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A Constraint-Based Approach to Fission Reduplication in Two Chinese Dialects*

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Sun, Pei-Ran & Chung, Chin-Wan. (2022). A constraint-based approach to fission reduplication in two Chinese dialects. *The Linguistic Association of Korea Journal, 30(3),* 63-87. This study focuses on the emergence of the unmarked (TETU) concerning syllabic structure and segmental features in the base of two Chinese dialects like Shunping and Pingyao. Partial reduplication generally exhibits intriguing TETUs in the reduplicant. In Shunping, the onglide and a vowel simplify into a simple vowel while a coda consonant deletes in the base. This shows structural TETU in the base: no diphthong and a closed syllable. The reduplicant in Shunping implies the prevocalic glide belongs to the rime. The segmental content of the rime in the reduplicant comes from the input. This shows a direct correspondent relation between the input and the reduplicant. In Pingyao, the rime excluding a prevocalic glide in the base is replaced by a fixed [-ʌʔ]. The rime including the prevocalic glide in the input is copied; the copied part appears after the fixed onset in the reduplicant. The base segments display two TETUs. One is related to the consonantal place features of the coda, and the other is with a reduced fixed vowel. However, the prevocalic glide seems to affiliate neither with the onset nor the rime. The Pingyao dialects also demonstrate direct correspondence relations between the input and the reduplicant. To account for the variant implementations of TETU, we adopt the full reduplication model proposed by McCarthy and Prince (1995), and put forth the constraint ranking schema for the TETU in two Chinese dialects.

Key Words: fission reduplication, Chinese dialectology, base-oriented TETU, constraints, prevocalic glides

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1. Introduction

Reduplication is a process by which a string of base segments is copied partially or totally onto a reduplicative morpheme called reduplicant. The copied portion is affixed to a specific position in the base, completing the process. This process has profoundly influenced the current phonology theory, and it has been frequently debated in phonology for decades in terms of several points of view (e.g. Wilbur, 1973; Marantz, 1982; McCarthy & Prince, 1986; Steriade, 1988). Morphologically, the reduplication process can be considered affixation, which acts as a suffix, prefix, and infix depending on its linear position. Phonologically, there is a well-known property that the reduplicant is not totally specified for segmental content, which is copied from the base that undergoes reduplication processes. Thus, reduplication involves phonological identity between the base and the corresponding reduplicant by the very nature of reduplication.

In total reduplication, the reduplicant and the base generally show obvious identity, so it is not easy to discern which part is base or reduplicant. It is shown in Axininca Campa full reduplication: /kawosi/ → [kawosi-kawosi] 'bathe' and /koma/→ [koma-koma] 'paddle' (Payne, 1981; McCarthy & Prince, 1995). Unlike total reduplication, however, the identity relation is not always maintained in partial reduplication. For example, the reduplicant of Oykangand partial reduplication is parochially identical to the base: /eder/ → [ed-eder] 'rain,' /igun/→ [ig-igun] 'go' (Sommer, 1981; McCarthy & Prince, 1986).

McCarthy and Prince (1986) argue that the reduplicative affixes are somewhat allowed more 'freely' than their bases in terms of phonological pattern in Oykangand partial reduplication. It indicates that less marked segment features or structures can appear in the reduplicant, which can be summarized as the emergence of the unmarked (TETU: McCarthy & Prince, 1994). Except for the reduplicant portion, the base may contain marked features or structures because there is a strict identity between the input and the output.

We can observe these phonological and morphological factors of reduplication in Mandarin Chinese and other dialects. Sun (1999) claims a type of reduplication in some Chinese dialects, dubbed fission reduplication (henceforth FR). Compared to total reduplication in Chinese dialects, FR is a type of morphological mechanism that repeats a form to express a diminutive sense or a specialized meaning. It is noteworthy that FR is one of the pieces of evidence of the 'Fanqie (reverse cutting)' process (Bao, 1990) in Old Chinese word formation, having been in dispute for several decades (Hou, 1989; Bao, 1990, 2000; Sun, 2006a, 2006b).

From a general perspective, fission is a process that tends to eliminate marked structures, and Struijke (2002) shows that segmental fission is a reflection of the TETU effect. Chung (2011) claims a unique TETU schema, applying to fission reduplication, is divergent from the typical emergence of the unmarked. That is, the TETU effect in FR is observed in the base rather than in the reduplicant. Besides, we assume that the base-oriented TETU effect also can be found in different syllabic-membership of a segment in dialect-specified cases.

To this end, we firstly take two Chinese dialects into account and attempt to observe the similarities and divergences of patterns between them. Secondly, we try to resolve the potential problems within the parameter of Optimality Theory (Prince & Smolensky, 1993/2004) and Correspondence Theory (McCarthy & Prince, 1995). In addition, we show how the 'base-oriented' TETU schema differs from the typical 'reduplicant-oriented' TETU schema. Thirdly, we offer how the base-oriented TETU schema differently applies to two Chinese dialects.

We separate this study into five sections: Section 2 presents the data of FR in two Chinese dialects and summarizes their characteristics. Section 3 reviews some previous studies related to FR in Chinese dialects. Section 4 provides a constraint-based account for FR in two different dialects. Section 5 concludes the study along with its implications.

2. Phonological Background and Data Presentation

This section presents some examples of FR in Shunping and Pingyao. Before the data presentation, let us briefly show the FR formation along with the phonemic inventory of the two dialects. A stepwise FR formation is given in (1).

(1) The FR formation
  a. Step one: Reduplicate a monosyllabic word that results in two identical syllables. ($\sigma \rightarrow \sigma_1 \sigma_2$)
  b. Step two: Replace the rime of the σ_1 with new segments. (Shunping: with an open syllable; Pingyao: with a checked syllable[1]).

1) The distribution of a contour tone in Chinese is relevant to two structures of syllable: a checked syllable (syllables closed with obstruents /p/, /t/, /k/, or /ʔ/) and a non-checked syllables (open syllables or syllables closed with a nasal /m/, /n/, /ŋ/). Historically, the glottal stop is not the

c. Step three: Fix the leftmost consonant of σ_2 with a diminutive morpheme /l-/.

