MANDARIN DIMINUTIVE FORMATION: AN OPTIMALITY ANALYSIS

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Introduction

This paper presents an analysis of Mandarin diminutive formation in terms of Optimality Theory (OT) (Prince and Smolensky 1993, McCarthy and Prince 1993a&b, 1994 a&b). The diminutive suffix /- ər/ surfaces in many Mandarin dialects. It brings about prosodic and segmental alternations through interaction with the stem. The suffixation process eventually merges two syllables, resulting in the phonological phenomena of syncope, coda deletion, gliding, spreading and stability. A number of linguists have addressed this issue in different ways, for example Chao (1968) uses a structuralist approach; Cheng (1973), Yin (1989), Lin (1989) and Duanmu (1990), among others follow a generative framework. However, all these studies fall into a derivational account. Unlike previous studies, this paper will offer a constraint-based, nonderivational study of the issue along the lines of Prince & Smolensky (1993) and McCarthy & Prince (1993a,b; 1994a,b).

I argue that the constraint-based Optimality Theory plays a role in the interface between prosodic categories and morphological categories in Mandarin. I adopt the view of Prince and Smolensky (1993), and assume constraints are ranked and violable. Given an input form, the optimal output form is the one which satisfies all constraints, or at least the more highly ranked constraints. The grammatical wellformedness of any phonological output is thus achieved by satisfying certain constraints rather than following phonological rules.

The paper is organized as follows: Section 1 consists of a description of Mandarin diminutive formation; Section 2 lays out some problems in the previous studies; Section 3 provides an overview of the theoretical framework; Section 4 deals with the analysis and Section 5 is the conclusion.

1. Diminutive Formation in Mandarin

In order to provide basic background information essential to the examination of Mandarin diminutive formation, I will first give a brief account of the Mandarin consonant and vowel inventory and the prosodic structure.

1.1. Mandarin Consonants and Vowels

(1)Mandarin Consonants:

p	t	ts	$\underline{\text{ts}}$	tɕ	k	(_ = retroflex)
p`	t`	ts`	$\underline{\text{ts}}$’	$\underline{\text{tɕ}}$’	k`	
f		s	$\underline{\text{s}}$	ɕ		
m		n			ŋ	
	l	$\underline{\text{r}}$				
y		w	ÿ		χ	

(2)Mandarin Vowels:

	Front		Central	Back
High	i	ü	ɨ	u
Mid	e		ə	
Low			a	

1.2. Mandarin Syllable Structure

The Mandarin syllable has a canonical structure: (C) (G) V {(G), (N) }, which allows the following representations:

(3) Mandarin Syllable Shapes:

ó shape	V	VG(lide)	VN(asal/[r])	GV	CV	GVN	GVG
example	ə	*ay*	*an*	*ya*	*xə*	*wan*	*way*
gloss	goose	love	bank	duck	drink	finish	out

ó shape	CVG	CVN	CGV	CGVN	CGVG
example	*t'ay*	*p'an*	*kwa*	*t'yan*	*xwey*
gloss	very	plate	melon	heaven	meeting

Duanmu (1990) proposes that all Chinese languages have a uniform syllable structure of three timing slots: one in the onset and two in the rime, schematized as follows:

(4) The Uniform Syllable Structure of Chinese (Duanmu, 1990)

```
      Syllable
      /     \
  Onset     Rime
    |       /  \
    X      X    X
```

I assume that Mandarin, a dialect of Chinese, has the same syllable structure. Thus, the canonical representation can be reduced to CV(C). There are three assumptions associated with this proposal. First, onset is obligatory in the CV (C) structure. According to Chao (1948:2, 1968: 20), Mandarin syllables that are not written with an onset, such as 'e' (goose) in (3), are actually always filled by a consonant, depending on what the nucleus is. However, this practice is phonetic in nature. When the nucleus is a high vowel, i.e. [i, u, ü], the seemingly empty onset is filled by one of the glides [y, w, ÿ] homorganic with the following vowel. When the nuclear vowel is [-high], the onset has four variants: glottal stop [ʔ], [ŋ], velar or uvular unaspirated fricative [ɣ], and glottal unaspirated continuant [H].

