SCHWA INSERTION IN DIMINUTIVES OF BEIJING CHINESE: AN AP ANALYSIS*

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1. Introduction

In Beijing Chinese (henceforth, BC), the basic pattern of constructing diminutives is to add the diminutive suffix /ɹ/[1] to the end of the stems, as illustrated in (1).

(1)

	Stem		*Diminutive suffix*	*Diminutive form*	*Gloss*
a.	/kɤ/	+	/ɹ/	[kɤɹ]	'song'
b.	/hu/	+	/ɹ/	[huɹ]	'lake'
c.	/wo/	+	/ɹ/	[woɹ]	'nest'

However, in two patterns, namely the /ɨ-ɹ/ pattern and /i-ɹ/ pattern, schwa insertion occurs, and the stem nucleus is also affected.

ⅰ. The /ɨ-ɹ/ pattern

When the stem ends with the high central vowel /ɨ/, in creating diminutives, /ɨ/ disappears, and a schwa is inserted, as illustrated in (2).

(2)

	Stem		*Diminutive suffix*	*Diminutive form*	*Gloss*
a.	/sɨ/	+	/ɹ/	[səɹ]	'silk'
b.	/tsɨ/	+	/ɹ/	[tsəɹ]	'character'
c.	/ts^{h}ɨ/	+	/ɹ/	[ts^{h}əɹ]	'lyrics'
d.	/ʂɨ/	+	/ɹ/	[ʂər]	'thing'
e.	/ʈʂɨ/	+	/ɹ/	[ʈʂər]	'twig'
f.	/ʈʂhɨ/	+	/ɹ/	[ʈʂ^{h}ər]	'tooth'

* I wish to thank Sonya Bird for her great help. All errors are my own.

[1] There is no agreement in the literature on the UR of the diminutive suffix in BC. Some researchers (e.g. Duanmu, 1990) argue that the UR is /ɹ/; some others researchers (e.g. Ma, 1997) argue that it is /əɹ/. In the present study, I analyze the UR of BC diminutive suffix as /ɹ/.

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ⅱ. The /i-ɹ/ pattern

When the stem ends with the high front vowel /i/, in creating diminutives, /i/ becomes [j] and attaches to its preceding consonant as secondary articulation, and a schwa is inserted, as illustrated in (3).

(3)		*Stem*		*Diminutive suffix*	*Diminutive form*	*Gloss*
	a.	/pi/	+	/ɹ/	[pʲəɹ]	'skin'
	b.	/ʨi/	+	/ɹ/	[ʨʲəɹ]	'chicken'
	c.	/di/	+	/ɹ/	[dʲəɹ]	'place'

So far there is no satisfactory explanation of the asymmetry between the /ɨ-ɹ/ and /i-ɹ/ patterns: why is it that in the /ɨ-ɹ/ pattern, /ɨ/ disappears, while in the /i-ɹ/ pattern, /i/ remains as a glide? In previous analyses (e.g. Ma, 1997; Tian, 2009), these two patterns are analyzed as unrelated, and are accounted for by separate constraints. In this study I explore an articulatory phonological (AP) analysis; I argue and demonstrate that the differences between the /ɨ-ɹ/ and /i-ɹ/ patterns can be further reduced and explained in a unified way.

This paper is organized as follows: section 2 introduces relevant basic facts of BC, and section 3 introduces two previous analyses, Ma (1997) and Tian (2009). Section 4 is the theoretical framework of the present study. In section 5 I present an AP analysis. I argue that schwa insertion in these two patterns is due to the intrinsic conflict between high [-back] vowels and /ɹ/. I then posit that to accommodate the inserted schwa, the coordination pattern of the stem is rearranged. The result is /ɨ/ disappears in the /ɨ-ɹ/ pattern and /i/ surfaces as [j] in the /i-ɹ/ pattern. Finally section 6 concludes.