The first and the third step are similar to FR processes in other dialects, such as the Fuzhou dialect (Liang, 1982; Bao, 2000; Chung, 2011) and the Jianou dialect (Da, 1996; Chung, 2011). The FR operation may influence the word's meaning and result in an FR form that usually expresses the diminutive sense of smallness or a specified action. This section will briefly introduce the basics of Shunping and Pingyao phonology and show the FR data of the two dialects.

2.1. The Shunping Dialect[2)]

Shunping dialect is mainly used by Mandarin speakers in Shunping county, the middle area of Hebei province. The consonant inventory of Mandarin Chinese is adopted from Lee and Zee (2003), and a seven-vowel system is selected from Zee and Lee (2007), which is one of the most frequent systems of the 86 sample dialects, as shown in (2a-b).

(2) The phoneme inventory of Mandarin Chinese

a. Consonants (Lee & Zee, 2003)

	Bilabial	Labiodental	Dental	Alveolar	Retroflex	Palatal	Velar
Plosive	p, pʰ		t, tʰ				k, kʰ
Affricate			ts, tsʰ		tʂ, tʂʰ	tɕ, tɕʰ	
Nasal	m		n				ŋ
Fricative		f	s		ʂ		x
Approximant	w, (ɥ)				ɻ	j, ɥ	
Lateral			l				

b. Vowel phonemes (Zee & Lee, 2007)

	Front		Central	Back
+High	i	y[3)]		u
-High	e		ə	o
			a	

only legitimate coda consonant of a checked syllable in this dialect. /p, t, k/ are also possible for a checked syllable with an entering tone. However, /p, t, k/ are weakened to /ʔ/ in the modern Pingyao dialect (Wen, 1997).

2) The phonemic inventory of Shunping Mandarin is not transcribed into IPA symbols yet. Therefore, we will provide the phoneme of Mandarin Chinese (Beijing), which shows the comprehensiveness of Mandarin and other variations.

As for the syllable structure, Mandarin contrasts full and weak syllables. Duanmu (2007, pp. 40-41) mentions that full syllables have similar duration, which means that a vowel is long in full open syllables, shown in [ma:], and short in full closed syllables, appeared in [man] and [maj]. Thus, vowel length is not contrastive in full syllables. The glide in Chinese acts as an onglide or an offglide of a vowel, while being treated as part of a consonant.

With the brief introduction to phonology in Mandarin, in what follows, we present the data of FR, which are adopted from Sun (2006b). Reduplicants are underlined in the following data.

(3) Shunping fission reduplication (cf. Sun, 2006b)

a.	CV→ CV.lV	Gloss	FR	Gloss
	ts^{h}a	'to wipe'	ts^{h}ɨ-la	'rub one's shoe against something in order to remove dirt on it'
	tʂa	'dregs'	tʂɨ^{r}-la	'dregs of fat'
	pa	'scar'	pa-la	'push slightly'
	kɤ	'coarse cloth'	kɤ-lɤ	'bib'
b.	CVC→ CV.lVC			
	tɕiŋ	'startle'	tɕi-liŋ	'startle with physical reaction'
	tɕiŋ[4]	'smart'	tɕi-liŋ	'clever, nimble'
	k^{h}əw	'mouth'	k^{h}ɤ-ləw	'back area inside of shoe'
c.	CGV→ CV.lGV			
	t^{h}wo	'take off'	t^{h}u-lwo	'hang loose'
	xwo	'mix (powder)'	xu-lwo	'to sweep powder together with hand, Broom and, etc.'
	xwa	'cut the surface on'	xu-lwa[5]	'scratch, scribble'
	ʂwo	'say, speak'	ʂu-lwo	'rebuke, reproach'

3) To discern glides and vowels, we present them as /j/ for a high front glide (do not discern prevocalic and postvocalic), /y/ for a high front rounded vowel, /ɥ/ for a high front rounded glide, and /i/ for a front unrounded vowel.

4) In Mandarin Chinese, /tɕiŋ/ 'startle' and /tɕiŋ/ 'smart' are homonyms. The FR forms of the two cases are identical.

5) An anonymous reviewer mentions that the reduplicated form for /xwa/ in (3c) is different from that on Sun (2006b). In Sun (2006b), the reduplicant is realized as [xu-la], in which [-la] may be

d.	CGVC →CV. lGVC			
	$t\text{ɕ}^h$ɥɛn	'circle'	$t\text{ɕ}^h$y-lɥɛn[6]	'curly (hair)'
	xwan	'hoop, ring'	xu-lwan	'an area centered around the speaker'
	t^hwan	'something shaped like a ball'	t^hu-lwan	'messy things shaped like a ball'
	tɕjaw	'cry, shout'	tɕi-ljaw	'cicada'

As shown in (3a-b), we observe that monosyllabic words fission into disyllabic words. The base consists of a CV sequence (with an underlying tone value) without a coda segment, whereas the reduplicant begins with a fixed /l-/ that is obligatory in the reduplicative morpheme of all the FR. Hence, the fixed segmentism in FR is morphological. In copying, the CV of the base is copied as the reduplicant, regardless of the structure of the input. Thus, the reduplicant consists of a fixed /l-/ plus the copied rime of the base. On the other hand, the base vowel is modified, which differs in quality.

The data in (3c-d) with different syllable types show that the reduplicant has a prevocalic glide but not the base. The rime of the reduplicant is copied from the base (/t^hwo/→ [t^hu-lwo], /tɕjaw/→ [tɕi-ljaw], and /$t\text{ɕ}^h$ɥɛn/→[$t\text{ɕ}^h$y-lɥɛn]), but the rime of base is realized as an open syllable with a high-vowel. So it seems that there is no direct correspondence between the base element and the reduplicant. As for the sub-syllabic classification of prevocalic glide, Duanmu (2007, p. 79) assumes it is part of the onset and shares one slot with the onset consonant realized as secondary articulation. In that case, the prevocalic glide deletes because the fixed /l-/ in the reduplicant replaces the base onset elements. Thus, the classification in Duanmu wrongly predicts the occurrence of /l/ without a glide in FR reduplicant, such as /t^hwo/→ *[t^hu-lo]. Besides, Sun (2006a) describes empirical cases to argue against Duanmu's assumption, and we will discuss the

ambiguous with a suffix /-la/. In addition, we consider that the realization of [-lwa] is an intermediate step between the underlying form /xwa/ and the final step [xu-la], which may be accompanied by glide deletion and cause opacity. Therefore, to avoid the possible opacity and to discern the reduplicative morpheme and the /-la/ suffix, we assume that [xu-lwa] is the rational FR form of the root /xwa/.