Second, in the canonical structure and in (4) as well, Mandarin allows a pre-nucleus glide [y, w, ÿ] in the syllable structure: CGV(C) (see (3)). According to Duanmu (1990), this G is assigned to the onset as a secondary articulation of the C, e.g. C^G. Thus, C^G realized as either a palatalized consonant or a labialized consonant, is a single segment occupying only one template slot. Since the distribution of glides is predictable, this solution does not increase the underlying inventory of Mandarin consonants. For example, /ty/ in 'tyan' (heaven) is actually /t^y/, with /y/ linked to the onset. The reason is that there is only one nuclear slot. If two elements compete for this nuclear position, priority is often given to a more sonorant vowel. In this case, it is the more sonorant /a/ that takes the nuclear position, and /y/ is forced into the onset, becoming the secondary articulation. Then, C^G best satisfies the well-formedness of the prosodic structure. Post-nuclear glides occupy the coda in VG, GVG, CVG and CGVG syllables as expected.

Third, the rime has two fixed slots as in (4). This means that: (I) diphthongs do not occur in closed syllables; (ii) when there is no coda in the syllable, [CV] is actually [CV:], with the nuclear vowel occupying two template slots; (iii) there is no complex coda in Chinese.

1. 3. Mandarin Minimal Word

The notion of minimal word is important in this task. In the previous section, we have examined Mandarin syllable, which has a constant template structure. This proposal is further expanded to link to other prosodic units. According to Duanmu (1990, 1993), each slot in the rime is equivalent to one mora position, one for the nucleus and the other for the coda. Furthermore, a minimal word in Mandarin is comprised of a bi-moraic syllable.

(5) Mandarin Minimal Word

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        ó
      Wd_min
      /  \
     µ    µ       (Duanmu 1990)
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1. 4. Mandarin Data

I assume that the lexical representation of the diminutive can be either /-ər/ or /-r/. While both representations are feasible in this proposal, /-ər/ is preferred in view of the general claim of OT: prosodic constraints dominate morphological constraints. When /-ər/ is used as a suffix, the [ə] in the nucleus is often dropped as in (6a-f). The deletion of [ə] is mainly constrained by the prosodic well-formedness of the output of the language. Use of the suffix /-r/ requires an account of [ə] insertion for cases such as (6g & h). The prosodic constraints do not play a significant role in this account. Therefore, the choice of /-ər/ is independently motivated, carrying more weight.

Unlike general processes of suffixation in many other languages, in which suffixes are directly adjoined to the base morphemes, the diminutive suffixation in Mandarin merges two syllables into one. The result is a Minimal Word with exactly one syllable, consisting of two fixed moras. The process triggers deletion in the base syllable and in the suffix syllable as well, depending on the base syllable shape. There are roughly four types of diminutive formation as follows. The data mainly come from Yin (1989).

(6) a. lan 'basket'→ lar 'small basket'
b. laŋ [1] 'wolf' → lãr 'small wolf'
c. p'ay 'signboard' → p'ar 'small signboard'
d. t'ow [2] 'head' → t'or^w 'small head'
e. taw 'knife' → tar^w 'small knife'
f. k^{w}ən 'club' → k^{w}ər 'small club'
g. ɕin 'heart' → ɕ^{y}ər 'heart'

[1] Duanmu (1990) suggests that in anticipation of the velar closure in [ŋ], the soft palate is lowered earlier. In other words, the nuclear vowel is nasalized before [ŋ] is drooped from the coda. Therefore, the input form is 'lãŋ' rather than 'laŋ'. This treatment is formulated to agree with his proposal on Chinese syllable structure. To me, this pre-suffixation nasalization is phonetic. Therefore, I treat the stem form as 'laŋ' rather than 'lãŋ'.

[2] Based on Duanmu (1990), the round feature is construed as spreading to the coda of the prosodic word.