2. Basics of BC

2.1 Consonants and Vowels Relevant to This Study

Two groups of consonants among the BC consonant inventory, the dentals /s/, /ts/, /tsʰ/ as one group, and the post-alveolars /ʂ/, /ʈʂ/, /ʈʂʰ/ as the other group, are of particular relevance to the present study in that one property of the segment /ɨ/ in BC is that only these two groups of consonants can precede /ɨ/ in the /ɨ-ɹ/ pattern. In terms of articulation, the alveolar fricative /s/ and its corresponding affricates /ts/ and /tsʰ/ share the same place, and are produced with the tip of the tongue against the alveolar ridge behind the upper front teeth. The retroflex /ʂ/ shares the same place as the two affricates /ʈʂ/ and /ʈʂʰ/, and they are produced with the tongue tip behind the alveolar ridge. In articulation, the tongue tip gesture is the same for the group of /s/, /ts/, /tsʰ/ and the group of /ʂ/, /ʈʂ/, /ʈʂʰ/. The major difference between /s/, /ts/, /tsʰ/ versus /ʂ/, /ʈʂ/, /ʈʂʰ/ is that the tongue tip is behind the front teeth in the former but behind the alveolar ridge in the latter.

The post-alveolar glide /ɹ/ in BC shares the same place of articulation with /ʂ/, /ʈʂ/, and /ʈʂ^h/. When it appears at the syllable-initial position, /ɹ/ is also an apical consonant produced with the tongue tip behind the alveolar ridge. It should be noted, however, that /ɹ/ also has tongue root retraction feature. In particular, when /ɹ/ is suffixed to the end of a rhyme, it is the feature of retracted tongue that is more dominant (Lin 2007). I argue in section 5 that it is this tongue body retraction feature of /ɹ/ that conflicts with high [-back] vowels.

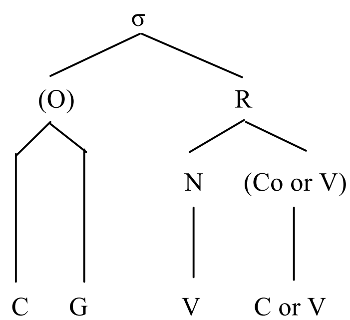
BC has two unusual high vowels, the alveolar apical vowel /ɿ/ and the retroflex apical /ʅ/ (Pulleyblank, 1984). These two apical vowels have two marked properties which are of particular importance for the present study. First, the distribution of /ɿ/ or /ʅ/ is very limited; /ɿ/ appears only after the alveolar fricative /s/ and the alveolar affricates /ts/, /ts^h/; /ʅ/ appears only after the retroflex fricative /ʂ/ and retroflex affricates /ʈʂ/, /ʈʂ^h/. Second, the apical vowels have the same place of articulation as their preceding consonants, that is, /ɿ/ has the same place of articulation as /s/, /ts/, and /ts^h/, and /ʅ/ has the same place of articulation as /ʂ/, /ʈʂ/, and /ʈʂ^h/ (Lin, 2007; Zee and Lee, 2007). That is to say, they are articulated with the tongue tip rather than the tongue body, like other vowels. Due to these two properties, some researchers (e.g. Chao, 1968; Lin, 2007) analyze /ɿ/ and /ʅ/ as simply the voiced extension of the preceding consonants into the syllabic nucleus position. In the present study, I adopt this analysis.

Cheng (1973) uses /ɨ/ to refer to the two apical vowel (/ɿ/ and /ʅ/) that occur only after the apical consonants, and this convention is commonly followed in studies on BC diminutives, including Ma (1997) and Tian (2009). In order to be consistent with these previous studies, I use the label /ɨ/ to refer to /ɿ/ and /ʅ/ in this study too. However, it is important to keep in mind that /ɨ/ in this study is just the cover term for the two apical vowels in BC, and it does not represent the high central vowel, as in other phonetic/phonological contexts.

2.2 Syllable Template

The canonical syllable structure of BC is (C)(G)V(X), as illustrated in (4), where C is a consonant, G a glide, V a vowel, and X either a consonant or the second segment of a diphthong (Lin 2007). Since the positions of C, G, and X are optional, the simplest syllable in BC can be just one vowel. A maximal BC syllable can contain as many as four positions: a consonant onset, a glide as the secondary articulation of the onset, a vowel as syllabic nucleus, and a coda, or an ending vowel which forms a diphthong with the vowel in the nucleus position.