6) Glide /ɥ/ can be transcribed as a /j^w/ combination in Mandarin Chinese. Sun (2006b) mentions that /-lɥɛn/ has no example in Shunping Mandarin (/-ljɛn/ in his work). However, Duanmu (2007) proposes that the prevocalic glide in /lɥɛn/ may come to the surface in standard Chinese. Thus, we assume this alternation is an optional case other than an exception.

membership of prevocalic glide in the following sections. For now, we preliminarily assume the prevocalic glide in Shunping does not share the same slot with the onset consonant.

For convenience, we separate the Shunping cases into C-initial and CG-initial and list them in terms of place of articulation, as shown in (4).

(4) The distribution of C-initial and CG-initial in Shunping FR

	Bilabial	Dental	Alveolar	Retroflex	Palatal	Velar
C	p, p^h	t, t^h, ts		tʂ	tɕ, tɕ^h	k, k^h
CG		t^{h}w, tj		ʂw	tɕ^{h}ɥ, tɕj	xw

The generalization of prevocalic glide in Shunping FR is two-fold. On the one hand, if the input form does not involve a prevocalic glide, the leftmost segment is preserved in the base, and the subsequent rime receives the place features of the onset[7] at the surface level. On the other hand, if the input contains a prevocalic glide, the vowel in the base licenses [+high, ±back, ±round]. Therefore, we consider that two different processes condition the vowel segment in the base: Onset assimilation for C-initials and Glide vocalization[8] for CG-initials. To illustrate these issues, let us recall the data in (5).

(5) Different Distributions of C- and CG-Initials

C-inital	CG-initial
a. tɕiŋ→tɕi-liŋ	e. tɕ^{h}ɥɛn→tɕ^{h}y-lɥɛn (*tɕ^{h}i-lɥɛn) f. tɕjaw→tɕi-ljaw
b. kɤ→kɤ-lɤ c. k^{h}əw→k^{h}ɤ-ləw	g. xwan→xu-lwan (*xɤ-lwan)
d. t^{h}a→t^{h}a-la	h. t^{h}wan→t^{h}u-lwan (*t^{h}a-lwan)

As shown in (5a-c), the consonantal features of the onset spread to the following vowel. For instance, /k^h/ and /ɤ/ share the same feature [+back] in /k^{h}əw/→[k^{h}ɤ-ləw].

7) Duanmu (2007) suggests that the coronal feature of the onset consonant spreads to the following vowel segment that is unspecified in terms of place features. The assimilation process also can be found in Shona-English loanword adaptation (/mepu/ 'map'; /saradhi/ 'salad') as consonantal assimilation to the inserted vowel in word-final (Miao, 2005; Uffmann, 2006)

8) The assumption that the surface high vowel /y, u, i/ are derived from glides via vocalization is proposed in Bao (1990) and Sun (2006a).

In (d), the input vowel in the base retains the vowel quality in the underlying form since /a/ in Mandarin is licensed as a central-low vowel with [-back]. Compared to (5a-d), the rime alternation process in (5e-h) results in different representations when CG-initial precedes them. We observe that the base rime in (5e-h), is not influenced by the onset segment, and it cannot be the target of onset assimilation. Hence, we consider that the vowel segment undergoes glide vocalization if it is CG-initial, such as /tɕʰɥVX-/→ [tɕʰy-], /tɕjVX-/→ [tɕi-], and /tʰwVX-/→ [tʰu-]. It may reveal that the prevocalic glide is an on-glide as a part of rime. In section four, we will analyze these issues in detail.

2.2. The Pingyao Dialect

FR also abounds in an extended dialect category. The Pingyao dialect is one of the subcategories of the Jin dialect that is mainly used in the Shanxi province. In this section, most transcriptions we employ are identical to Mandarin Chinese in (2), and the additional symbols are noted if necessary. For several decades, the FR process has been discussed by many Chinese linguists (cf. Hou, 1989; Wen & Hou, 1993; Sun, 2006b). The FR cases data of Pingyao are given in (6).

(6) The Pingyao dialect (cf. Wen & Hou, 1993; Sun, 1999, 2006b)

	CV→ CVC.lV	Gloss	FR	Gloss
a.	pæ	'swing'	pʌʔ[9)]-<u>læ</u>	'swing'
	pi	'lighted grain'	pʌʔ-<u>li</u>	'lighted grain'
	ti[10)]	'bring up'	tjʌʔ-<u>li</u>	'bring up (bags with belt)'
b.	CVG→CVC.lVG			
	tʰej	'to drag'	tʰʌʔ-<u>lej</u>	'to drag'
c.	CVC→CVC.lVC			
	kəŋ	'low bank of earth between fields'	kʌʔ-<u>ləŋ</u>	'Slope between terraced fields'
d.	CGV→CGVC.lGV			
	tjɔ	'hanging'	tjʌʔ-<u>ljɔ</u>	'hanging'
e.	CGVC→CGVC.lGVC			
	kwaŋ	'grouping'	kwʌʔ-<u>lwaŋ</u>	'a group of (something)'

9) The Pingyao dialect includes five lexical tones: 53, 35, 13, <u>ʔ23</u>, <u>ʔ54</u> (Hou 1989). The underlined lexical tones refer to an 'entering tone' that simultaneously emerges with a reduced vowel /-ʌ/ and a glottal stop as the tone bearing unit. One of the prominent characteristics of the Jin language is that

According to Sun (2006b), the FR generates two new syllables. As presented in (6), the rime of the base is replaced by a [-ʌʔ] sequence, which we cannot find the input correspondent. Unlike the rime of the base, the onset segments are maintained intact in the output. The reduplicant, however, consists of the fixed-l plus every element except for the initial consonant in the input. Interestingly, the reduplicant seems to copy input segments excepting the initial consonant instead of duplicating the base segments. It is because the rime of the base is substituted by the [-ʌʔ] in the output. We can observe it by comparing the rime in the base and the reduplicant. In addition, the instances in (6d-e) show that the prevocalic glides [j] in [tjʌʔ-] and [w] in [kwʌʔ-] survive in the base. At the same time, the prevocalic glides still appear right after the fixed-l in the reduplicant. Concerning the syllabic affiliation, Sun (2006a) argues that prevocalic glides in the Jin dialects may be treated as a 'symbiont' to both onset and nucleus.