In (6), all the codas in the root syllables are dropped and, in turn, the empty second mora position is filled by [r]. In (6a-f), [ə] in the suffix is also dropped. In (6c & d), the new coda is labialized, becoming [r^w]. In (6g), the original nucleus is replaced by the suffix [ə], and the [i] in (6g) becomes the secondary articulation of the onset. (6) shows that introducing the suffix to the stem syllable only causes some changes in the structure of the segments, but not in the structure of the syllable; the prosodic structure of the syllable is still preserved.

The roots with [CV] syllable structures constitute the second type of suffixation. In this case, the suffix [r] directly adjoins to the stem.

(7) a. p'a 'rake' → p'ar
kə 'song' → kər
ya 'duck' → yar
b. p'i 'skin' → p'^{y} ər
tɕi 'chicken' → tɕ^y ər
tɕ'ü 'song' → tɕ'^{ÿ} ər

In (7a), there is no change in the stem nucleus; while in the suffix, [ə] is deleted. In (7b), the high vowels [i, ü] are desyllabified (becoming glides) and relinked to the onsets as a secondary articulation. In turn, the rime is substituted by [-ər].

Stems with initial dental or retroflex sibilants followed by a high central vowel [ɨ] form the third type of diminutive formation. In this case, [ɨ] is replaced by [ə] in the suffixed form as shown in (8). According to Chao (1968), the motivation for this replacement is the incompatible articulation of [ɨ] and retroflex [r]. My explanation for this phenomenon is that the result best satisfies the constraints, especially NUCLEUS/V CONSTRAINT (see Section 4 for details).

(8) a. <u>ts</u> ɨ 'paper' → <u>ts</u> ə r
b. tsɨ 'word' → tsə r
c. s ɨ 'silk' → s ə r
d. ts'ɨ 'lyrics' → ts'ə r
e. <u>s</u> ɨ 'things' → <u>s</u> ər

Now let us examine the last type. Consider the following (from Duanmu 1990):

(9) a. hu 'lake' → hur^w
b. kow 'hook' → kor^w
c. taw 'knife' → tar^w

In (9), there is no diphthong in the suffixed forms. The coda is replaced by [r^w], with the feature [labial] spreading from the original [u]/[w] to the new coda. Furthermore, [ə] is dropped in all the suffixed forms.

2. Problems

The underlying form of the Mandarin diminutive is controversial. Some scholars take /-r/ to be the underlying suffix form (Chao 1968, Duanmu 1990), while others prefer /-ər/ (Cheng 1973, Yin 1989). None of the explanations is satisfactory. The former fail to account for the fact that [ə], rather than other vowels, is inserted as shown in (7b) and (8); the latter cannot explain why [ə] in the suffix is dropped throughout (7a) and (9). Moreover, it is not clear why final [w] and nuclear [u] behave differently from other final consonants and vowels as in (9) (see Duanmu 1990 and Yin 1989). In addition, there is no convincing explanation for the asymmetrical behaviour of the final nasals: /n/ $\rightarrow \varnothing$ without [nasal] relinking as in (6a); in contrast, /ŋ/$\rightarrow \varnothing$ with [nasal] relinked to the nucleus as in (6b).

This paper offers a solution in terms of OT (see Section 4 for details). For the convenience of the analysis, I assume that the underlying suffix form is /-ər/. The deletion of [ə] in certain cases can be accounted for by satisfying prosodic constraints. The difficulty brought about by the odd behaviour of [w]/[u], [i]/[ü] and final nasals can be circumvented in terms of the Correspondence Theory (McCarthy and Prince 1995). In the following section, I will give a brief review of two analyses with regard to these issues.

2.1. Duanmu's Analysis (1990)

Duanmu (1990) provides a formal study of Mandarin diminutive formation. In this study, the Mandarin diminutive morpheme is treated as a retroflex vowel [r]. In the process of the suffixation, [r] replaces the coda of the root rime. Since the syllable structure is claimed to have three fixed slots, as in (4), the deletion occurring in the coda position is driven by the syllable template. On the whole, the three slot syllable structure theory renders the account simple and plausible. However, it is not clear why this retroflex vowel [r] always occupies the coda position rather than the nucleus. Furthermore, the study ignores the changes happened in the nucleus. In addition, the account of the asymmetrical behaviour of the final nasals is not very convincing.