(4). BC syllable template (Lin, 2007, p. 108)



σ: syllable O: onset R: rhyme N: nucleus
Co: coda C: consonant G: glide V: vowel

One phonotactic constraint directly from BC syllable template is that the maximal number of segments in the rhyme is limited to two: it can be one, a monophthong; or it can be two, a diphthong or a monophthong plus a consonant. This phonotactic constraint plays a key rule in the analysis of section 5.

3. Two Previous Analyses of BC Diminutives: Ma (1997); Tian (2009)

I here introduce Ma (1997) and Tian (2009), two OT analyses based on rule-based phonologies, which typify previous studies on BC diminutives.

Ma (1997) assumes that the UR of the BC diminutive suffix is /əɹ/ and she suggests the following constraints to account for the asymmetry between the /ɨ-ɹ/ and /i-ɹ/ patterns:

i . MINIMAL WORD CONSTRAINT (MIN-WD): One syllable allows only one nucleus slot.
ii . NUCLEUS/V CONSTRAINT (NUCL/V): If two vowels compete for one nuclear slot, the more sonorant wins.
iii. MAX-IO: Every input segment has a correspondent in the output.
iv . CORR (I, O /*high*, *front* V/) (CORR): Every input high front vowel has an output correspondent.

Ma orders these constraints as follows:

MIN-WD>> CORR (I, O /*high*, *front* V/)>> UNCL/V>> MAX-IO

Ma claims that in the /ɨ-ɹ/ pattern, when the diminutive suffix /əɹ/ adjoins to the ending vowel /ɨ/ of the stem to form the sequence /ɨəɹ/, /ɨ/ will compete with /ə/ for the nucleus slot due to the MIN-WD constraint. Since /ə/ is more sonorant, NUCL/V chooses /ə/ as the nucleus, and /ɨ/ is therefore forced out of the nucleus slot and deleted. The tableau in (5) below illustrates this effect.

(5). Tableau for the /ɨ-ɹ/ pattern with the input of /tsʰɨ-əɹ/ 'lyrics'

Input: /tsʰɨ-əɹ/	MIN-WD	CORR	NUCL/V	MAX–IO
a. [tsʰɨəɹ]	*!		*	
b. [tsʰɨɹ]			*!	*
c. ☞ [tsʰəɹ]				*

In the /i-ɹ/ pattern, Ma claims that when /əɹ/ is added to /i/, /i/ will also compete for the nucleus slot with /ə/, and again because of the NUCL/V, /ə/ will win out and /i/ will be forced out of the nucleus. However, the CORR constraint, which requires that every input high front vowel has an output correspondent, prevents /i/ from being deleted. Ma claims that the contradiction is reconciled by changing /i/ into the glide [j] (6).

(6). Tableau for the /i-ɹ/ pattern with the input of /pʰi-əɹ/ 'skin'

Input: /pʰi–əɹ/	MIN-WD	CORR	NUCL/V	MAX–IO
a. [pʰiɹ]			*!	*
b. [pʰəɹ]		*!		*
c. [pʰiəɹ]	*!			
d. ☞ [pʰjəɹ]				

A major challenge that Ma's analysis faces is to explain why only the high front vowel, but not other vowels, needs to have an output correspondent. Therefore, Ma's CORR constraint seems ad hoc.

In her OT analysis of BC diminutives, Tian (2009) avoids assuming the UR of the diminutive suffix, and she suggests the following constraints:
*V /+high,-back/ /ɹ/: No [+high, -back] vowel before /ɹ/.
MAX-BA: Every element of base must have a correspondent in the affixed form.
*STRUC-σ: Do not have syllables.

Tian also assumes the incompatibility of the high [-back] vowel and /ɹ/ (hence, the *V /+high,-back/ /ɹ/ constraint in her analysis). Tian claims that in order to avoid the sequence of "/high, -back vowel/ + /ɹ/", a schwa inserted between them is needed; also due to the constraint *STRUC-σ, /ɨ/ or /i/ needs to be deleted at the same time. Therefore, in the /ɨ-ɹ/ pattern, the optimal output, taking /ʂɨ/ "thing" as an example, is /ʂəɹ/. In accounting for why in the /i-ɹ/ pattern /i/ surfaces as [j], Tian resorts to the MAX-BA constraint and claims that /i/ needs to have [j] as its SR correspondent. Therefore, in the /i-ɹ/ pattern, the optimal output, taking /ʨi/ 'chicken' as an example, is /ʨʲəɹ/.

