl			*!
☞ g. T-T.55-53 h-hl			

We will now consider the two tones on the left (i.e., 33.11). As mentioned, 11 is predicted to be the most preferred tone in the non-head position due to *NONHD/Hr and *CONTOUR. However, the two tone sequences cannot both be 11 because 11.11 is illicit and is ruled out by WFC. In other word, only one 11 will be found in the leftmost sequence. As the leftmost bitonal sequence also forms a B-R correspondence, to satisfy IDENT-BR-t, only 33(Hr, l) and 35(Hr, 1h), which are identical to 11(Lr, l) at the left edge at the tonemic level, are possible outputs. Among the two tones, 33 is less marked than 35 because it is a level tone. Consequently, 33 is the tone that is realized next to 11, as illustrated in (98).[34]

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patterns can be related to the existence of a floating high tone that accompanies reduplication.

[34] Notice that the 33.11 sequence in the fixed melody does not violate *o33.11 in WFC

(98)

/A-RED-A/	WFC	IDENT-BR-t-L	*NONHEAD/Hr	*CONTOUR
a. 11-11.T-T Lr-Lr l-l	*!			
b. 55-11.T-T Hr-Lr h-l		*!	*	
c. 55-55.T-T Hr-Hr h-h			**!	
d. 35-11.T-T Hr-Lr lh-l			*	*!
☞ e. 33-11.T-T Hr-Lr l-l			*	

One more question that remains to be answered concerns the reason why *11.33 does not surface in the leftmost disyllabic sequence. *11.33 ties the optimal candidate (i.e., 33.11) under the evaluation of the four constraints in (100). As none of the four output tones is determined by the input and IDENT-IO-T is the lowest ranked in AAAA reduplication, the choice between *11.33 and 33.11 cannot be based on the IO-faithfulness constraint. It can, however, be based on the markedness constraint. The markedness constraint that plays a role is the OCP-REG constraint, which prohibits tones that are identical in register to occur in an adjacent position.

(99) OCP-REG: Adjacent tones must disagree at the register level.

because the melody 33.11.55.53 is fixed and, as previously mentioned, is irrespective to the tonal input. In other words, it is not derived from the input; as a result, 33.11 cannot be inherited from the input.

The constraint will pick Hr.Lr in the leftmost sequence, since the disyllabic on the right begins with an Hr tone. As 11.33 forms an Lr.Hr sequence, it is rejected. This can be illustrated in (100).

(100)OCP-REG
33-11.55-53 > 11-33.55-53
Hr-Lr.Hr Lr-Hr.Hr

Notice that the disyllabic string on the right (i.e., 55 and 53) violates OCP-REG, because both members are high in register. The change of the final syllable to an Lr tone will violate *HD/Lr. Thus, the domination of *HD/Lr over OCP-REG can help rule out candidates such as *****33.11.55.31 that have the perfect register sequence Hr.Lr.Hr.Lr.

(101)*HD/Lr » OCP-REG
33-11.55-53 > 33-11.55-31
Hr-Lr.Hr-Hr Hr-Lr.Hr-Lr

One further question concerns why the sequence does not surface with the register pattern Lr.Hr.Lr.Hr, as it satisfies both OCP-REG and *HD/Lr. The reason why Lr.Hr.Lr.Hr (e.g., *11.33.31.53, *11.33.11.53) is not chosen is that according to IDENT-BR-t, the tone that has B-R correspondence with 53(Hr, hl) must begin with a high toneme (i.e., 31(Lr, hl), 53(Hr, hl), 55(Hr, h)); and given ||FALL}$_{utter}$ » *CONTOUR|| a falling (contour) tone (e.g., 31 and 53) is not allowed to surface unless in the utterance final position. Thus, the domination of *CONTOUR over OCP-REG can help rule out the unwanted Lr.Hr.Lr.Hr sequence.

(102)*CONTOUR » OCP-REG
33-11.55-53 > 11-33.31-53
Hr-Lr.Hr-Hr Lr-Hr.Lr-Hr

The final constraint ranking for AAAA reduplication is summarized in (103):

(103) Constraint ranking for AAAA reduplication
MAXFLOAT, *FLOAT, ALIGN-TR-R, IDENT-BR-t-L, *HD/Lr, FALL}$_{utter}$, WFC
» *NONHD/Hr, *CONTOUR
» OCP-REG
» IDENT-IO-T

(104) illustrates how the full constraint set predicts AAAA reduplication.