This section has introduced the brief phonological facts of the two dialects and FR formation examples. In Shunping FR, the base is an open syllable, and onset assimilation can trigger the quality change of the following vowel. In addition, the prevocalic glide in the base undergoes vocalization. Pingyao FR shows a different preference, in which the rime of the base tends to be alternated and ends in a glottal stop. The prevocalic glide is treated differently depending on its location (in the base or reduplicant). In the following section, we review some previous studies of fission reduplicant.

3. Previous Studies

This section introduces previous analyses of the FR process. Sun (1999, p. 123) illustrates the formation of fission reduplication. He generalizes the common properties of FR

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entering tones are lexically included in its tonal inventory (Wen & Hou 1993). According to Zhang (2007), an entering tone is about half the duration of other lexical tones (entering tones are around 148ms versus an average of 260ms for others). We can observe that the entering tone mainly surfaces as the rime of the base. In this study, we focus on the issues related to segment alternation other than tone value which is irrelevant in the following content.

10) The different representations of /pi/→ [pʌʔ li] (* [pjʌʔ li]) and /ti/→ [tjʌʔ li] (*[tʌʔ li]) are driven by the interaction of several different constraints. Rubach (2003) presents that labial fission is subject to the interaction of *SOFT-LAB and anti-fission constraints; *SOFT-LAB disallow palatalized labial segments. It produces a Duke-of-York derivation: /pi/→ [pji] → [pi]. We will discuss this serial derivation in further researches.

formation in modern Chinese dialects, which invokes a monosyllabic word to be a disyllabic word due to morph-phonological and semantic matters. The monosyllabic input form is fissioned into two syllables. Given that fact, Sun (2006b) claims that FR inevitably violates "One syllable/One meaning Principle" (OOP: Sun, 1999, p. 185) in Chinese languages.

Sun (2006b) categorizes the fission process into three subtypes differentiated by rime modification in the base and reduplicant. The first type terms Faithful Type, which involves the modification in the rime of the base. For instance, the base tends to be simplified but the rime is faithfully copied in the reduplicant, as in /k^{h}waŋ/→ [k^{h}wa-lwaŋ]. The second type is Fixed Rime Type. As we presented in section two, no matter what rime the base has, the reduplicant always contains a reduced vowel and ends with a glottal stop /ʔ/ in the Pingyao dialect. Sun (2006b) proposes that the rime of the base is fixed, the onset of the reduplicant /l-/ as well. The third one terms the Trochaic Type, in which the base consistently presents a single vowel as the rime, regardless of whether it contains a coda segment or not. The tone of the second syllable is realized as a light syllable with a neutral tone (light syllable) in the Shunping dialect.

This study mainly focuses on the so-called Fixed Rime Type and Trochaic Type. To illustrate the FR case in the two types, Sun assumes that this process arises from the effect of OOP that restricts the two syllables from coming close to each other to make them one-syllable perceptions. For instance, the checked syllables [-ʌʔ] and [-əʔ] are described as short in terms of duration, which bring the two syllables closer. Thus, it is natural to choose [-ʌʔ] and [-əʔ] as the first rime. In view of the significant phonological difference between the monosyllabic form and the FR form, the latter expresses a diminutive or specific meaning. The derivational process is shown as follows:

(7) A stepwise account for FR (Sun, 2006b)

Input:	/tɕ^{h}ɥɛn/ (Shunping)	/kwʌʔ-lwaŋ/ (Pingyao)
total reduplication:	[tɕ^{h}ɥɛn.tɕ^{h}ɥɛn]	[kwaŋ.kwaŋ]
fission reduplication:	[tɕ^{h}y.lɥɛn]	[kwʌʔ-.lwaŋ]
Output:	[tɕ^{h}y.lɥɛn]	[kwʌʔ-.lwaŋ]

The rule-based account shows the phonological modification during the formation of FR. Sun (2006b) proposes the liquid /l-/ is chosen to replace the onset of the reduplicant to raise the sonority level and blur the boundary of the two syllables. In the Shunping dialect, the base loses its coda segment resulting in a CV structure, which makes the two-syllable peaks get closer. Pingyao FR produces checked syllables to minimize the perceptive discernment of the two syllables, and /ʌʔ/ or /əʔ/ is very natural to be chosen as the rime. To reconcile OOP, the FR formation tends to shorten the distance between the two peaks for making a one-syllable impression, although the violation is inevitable.

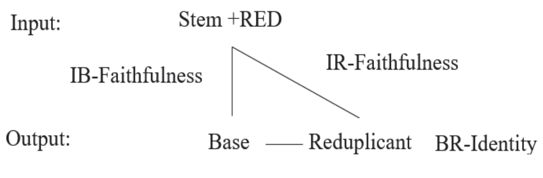
However, his account cannot provide a convincing analysis of the following problems: Firstly, this account does not give a tenable explanation about what triggers /-ʌʔ/ or /-əʔ/ to be represented in the base of FR in the Pingyao dialect. Instead, he regards these segments as fixed rime. Secondly, the given account cannot describe what conditions the vowel segment in Shunping FR. OOP does not suffice for explaining the rime alternation in the base and the different sub-syllabic classifications of prevocalic glide. Thirdly, the derivational analysis in (7) fails to specify this base-oriented TETU in fission reduplication.

To figure out these problems, we offer a constraint-based account for the FR process in Chinese dialects.