Tian's (2009) analysis also faces challenges. First, Tian does not formally account for why it is [j] that serves as the correspondence of /i/ in the SR. Second, similar to Ma (1997), Tian (2009) does not explain why the MAX-BA constraint only applies to the /i-ɹ/ pattern but not the /ɨ-ɹ/ pattern.

4. Theoretical Framework

The analysis provided in this paper is based on AP, which is described in 4.1. Gafos' (2002) work which proposes the internal structure of gestures and formalizes gestural timing and coordination as grammatical constraints is also an assumption of this analysis, and will be introduced in 4.2.

4.1 Articulatory Phonology (AP)

In recent decades, one research area in the field of phonetics and phonology is to account for certain phenomena and data, which have been regarded as belonging to the phonological domain, from an articulatory perspective. One theory that does this is Articulatory Phonology (AP; Browman & Goldstein 1986, 1989). AP suggests that the basic units of speech are articulatory gestures which have both a space dimension and a time dimension. Beside the space dimension, phonological processes also involve changes in the timing of articulatory gestures. By the conception of gesture, AP is a significant departure from phonological theories based on the notion of features or segments.

With in the AP framework, recent studies have shown that some processes traditionally thought of as within the realm of phonology are very much like processes that are phonetic or articulatory. For example, the pretonic schwa elision in English (e.g. potential → [pt]entail, tomorrow→ [tm]orrow) has long been analyzed as a phonological deletion. Davidson (2006), however, shows that the pretonic schwa is actually not deleted, but become acoustically imperceptible. Davidson argues that in fast speech the coordination pattern of the stem is rearranged, and the overlap between the pretonic schwa and its preceding consonant is increased, and this increased overlap causes the "disappearance" of the pretonic schwa. Davidson finds that these "disappeared" pretonic schwas actually have some acoustic "residues" in their SR. Davidson claims that this pretonic schwa elision is more consistent with a gestural overlap account, rather than phonological segmental deletion.

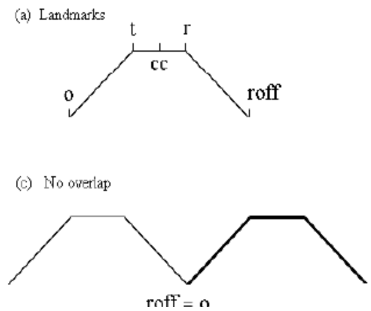
4.2 Gafos (2002)

The proposed analysis in this study also draws on Gafos's (2002) work. Gafos argues that phonological grammars are partly constructed out of the temporal coordination of gestures, "articulatory coordination relations project corresponding constraints into the phonological grammar" (p. 279).

In order to describe and define various types of gestural coordination patterns, Gafos (2002) proposes to break articulatory gestures into smaller units as *onset*, *target*, *c-center*, and *release*, which he terms "landmarks", as illustrated in (7a) below. According to Gafos, a coordination relation can be formulated by specifying that a certain landmark within the temporal structure of one gesture is synchronous with a certain landmark within the temporal structure of another gesture. Gafos suggests different overlapping situations between two adjacent gestures, as illustrated in (7b-d).

(7). Overlapping situations between adjacent gestures

(Gafos, 2002, p. 22)



(o: onset; t: target; r: release; roff: release offset; cc: c-center)

Gafos assumes that the default coordination relation that holds between an onset consonant and a tautosyllabic vowel is that the c-center of the C gesture is synchronous with the onset of the V gesture. I adopt this assumption in the present study, and I will suggest in section 5.2 that this is the coordination pattern between /i/ and its preceding consonant in the /i-ɹ/ pattern.