(104)

/A-RED-A/	MaxFloat, *Float	Align-TR-R	Ident-BR-t-L	*Hd/Lr	Fall}$_{utter}$	WFC	*NonHead/Hr	*Contour	OCP-Reg	Ident-IO-T	Ident-BR-T
a. 33-11.31-53 Hr-Lr.Lr-Hr l-l.hl-hl	*!						*	**	*		**
b. 33-35.55-53 Hr-Hr.Hr-Hr l-lh.h-hl		*!					***	**	***		**
c. 33-11.35-53 Hr-Lr.Hr-Hr l-l.lh-hl			*!				**	**	*		**
d. 33-11.55-31 Hr-Lr.Hr-Lr l-l.hl-hl				*!			**	*			**
e. 33-11.55-55 Hr-Lr.Hr-Hr l-l.h-h					*!		**		*		*
f. 11-11.55-53 Lr-Lr.Hr-Hr l-l.h-hl						*!	*	*	**		*
g. 55-55.55-53 Hr-Hr.Hr-Hr h-h.h-hl							***	*!	***		*
h. 31-31.55-53 Lr-Lr.Hr-Hr hl-hl.h-hl							*	** *!	**		*
i. 11-33.55-53 Lr-Hr.Hr-Hr l-l.h-hl							**	*	**!		**
☞ j. 33-11.55-53 Hr-Lr.Hr-Hr l-l.h-hl							**	*	*		**

In sum, it has been shown that AAAA reduplication is also accompanied by a floating high tone, as also in AB(C)AB(C) and AAA reduplication, and that the floating tone is docked on the right edge of the reduplicant, as in AB(C)AB(C) and AAA reduplication. The realization of the floating high tone and the docking site of the floating tone are mainly determined by MAXFLOAT, *FLOAT and ALIGN-TR-R. Further, it has also been shown that the markedness constraints *HD/Lr, FALL}$_{utter}$, WFC, *NONHD/Hr, *CONTOUR, and OCP-REG, which make a great contribution to the prediction of the fixed sequence are ranked above the IO-faithfulness constraint, generating a total unmarkedness effect.

4. CONCLUSION

This paper examines the special tone sandhi phenomena observed in the reduplication patterns of AB(C)AB(C), AAA, and AAAA in Dongshi Hakka that appear to be distinct from one another. AB(C)AB(C) reduplication is different from AAA reduplication and AAAA reduplication in that while the reduplicant of AB(C)AB(C) is sensitive to the input tones, that of AAA reduplication and AAAA reduplication surfaces with fixed tonal melodies irrespective of the nature of the input tones. Nonetheless, despite the fact that AAA reduplication and AAAA reduplication are alike in that both involve fixed tonal melodies that are shown to be driven out of markedness requirements, the markedness requirements pertain only to the reduplicant in the former but to both the reduplicant and the base in the latter. The differences among the three patterns of reduplication are reflected by the different rankings of the markedness, the BR identity and the IO faithfulness constraints in their respective constraint hierarchies. Yet, despite the fact the tonal behaviors observed in the three patterns of reduplication are rather different, it has been argued that they all involve a floating high tone that contributes to the special tonal patterns observed in the three patterns. The floating high tone always aligns its right edge with the right edge of the reduplicant, and prefers to align its left edge with the left edge of the word. As a result, the floating high tone occurs at the right edge of the first reduplicant. The docking of the floating high tone on the right edge of the first reduplicant is mainly accounted for by the interaction between MAXFLOAT, *FLOAT, ALIGN-TW-L, and ALIGN-TR-R.

The assumption of floating tone in the present paper is not new. African languages and languages in Central America are usually assumed to have floating tones that participate in phonological processes (Yip 2002, Hyman 2003). The floating tone is also assumed to play a role in hypocoristic in the Chinese dialect of Cantonese (Yip 1980, Chen 2000). In reduplication, it is not uncommon to find floating tones accompanying reduplication. African languages such as Urhobo (Aziza 2003) and Chichewa (Carleton and Myers 1994) are assumed to be accompanied with a floating tone. In Chinese dialects, double reduplication in Southern Min (e.g., *dua*33 'big' → *dua*35-*dua*21-*dua*33 'very big'; Cheng 1973, C. Lin 2004, Myers & Tsay 2001, Wu 1996, Yip 1990, and Zhang and Lai 2007, 2008) as well as monosyllabic adjectival reduplication in Beijing Mandarin (e.g., *hao*L 'good' → *hao*L *haor*H (*de*); Yip 1990) are also considered to be involved with a floating high tone. Thus, the presence of a floating tone in reduplication, as assumed in the present paper, is not unique to Dongshi Hakka, but is also observed in other languages.[35]

[35] The present paper does not assume that floating tones always exist when it comes to reduplication. Even in Dongshi Hakka, floating high tones are found only in the reduplication patterns of AB(C)AB(C), AAA, and AAAA. For those reduplication patterns that surface without floating tones, either there is no floating tone lexically specified, or if there is any, there must be constraints prohibiting the realization of floating tones (e.g., *MULTI-ASSOCIATIONS, which prohibits a segment from being associated with more than one tone) outranking constraints encouraging the realization of them (e.g., MAXFLOAT and *FLOAT).

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東勢客語重疊詞的特殊變調

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本文以優選理論（Optimality Theory）分析東勢客語中涉及特殊變調的三種重疊型式，包含 AB(C)AB(C)型式、AAA 型式、以及 AAAA 型式。本文指出，這三類重疊型式之變調現象看似十分不同，卻都內含一個浮游聲調（floating tone），且該聲調均出現在重疊部份（reduplicant）之右側。此外，AAA 型式和 AAAA 型式另外涉及了特定聲調組合。本文指出，這種現象和文獻中常見涉及特定音段的重疊現象十分相似，出現的特定成份也都屬於較為無標的聲調。

關鍵詞：東勢客語，重疊詞，特殊變調，浮游聲調，特定聲調，優選理論