4. A Constraint-Based Analysis

In this section, we propose a constraint-based account of FR formation in Shunping and Pingyao within the framework of Optimality Theory (Prince & Smolesky, 1993/2004) and Correspondence Theory (McCarthy & Prince, 1995). Both dialects show a base-oriented TETU and Input-Reduplicant faithfulness in the reduplicant, which is different from the normal TETU. To illustrate this issue, we adopt the model of identity (McCarthy & Prince, 1995), which develops the reduplicative relation of McCarthy and Prince (1993/2004) in terms of input-output faithfulness and other dimensions. The full model involves the correspondence relationship between stem-base, stem-reduplicant, and base-reduplicant. The full model of FR is shown in (8).

(8) The full model (McCarthy & Prince, 1995, p. 273)



As mentioned in the data presentation section, we consider that IR faithfulness turns out to play an essential role in Shunping FR and Pingyao FR. To interpret this issue properly, it is necessary to clarify how Input-Reduplicant (IR) faithfulness outranks Input-Output (IO) and Base-Redulicant (BR) faithfulness. In the following subsection, the analysis of Shunping FR will be given.

4.1. Fission Reduplication in the Shunping Dialect

According to previous studies (Hou, 1989; Bao, 2000; Sun, 2006a, 2006b), the diminutive formation is assumed to be a case of partial reduplication. Every segment in the reduplicant except for the leftmost one has a correspondent in the input. On the other hand, the initial element of the reduplicant is fixed with /l-/. Since the input segments have more correspondents with the reduplicant than the base, the base in the output incurs more violations of IO-faithfulness. Chung (2011) also argues that partial reduplication in some Chinese dialects shows the implementation of TETU that applies to the base rather than to the reduplicant. He provides an alternative analysis to explain the base-oriented TETU and the different roles of prevocalic glides in two Chinese dialects.

In this subsection, we first analyze Shunping FR and provide some related constraints, as shown in (9) and (10).

(9) Faithfulness constraints for Shunping FR
- a. Max-IR: Every segment of the input has its correspondent in the reduplicant.
- b. Max-BR: Every segment in the base has its correspondent in the reduplicant.
- c. Max-IO: Every segment in the input has its correspondent in the output.
- d. Anchor-L: The leftmost segment of the input must be preserved in the output.

To illustrate the three relationships in (8), the Max constraint family is utilized. Max-IR requires the complete correspondence between the input and the reduplicant. Max-BR emphasizes the perfect mapping between base and reduplicant. Base-Reduplicant identity, regardless of the input forms, is less important in this dialect. Besides, Max-IO requires that output must have the correspondent counterpart in the input. According to the generalization of FR in section two, Max-IO and Max-BR do not show any hierarchical distinction among them, whereas MAX-IR must dominate Max-IO and Max-BR. In what follows, Anchor-L dominates Max-IO in terms of stringency, which requires the leftmost segment to be a perfect mapping between input and output.

In addition, the markedness constraints that are needed in this study are presented in (10):

(10) Markedness constraints for Shunping FR
 a. NoCoda: Syllables are open.
 b. Tone-Stress Principle (cf. Duanmu, 2007:249)[11]: Every toned syllable must be heavy.
 c. *CG: A consonant-glide cluster sequence is prohibited.
 d. Agree [BACKNESS][12] (Flemming, 2003): A consonant and the adjacent vowel must have the same value of [backness].
 e. Palatal-Alveolar→Front=PA→FT: [-anterior, laminal] →[front][13] (Flemming, 2003): A laminal sibilant cooperates with a front tongue body of the following vowel segment.

NoCoda requires that every syllable be open. On the contrary, any loss of the coda segment in the reduplicant is prohibited due to Max-IR >> NoCoda. Duanmu (2007, p. 249) proposes Tone-Stress Principle (henceforth TSP). It regulates that only heavy syllables can bear lexical tones due to their bimoraicity. Thus, TSP is employed to militate against light syllables at the surface level, viz, the base is ill-formed when it contains an open syllable with a schwa. NoCoda and TSP do not show any ranking between them. However, Max-IR dominates both constraints in the analysis.

We have discussed that C-initials and CG-initials have different representations in the

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11) A weak syllable cannot keep its underlying tones in Chinese dialects. There is a contrast between full (stressed) and weak (unstressed) syllables, and only full syllables (bimoraic) bear underlying tones. According to Duanmu (2007:153), a full syllable has stress and light one does not. Since each full syllable has two morae, it forms a moraic foot and bears a stress. Since a light syllable has just one mora, it cannot form a moraic foot. Observing such facts, Duanmu (2007, p. 249) states Tone-Stress Principle: a. A stressed syllable can be assigned a lexical tone or pitch accent. b. An unstressed syllable is not assigned a lexical tone or pitch accent.

12) Flemming (2003) proposes that AGR [back] can create conflict between vowel backness feature and an adjacent coronal segment. It can be reconciled by alternating vowel backness to make it compatible with coronal features and vice versa.

13) This constraint is adopted from Flemming (2003). He mentions that the tongue blade behind the alveolar ridge can form a constriction, which is involved by non-anterior laminal coronals Since the tongue blade is in front of the tongue body, the tongue blade is difficult to being placed in the palatal-alveolar area without the tongue body being fronted.

base. The former, we claim, is subject to onset assimilation, whereas the latter is controlled by the syllable well-formedness constraint, which triggers glide vocalization in the base. Therefore, we use the following constraints in this dialect. Firstly, *CG requires that a CG sequence cannot realize in the surface form, but the CG sequence does surface in the reduplicant since MAX-IR dominates *CG.

Secondly, we employ the constraint that has to do with onset assimilation. Miao (2005) and Uffmann (2006) propose the onset assimilation, which requires the epenthetic vowels to share the identical place feature of the preceding consonant. Therefore, we posit that the onset spreads the place features to the following vowel to achieve the onset-nucleus place conformity in the Shunping dialect. Given this fact, the PA→FT and AGR [back] (Flemming, 2003) are adopted. The constraint requires onset-nucleus conformity for a specific feature: the place features and vowel backness. Hence, it is necessary to distinguish three contrast tongue body positions: [front], [central], and [back]. It is because the high vowel in the base varies in three tongue body positions according to features of the preceding three-way distributed sibilants, which we will show in the next subsection. So far, the ranking relation for Shunping FR is shown in (11).