5. Articulatory Analysis of the /ɨ-ɹ/ and /i-ɹ/ Patterns

In this section, I first argue that it is an articulatory motivation, that is, the physical conflict between /ɨ～i/ and the retroflex /ɹ/, that causes the schwa insertion in the /ɨ-ɹ/ and /i-ɹ/ patterns (5.1). Based on this, I propose a gestural representation for these two patterns. I argue that in order to accommodate the inserted schwa, the coordination pattern of the stem is rearranged, the result of which is that /ɨ/ disappears in the /ɨ-ɹ/ pattern and /i/ surfaces as [j] in the /i-ɹ/ pattern, and these outputs are the consequences of the interplay between gestural coordination constraints and faithfulness constraints (5.2).

5.1 Schwa Insertion in the /i-ɹ/ and /ɨ-ɹ/ Patterns

5.1.1 The /i-ɹ/ Pattern

In many dialects of English, the sequences of high tense vowel plus a liquid elicit the percept of an intervening schwa, e.g. 'fire' /faiɹ/→ [faiəɹ]. Gick and Wilson (2006) argue that the schwa perceived in these sequences is due to the intrinsic articulatory conflict between the high tense vowel and the liquid, as the articulation of the former requires an advanced tongue root, while articulation of the latter requires a retracted tongue root. The ultrasound experiment conducted in Gick and Wilson (2006) indicates that in the transition from the preceding high tense vowel to the following liquid, the tongue body moves through an articulatory space almost identical to that of canonical schwa. An acoustic experiment also indicates that at approximately the midpoint of this transition, both F1 and F2 cross from above to below the formant values for canonical schwa.

In BC, the diminutive sequence of the stem ending with a high vowel plus the diminutive suffix /ɹ/ also forms the sequence of a high tense vowel plus a liquid. Gick and Wilson (2006) studied the sequence of /ʨi/ + /ɹ/ in BC, and their ultrasound experiment indicated that all speakers exhibited tongue root advancement for /i/, and tongue root retraction for /ɹ/; in the transition from [i] to [ɹ], the tongue body passed through an apparent schwa-like configuration, leading to [ʨiəɹ]. Gick and Wilson concluded that the schwa inserted in /ʨi/ + /ɹ/ in BC is due to the physical conflict between the high front vowel /i/ and the liquid /ɹ/, like the case in various English dialects.

5.1.2 The /ɨ-ɹ/ Pattern

While Gick and Wilson (2006) did not study the /ɨ-ɹ/ sequence, some other studies, however, have reported the articulatory conflict and *incompatibility* between /ɨ/ and /ɹ/ in BC. Chao (1968) claims that the motivation for replacing /ɨ/ with a schwa is the incompatible articulation of /ɨ/ and the retroflex /ɹ/. Lin (2007) states that /ɹ/ and the high vowels/syllabic consonants (/ʅ/ and /ʮ/) are incompatible "because of contradictory articulatory gestures: retroflexion involves the retraction of the tongue body and yet a high front vowel and a syllabic coronal consonant involve the raising and/or advancing of the front of the tongue" (p. 185). Lin claims that to resolve this incompatibility, a schwa is inserted. Ma (2002) states that while the high [+back] vowels are compatible with retroflexion, the high [-back] vowels are not. Specifically, in explaining the deletion of /ɨ/ in the /ɨ/ case, Ma states that "the lexically present apical high vowel /ɨ/ is deleted due to the incompatibility for articulation with a retroflex feature." (p. 10).

Tian's (2009) analysis also assumes the incompatibility caused by the intrinsic conflict between /ɨ/ (or /i/) and /ɹ/, and she formalizes this into an OT constraint "*V /+high,-back/ /ɹ/", which stipulates no [+high, -back] vowel before [r]. Like Gick and Wilson (2006), Tian assumes that schwa insertion between the /+high,-back/ vowel and /ɹ/ is due to the conflict between them; however, according to Tian, it is the height and frontness of a vowel, rather than advanced tongue root, as suggested by Gick and Wilson, that influences the transition between a vowel and a postvocalic /ɹ/.

Given these analyses mentioned above, I propose in this study that it is concrete articulatory conflict, rather a more abstract phonological motivation, that caused schwa insertion in both /ɨ-ɹ/ and /i-ɹ/ sequences. This proposition will be the basis of my following analysis.

5.2 Gestural Presentation of the /ɨ-ɹ/ and /i-ɹ/ Patterns

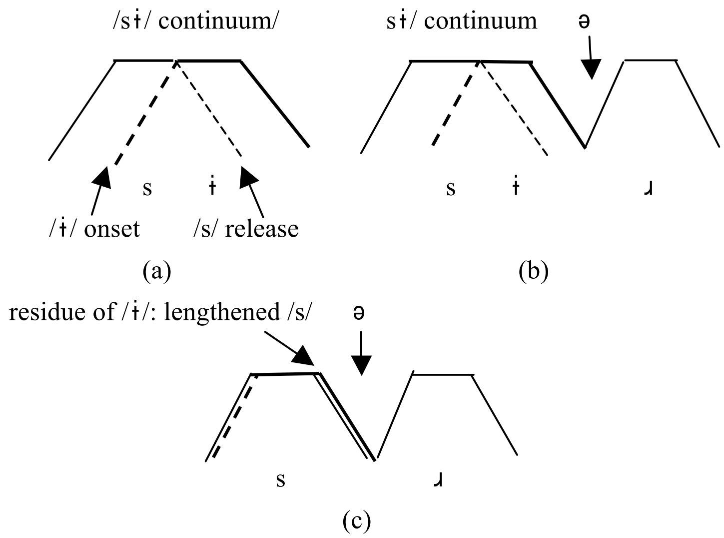
Having argued that the schwa insertion in the /ɨ-ɹ/ and /i-ɹ/ patterns is due to articulatory conflict, I now propose the gestural presentation of these two patterns, and address the asymmetry between them.

5.2.1 Gestural Coordination of the /ɨ-ɹ/ Pattern

I propose the gestural coordination model of the /ɨ-ɹ/ pattern by taking /sɨ-ɹ/ “silk” as an example. Let’s first consider the gestural coordination pattern between /s/ and /ɨ/. According to Gafos (2002), as introduced in 4.2, the default C(onsonant)-V(owel) coordination relation that holds between an onset consonant and a tautosyllabic vowel is that the c-center of the consonantal gesture is synchronous with the onset of the vowel gesture. However, due to the special property of the two segments /s/ and /ɨ/ in BC, that is, /s/ and /ɨ/ have the same place feature, and /ɨ/ is generally analyzed as the voiced extension of the preceding consonants into the syllabic nucleus position, the default CV coordination pattern seems not to apply to /sɨ/ in BC. In articulating /sɨ/, the tongue tip stays in the same location throughout the whole syllable (Lin, 2007). The only thing that changes in the phase of articulating /ɨ/ is that a [+voice] feature is added. In terms of the landmarks in the sense of Gafos (2002), this means the gesture /s/ lacks the *release* phase and the gesture /ɨ/ lacks the *onset* phase, and the *target* phase of /s/ and /ɨ/ form a continuum. I hence suggest that the gestural coordination pattern for [sɨ] is as illustrated in (8a).

Now let’s consider the gestural coordination pattern for merging of /ɹ/ with the stem /sɨ/. Recall that in 5.1 I argue that /ɨ/ is incompatible with /ɹ/ and this incompatibility causes the schwa insertion between them, I assume that in articulating the /ɨ/- /ɹ/ sequence, there is little or no overlap between them, and a schwa occurs in the transition from /ɨ/ to /ɹ/. I therefore suggest the gestural coordination pattern in (8b) as the input form of the stem /sɨ/ plus the suffixed diminutive suffix /ɹ/.

(8). Gestural coordination of the /ɨ-ɹ/ pattern



Now, the construction of the SR of the stem /sɨ/ merged with the diminutive suffix /ɹ/ is subject to the following considerations.

(i). /ɹ/ needs to be realized, as it is the primary phonological and acoustic character of diminutives.

(ii). The rhyme of a prosodic word in BC has two slots at most, and /ɹ/ has occupied one. This means /ɨ/ and /ə/ cannot be both retained in SR.

(iii). The inserted schwa is unavoidable, as it is caused by the intrinsic conflict between /ɨ/ and /ɹ/.