(11) Constraint ranking For Shunping FR
Max-IR, Anchor-L>> TSP, NoCoda, *CG, PA→FT>> AGR [BK], >> Max-IO, Max-BR

Based on the constraints in (9) and (10) and their ranking relations in (11), we provide an analysis of the FR of the Shunping dialect. In the following tableaux, we omit the constraints, which are unnecessary in the selection of the optimal form. The following two tableaux show the analysis of the root with CV and CVC structures.

(12) A root with CV structure (/kɤ/→ [kɤ-lɤ] 'bib')

Input: $k_1ɤ_2$-l-RED	Max-IR	An-L	TSP	AGR[bk]	Max-IO	Max-BR
a. ☞$k_1ɤ_2$-$lɤ_2$	*					*
b. k_1a_2-$lɤ_2$	*			*!		*
c. k_1i_2-$lɤ_2$	*			*!		*
d. $k_1ə_2$-$lɤ_2$	*		*!	*		*
e. $ɤ_2$-$lɤ_2$	*	*!			*	

Similar to Mandarin Chinese, the Shunping dialect does not contrast in vowel length within a full syllable, such as [ka] and [kɤ]. Therefore, all the surface vowels in a CV sequence are heavy, and vowel length can be ignored since tones are assigned to the syllables anyway (neutral tone is not related to this study). Candidates (12b-d) involve vowel alternation in the base, and they are evaluated differently due to their different vowel qualities. The ranking, AGR [back] >> Max-IO, shows a strong tendency to achieve the CV place agreement, as shown in (12b-d). In (12d), the emerged schwa is punished by TSP, which is illegal to bear a lexical tone as the full vowels do. Next, candidate (12e) incurs a fatal violation of undominated Anchor-L, which manifests the anchoring effect playing a crucial role in FR. So, candidate (12a) turns out to be the optimal form regardless of the violations to the lower-ranked Max-BR.

In what follows, the ranking given in (12) provides solid evidence for base-oriented TETU, which reveals more clearly in (13).

(13) A root with CVC structure (/k^həw/→ [k^hɤ-ləw] 'back area inside of shoe')

Input: $k^h ə_1 w_2$-l-RED	Max-IR	NoCoda	TSP	AGR[bk]	Max-IO
a. [$k^h ə_1$]w_2-ləw	*	**!		*	
b. [$k^h ə_1$]-ləw	*	*	*!	*	*
c. [$k^h a_1$]-ləw	*	*		*!	*
d. ☞[$k^h ɤ_1$]-ləw	*	*			*

Because NoCoda outranks Max-IO, the unmarked CV structure in the base comes to the surface, whereas the rime of reduplicant form involves a CVC structure to satisfy Max-IR. In addition, onset assimilation drives the quality change of the input vowel /ə/ in (13d), which shows /ɤ/ is more harmonic than the suboptimal candidate (13c) in terms of AGR [bk] >> Max-IO. The tableau reveals that the current ranking, Max-IR>> NoCoda>> Max-IO, suppresses a CVC structure in the base and tolerates the identical structure in the reduplicant (the off-glide is treated as a coda segment). This base-oriented TETU is also attested in the Pingyao dialect in the next section.

Section two discusses that C-initial and CG-initial are motivated by different phonological processes. So far, we have accounted for the CV and CVC inputs in tableaux (12) and (13). The following cases (14) show the status of the prevocalic glide with a CGV(X) structure.

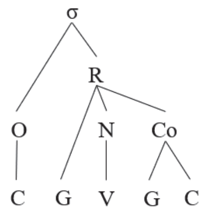
(14) A root with CGV structure (/xwan/→ [xu-lwan] 'hoop, ring')

Input: $x_1w_2a_3n_4$-l-RED	Max-IR	NoCoda	*CG	AGR[bk]	Max-IO
a. $[x_1w_2]a_3n_4$-$lw_2a_3n_4$	*	**!	**		
b. $[x_1w_2]a_3$-$lw_2a_3n_4$	*	*	**!		*
c. ☞$[x_1u_2]$-$lw_2a_3n_4$	*	*	*		**
d. $[x_1a_3]$-$lw_2a_3n_4$	*	*	*	*!	**
e. $[x_1w_2]a_3$-$lw_2a_3n_4$	*	*	**!		*

Shown by the winner, the prevocalic glide surfaces as a nucleus via vocalization since it wins over glide deletion in (14d). *CG functions as a trigger constraint that militates against the marked CG cluster in the base. This analysis implies another TETU effect in the Shunping dialect: the undominated MAX-IR protects the CG sequence in the reduplication, but it is powerless in the base. Additionally, the prevocalic glide acts as part of syllable rime, because it is faithfully preserved in the reduplicant even though the onset segment is replaced by the diminutive morpheme /l-/. In the base, it alternates to a homorganic vowel segment as the syllable rime.

This analysis casts doubt on Sun's assumption (2006a), in which the prevocalic glide in the Shunping dialect is independent, viz, the prevocalic glide directly links to the syllable node. The reason is two-fold: on the one hand, the prevocalic glide survives in the reduplicant instead of changing with the fixed /l-/. On the other hand, it vocalizes to the syllable nucleus in the base. Thus, the syllable structure of Shunping is hypothesized in this study as follows.

(15) The syllable structure for the Shunping dialect



The prevocalic glide in (15) links to the rime, and this structure is assumed mainly for the Shunping region in this analysis. It undergoes vocalization in the base as a part of a rime. In the reduplicant, the prevocalic glide fails to be replaced by the fixed /l-/ at the onset position. Besides, the base-oriented TETU prefers a CV structure in the base rather than in the reduplicant due to Max-IR>>*CG>>Max-IO and Max-IR>>NoCoda>>Max-IO.

4.1.1. Co-occurrence Restriction for C-Initials

So far, we have discussed glide vocalization in CG-initials, and another issue is onset assimilation for C-initials. There is a well-known co-occurrence restriction[14] in Mandarin Chinese. To analyze this issue, we need to introduce two new constraints for analysis to reflect this co-occurrence restriction for sibilants and vowels.

(16) Co-occurrence Restrictions

a. *C[apical, +sibilant]i: an apical sibilant and a high-front vowel sequence are prohibited.

b. Ident-IO [Back]: The [Back] feature in the input must be identical to the output correspondent.