(iv). As a general rule, the construction of the SR needs to remain faithful to the UR to the largest possible degree.

Given these considerations, I suggest that the optimal solution is for the phonology to increase the overlap between /s/ and /ɨ/ to such a degree that /ɨ/ will not occupy a rhyme slot. The advantage of this strategy is that it can satisfy the first three considerations at once. The cost of this strategy is that with /ɨ/ being "overlapped away", faithfulness to the input is compromised. However, given /s/ and /ɨ/ crucially have the same place feature, /s/ can indicate the place feature of /ɨ/. That is, /ɨ/ will still be able to maintain a correspondent--- its place feature--- in the surface representation, thereby ensuring at least some degree of faithfulness to the UR.

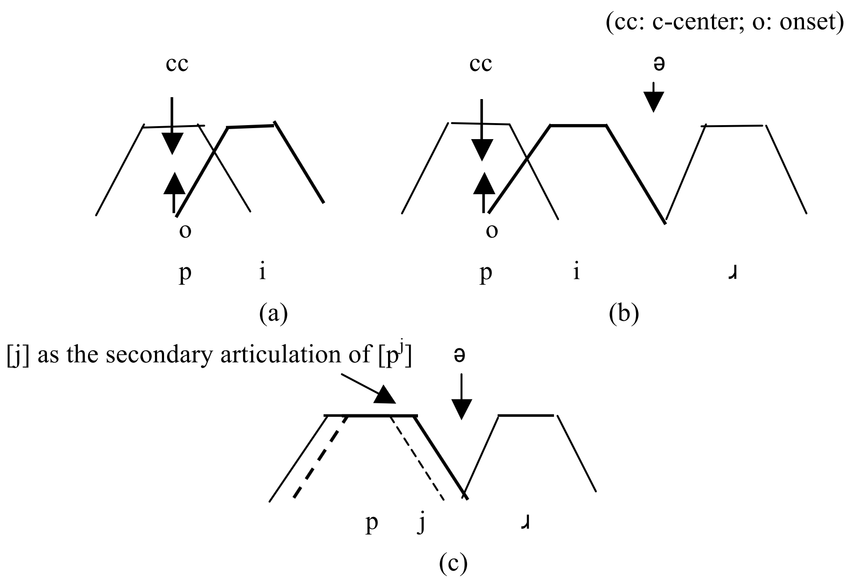
Analyses of BC diminutives conducted within the framework of rule-based phonology (e.g. Duanmu, 1990; Ma, 1997; Ma, 2002) generally claim that in the /ɨ-ɹ/ pattern /ɨ/ is replaced by a schwa. Based on the above analysis, however, I propose that this is not simply a process of replacing /ɨ/ with schwa.

In fact, two related but separate processes happen here, first the schwa insertion, and then the increase of the overlap between /ɨ/ and its preceding consonant, caused by the schwa insertion, and to the effect that /ɨ/ becomes acoustically imperceptible. Following Davidson (2006) introduced in 4.1, I further hypothesize that in the /ɨ-ɹ/ pattern, the consonant preceding /ɨ/ is lengthened, with the lengthened part as the acoustic manifestation of /ɨ/ in the SR. I propose the gestural coordination pattern in (8c) above to illustrate this process.

5.2.2 Gestural Coordination of the /i-ɹ / Pattern

I now suggest the gestural coordination of the /i-ɹ/ pattern, and I take /pi-ɹ/ ‘peel’ as an example. First, following the default CV coordination pattern suggested in Gafos (2002), I assume that the gestural coordination pattern between /p/ and /i/ is as (9a) below. Second, considering the incompatibility between /i/ and /ɹ/ causes a schwa inserted between them, as discussed in section 5.1, I suggest that the gestural coordination patter of /pi/ plus /ɹ/ is as in (9b).

(9). Gestural coordination of the /i-ɹ/ pattern



The construction of the SR of the stem /pi/ suffixed with /ɹ/ is subject to the same considerations as is the /ɨ-ɹ/ pattern. Again, I hypothesize that under these considerations, the optimal strategy is to increase the overlap between /p/ and /i/ to such a degree that /i/ will not occupy a rhyme slot. To be more specific, I hypothesize that BC phonology rearranges the gestural coordination in producing the sequence "/pi/ + /ə/ + /ɹ/" in this way: the articulatory organs first complete the production of /p/, then the tongue body moves to the place for the production of /i/. However, the tongue holds at the configuration for the production of /i/ only for a very brief period, and before it can produce a complete vowel sound, it moves to the configuration for the production of /ə/ and /ɹ/. The result of this partly realized /i/ is the glide [j], which has the same place feature with /i/, but is more transitional in nature. Like in the /sɨ-ɹ/ pattern, to overlap /i/ into a glide [j] violates faithfulness, since a vowel turns into a consonant; however, since [j] has the same place features as /i/, I argue that [j] is the correspondent of /i/ in the SR, whose function is to indicate the place feature of /i/ which has been overlapped away, and in this way, faithfulness to the UR is maintained. I propose (9c) above to illustrate this process.

Now I address the key issue, the asymmetry between the /ɨ-ɹ/ and /i-ɹ/ patterns. I propose that in the /ɨ-ɹ/ pattern, the reason that /ɨ/ can be overlapped away completely is because the consonant preceding /ɨ/ always has the same place feature with /ɨ/ and can therefore indicate the place feature of /ɨ/ in the SR. In contrast, in the /i-ɹ/ pattern, as BC phonology allows the preceding consonant to have a different place feature from /i/, this means that if /i/ were overlapped away completely, there would not necessarily be any way to indicate the place feature of /i/ in the SR. The glide [j] satisfies faithfulness in the /i-ɹ/ pattern without creating a syllabification problem.

6. Conclusion

Different from previous analyses conducted within the framework of rule-based phonology, this study explored an AP analysis of the /ɨ-ɹ/ and /i-ɹ/ BC diminutive patterns. I have argued that the asymmetry between these two patterns can be further reduced and explained in a unified way. I demonstrate that the SR of the /ɨ-ɹ/ and /i-ɹ/ patterns are the consequences of the interaction between certain gestural coordination constraints and faithfulness constraints.

References

Browman, Catherine., Louis, Goldstein. 1986. Towards an articulatory phonology. Phonology Yearbook, 3, 219-252.

Browman, Catherine., Louis, Goldstein. 1989. Articulatory gestures as phonological units. Phonology, 6, 201-251.

Chao, Yuanren. 1968. *A Grammar of Spoken Chinese*. Berkeley: University of California Press.

Chen, Chin-chuan. 1973. *A Synchronic Phonology of Mandarin Chinese*. The Hague: Mouton.

Davidson, Lisa. 2006. Schwa Elision in Fast Speech: Segmental Deletion or Gestural Overlap? *Phonetica* 63. 79-112.

Duanmu, San. 1990. A Formal Study of Syllable, Tone, Stress, and Domain in Chinese Languages. Ph.D. Dissertation. MIT.

Gafos, Adamantios. 2002. A grammar of gestural coordination. *NLLT* 20: 269-337.

Gick, Brain., Ian, Wilson. 2006. Excrescent schwa and vowel laxing: Cross-linguistic responses to conflicting articulatory targets. In L. Goldstein, D.H. Whalen, & C.T. Best, (Eds.) *Laboratory Phonology* 8, 635–659.

Lin, Yen-Hwei. 2007. *The sounds of Chinese*. New York: Cambridge University Press.

Ma, Lili. 1997. Mandarin diminutive formation: An optimality analysis. *WPLC at the University of Victoria*. 14, 47-59.

Ma, Qiuwu. 2002. Mandarin retroflex suffixation: an OT account. Beijing Normal University. Rutgers Optimality Archive-454, 1-36.

Pulleyblank, Edwin. 1984. *Middle Chinese: A Study in Historical Phonology*, Vancouver, Canada: UBC Press.

Tian, Jun. 2009. An Optimality Theory Analysis of Diminutive Suffixation of Beijing Chinese. *Working Papers in Linguistics* Vol. 19*,* University of Victoria. 217-231.

Zee, Eric., Wai-Sum, Lee. 2007. Vowel typology in Chinese. *Proc. 16th ICPhS* Saarbrücken, 1429-1432.