*C[apical, +sibilant]i disfavors an apical sibilant and high-front vowel to be adjacent. The co-occurrence restriction in Mandarin Chinese can be presented in this ranking: *C[apical, +sibilant]i, PA-FT>> ID-IO [F]. The following tableau shows that when a hypothetic central vowel /a/ is preceded by a sibilant, it undergoes quality changes depending on the place of articulation of the sibilant.

(17) Co-occurrence Restriction of sibilants and High Vowels

Input: Sib+a	Candidates	TSP	*C[api, +sib]i	PA-FT	AGR[bk]	ID-[bk]
tsa	a. ☞tsɨ					
	b. tsi		*!			*
	c. tsɨ^{r}				*!	*

14) A rich inventory of sibilant sounds is well-known in Mandarin Chinese: a three-way contrast can be found in place of articulation for fricatives/affricates: Apical dental, sub-apical retroflex, and laminal palatal (alveola-palatal). The high front vowel /i/ cannot occur after the apical dental and sub-apical retroflex sibilants: /si, tsi, ts^{h}i, ʂi, tʂi, tʂ^{h}i/ strings are disallowed. But the rime of alveolo-palatal fricatives/affricates /ɕ, tɕ, tɕ^{h}/ can be filled with the high front vowel /i/. There is an asymmetric distribution in that Chinese coronal fricatives/affricates are filled with different vowels. The feature [±distributed] for the contrast between apical and laminal segments. Flemming (2003) argues that the features [apical] and [laminal] are preferred rather than using [±distributed] because the part of the tongue used to make a coronal constriction is relevant to the proper tongue body position.

Input: Sib+a	Candidates	TSP	*C[api, +sib]i	PA-FT	AGR[bk]	ID-[bk]
tʂa	d. tʂɨ				*!	
	e. tʂi		*!		*	*
	f. ☞tʂɨ^{r}					*
tɕa	g. tɕɨ			*!	*	
	h. ☞tɕi					*
	i. tɕɨ^{r}				*!	*

As shown in (17), the three-way contrast of sibilants in Mandarin forces the vowel in the FR base to select the more harmonious candidate that incurs a minor violation of the markedness constraints. Candidates (17b) and (17e) violate the co-occurrence constraint *C[api, +sib]i, but laminal sibilant in (17h) is excluded. Candidate (17f) contains a retroflexed back vowel which avoids the violation of AGR [bk], compared to the candidates (17c) and (17i)

To conclude, the constraint ranking reveals a base-oriented TETU schema in Shunping FR, and the TETU effects are summarized as follows:

(18) The ranking Schema for base-oriented TETU in Shunping FR
  a. Max-IR >> NoCoda>> Max-IO (An open syllable in the base)
  b. Max-IR >> *CG >> Max-IO (A CV structure in the base)

The two TETU in (18) are observed only in FR forms, but they are not found in the regular phonology of the Shunping dialect. In the regular phonology, the Shunping dialect allows coda segments and CG clusters, so NoCoda and *CG are crucial only in the FR base because Max-IR outranks both of them. Compared to the derivational account in (7), this constraint-based account can provide a better illustration of the TETU effect and the sub-syllabic classification in the Shunping dialect.

4.2. Fission Reduplication in the Pingyao Dialect

In section three, we have discussed Shunping FR and how the TETU works to the reduplicative base. Compared to Shunping, Pingyao FR shows different TETU effects via new constraints and their ranking relation. In this section, let us account for FR in the Pingyao dialect and present new constraints.

In contrast with Sun (2006b), we assume that the rime in the base is not fixed but results from vowel reduction and glottal stop insertion separately. The vowel segment of the input form is realized as a reduced vowel at the surface level. On the other hand, the following coda consonant is forced to be placeless. To this end, a set of new constraints to illustrate vowel reduction and glottal stop insertion is necessary. Meanwhile, the general constraints for fission reduplication are also involved.

(19) Constraints for Pingyao FR
a. Reduce: Vowels lack quality.
b. *C_{pl}C (Chung 2021): An obstruent does not have its place when followed by a consonant across a syllable boundary.
c. Ident-IO [V]: Input and output vowels are identical in their feature specification.
d. Ident-IR [V]: Input vowels and the vowels in the reduplicant are identical in their feature specification.
e. Max-IO: Every segment in the input has its correspondent in the output.
f. Max-IR: Every segment of the input has its correspondent in the reduplicant.
g. Anchor-L: The leftmost segment of the input must be preserved in the output.

The first constraint demands that the unmarked vowel surface, which lacks quality, such as [ə] (or [ʌ][15] in the Pingyao dialect). At the syllable boundary, the base prefers a placeless segment because of *C_{pl}C>>Max-IO. Next, an open syllable with a reduced vowel is not allowed in the Pingyao dialect. To solve this problem, an epenthetic glottal stop at the coda position is motivated by a well-formedness constraint to keep the syllable weight, viz, TSP. Similar to Shunping, Max-IR and Anchor-L must dominate well-formedness constraints: Reduce and *C_{pl}C. In Pingyao FR, TSP is undominated since there is no neutral tone at the surface level. Next, Ident-IO [V] punishes quality changes of a vowel, for instance, the reduced vowel in Pingyao FR. Glottal stop epenthesis is used as a fixing strategy to satisfy TSP, and it should be panelized by DEP-IO as well. Since DEP-IO is ranked significantly low in this dialect, thus, we omit this constraint for space limitation. The ranking relation for Pingyao FR is assumed as follows, see in (20).

(20) Constraint ranking For Pingyao FR
Max-IR, Ident-IR [V], Anchor-L, TSP>> Reduce, *C_{pl}C>> Ident-IO [V], Max-IO

15) According to Ladefoged & Johnson (2014, p. 222), the symbol /ə/ is not defined in terms of cardinal vowels but is used for a range of mid-central vowels. In addition, the symbol /ʌ/, which is the symbol for an unrounded cardinal vowel, is often used for a lowered mid-central vowel.

We show how constraints interact with one another to result in the intended outputs, and the well-illustrated issues will be omitted for convenience's sake.

Unlike the Shunping dialect, both the base and reduplicant require heavy syllables because they bear a lexical tone. To this end, a CV structure is strictly prohibited, see (21).

(21) CV Structures (/pæ/→ [pʌʔ-læ] 'swing')

Input: pæ-l-RED	Max-IR	Id-IR [V]	TSP	Reduce	*C$_{pl}$C	Id-IO [V]
a. pæ-læ	*			**!		
b. pʌʔ-lʌʔ	*	*!				*
c. pʌ-læ	*		*!	*		*
d. pʌt-læ	*			*	*!	*
e. ☞pʌʔ-læ	*			*		*

In tableau (21), candidate (21a) is ruled out because the full vowel in the base violates Reduce twice since IR Faithfulness constraint>> Reduce protects the vowel segment in the reduplicant. Candidate (21b) refers to an overapplication case that fatally violates Id-IR [V]. Candidate (21c) contains an open syllable with a reduced vowel, but it violates TSP, which requires a bimoraic syllable. To satisfy TSP, candidates (21d) and (21e) involve an epenthetic segment in the base, but only (21e) wins over with a placeless coda which is less marked.

Now let us consider the status of the prevocalic glide in Pingyao.

(22) CGV Structures (/tjɔ/→ [tjʌʔ-ljɔ] 'hanging')

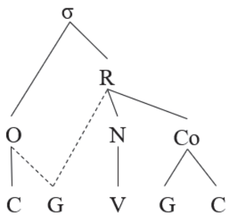
Input: t$_1$j$_2$ɔ$_3$-l-RED	Max-IR	Reduce	Max-IO
a. t$_1$j$_2$ɔ$_3$-lj$_2$~	*	*!	
b. ☞t$_1$j$_2$ʌ$_3$ʔ-lj$_2$~	*		
c. t$_1$ʌ$_3$ʔ-lj$_2$~	*		*!
d. t$_1$j$_2$ɔ$_3$ʔ-lj$_2$~	*	*!	

(23) CGV Structures (kwaŋ→ kwʌʔ-lwaŋ 'a group of (something)')

Input: k$_1$w$_2$a$_3$ŋ$_4$-l-RED	Max-IR	Reduce	*C$_{pl}$C	Max-IO
a. k$_1$w$_2$ʌ$_3$ŋ$_4$-lw$_2$~	*		*!	
b. ☞k$_1$w$_2$ʌ$_3$ʔ-lw$_2$~	*			
c. k$_1$w$_2$a$_3$-lw$_2$~	*	*!		
d. k$_1$ʌ$_3$ʔ-lw$_2$~	*			*!

In tableaux (22) and (23), the prevocalic glides are preserved in IO mapping and in IR mapping, which seems to reveal the status of prevocalic glide in this dialect. On the one hand, the undominated Max-IR protects the prevocalic glide in the reduplicant so that the prevocalic glide does not undergo deletion. On the other hand, Max-IO preserves the realization of the glides in the base. Given this fact, we can assume that the sub-syllabic classification of the prevocalic glide in the Pingyao dialect is double-linked. Firstly, the glide segment is exempt from being deleted as the rime part of the base. That is, it is closer to the onset rather than the rime. Secondly, FR replaces the onset segment with a fixed segment /-l/ in the reduplicant, but the prevocalic glide is excluded from the replacement. Therefore, in the reduplicant, it is closer to the rime. This fact is similar to the previous assumption in Sun (2006a), in which he regards the medial glide as a 'symbiont' in the Pingyao dialact, as in (24).

(24) The syllable structure for the Pingyao dialect



To sum up, Pingyao FR favors the unmarked segments to be realized as the nucleus and coda in the base to satisfy this language-specific preference. Every syllable in the FR must fulfill the requirement of a legitimate syllable in Pingyao due to the top-ranked TSP. The ranking Max-IR >> Reduce>> Ident-IO [V] shows that vowel reduction imposes that any full vowel results in a less marked vowel /ʌ/. Moreover, the ranking TSP, Max-IR >> $*C_{pl}C$ >> Ident-IO [C] results in a [C(G)ʌʔ] sequence that satisfies $*C_{pl}C$ and TSP to form a legitimate syllable with glottal stop epenthesis. We can summarize two different TETU patterns in Pingyao FR:

(25) The ranking Schema for base-oriented TETU in Pingyao FR
a. Max-IR>> Reduce>> Ident-IO [V] (Vowel reduction in the base)
b. Max-IR>> $*C_{pl}C$>> Ident-IO [C] (Coda placelessness in the base)

5. Conclusion

In this study, we have analyzed the fission reduplication processes in Shunping and Pingyao dialects. Both dialects show a strong tendency of Max-IR>> Max-IO. The second similarity is that both dialects are subject to the well-formedness constraint TSP, though the ranking relations are different.

As for TETU patterns, Shunping FR shows the TETU rankings prefer a heavy CV syllable in the base, but CVC and CGV are not preferable. The extended reduction in the reduplicant is suppressed, forcing the TETU effect to apply in the base. The ranking Schema for the base-oriented TETU of Shunping is shown in (18). On the other hand, in Pingyao, Reduce forces the vowel segments to become a /ʌ/, but NoCoda plays no role in this dialect. Instead of NoCoda and *CG, this ranking Max-IR, TSP >> Reduce results in a /C(G)ʌʔ/ sequence in the base. The TETU pattern is given in (25).

From this analysis, we consider several implications. Firstly, FR in Shunping and Pingyao provides a tenable claim that the sub-syllabic classification of the prevocalic glide should be considered separately. The G in a CGV(X) is a part of syllable rime in the Shunping dialect, as seen in (15), whereas it acts simultaneously with the onset and rime in the Pingyao dialect. Thus, the status of on-glide and off-glides are asymmetrical in the Shunping dialect. But the classification is difficult to be distinguished in the Pingyao dialect. Secondly, C-initial and CG-initial act differently in Shunping FR. When the input form initiates with a sole consonant, the nucleus of the base will undergo progressive place assimilation, depending on the place feature of the onset. When the input form begins with a CG-initial, the prevocalic glide is vocalized and faithfully preserves its tongue position and round features to avoid the violation of *CG. Thirdly, the base-oriented TETU is manifested in Shunping and Pingyao FR process, and it should be supplemented as a ranking schema.

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