2.2. Yin's Analysis (1989)

Yin (1989) gives a different account. In this analysis, the diminutive suffix form is treated as [-ər]. And a four slot syllable structure, i.e. C G V G/N is proposed to describe the derivation of the suffixation. Yin suggests that the process is a merger of two syllables, involving de-linking and re-association of certain segments. The re-association is involved with certain vowels, guided by the *Vowel Association Principle*. It requires that association of vocalic melody to the nucleus proceed according to the sonority hierarchy: a > o > e >ə > [+high] (Yin, 1989: 48). This study explains why the nuclear vowels change sometimes. However, it does not give any account of the final [u]/[w] behaviour. Based on the Vowel Association Principle, the high vowel [u] should be dropped from the nucleus, and [ə] should shift in. But the result is contrary to the prediction: 'hu' (lake)$\rightarrow$ 'hur^w' /* 'hər^w'. Further, it is not clear why [w] and [u] spread [labial] onto the new coda, i.e. 'taw' (knife) $\rightarrow$ 'tar^w', while [y] does not, i.e. 'kay' (cover)$\rightarrow$ 'kar'/* 'kar^y'.

3. Theoretical Prerequisites

The spirit of Optimality Theory can be captured by the interplay of two functional components: Generator (Gen) and Evaluator (Eval). Gen is responsible for generating possible candidates to Eval. Eval is a system of constraints that assesses the various candidate forms provided by Gen. The constraints are ranked and violable. The optimal candidate chosen by Eval is the one that minimally violates the constraints. OT departs from the traditional derivational grammar to a nonderivational grammar, shifting 'the burden of linguistic theory from input-based rewrite rules to output-based constraints' (MacCarthy and Prince, 1993a).

The grammar also lays out three principles underlying the theory of Gen:

(I) Freedom of Analysis. Any amount of structure may be posited.

(II) Containment. No element may be literally moved from the input form.

(III) Consistency of Exponence. No changes in the exponence of a phonologically specified morpheme are permitted.

Freedom of Analysis requires that Gen provide any amount of structure to an underlying representation so as to generate a range of possible surface candidates for Eval. Consistency of Exponence says that the lexical specifications of a morpheme can never be changed by Gen. Containment maintains that the underlying representation must be contained in any legitimate candidate. It literally will not allow anything to be deleted from the input. Deletion is treated as unparse. This principle disallows nonidentical correspondents. Regarding 'laŋ 'wolf' → lã̆r 'small wolf', a stability phenomenon preserves the feature [nasal] when the input coda /ŋ/ is deleted and relinks [nasal] to /a/. In the sense of PARSE, this [nasal] already satisfies PARSE [nasal] through the linkage to the unparsed [ŋ]. Therefore, it cannot be relinked to /a/.

Since Containment is empirically problematic, it has been abandoned by McCarthy and Prince (1994a). Instead, McCarthy and Prince (1994a) propose the correspondence theory that gives license to potential input-output non-identical pairs.

(10) Correspondence (McCarthy and Prince 1995)

Given two strings S_1 and S_2, *Correspondence* is a relation R from the elements of S_1 to those of S_2. Segments $\acute{a} \in S_1$ and $\hat{a} \in S_2$ are referred to as correspondents of one another when $\acute{a}\ R\ \hat{a}$.

All correspondent constraints in this proposal are faithfulness constraints. Faithfulness of input to output is achieved by segment to segment correspondence. Therefore, this proposal is not supposed to license segment to feature input-output pairs.

In view of the stability phenomenon occurring in the deletion of /ŋ/, I propose the following CORR, which permits segment to segment or segment to feature correspondence.

(11) CORR(string_1, string_2, X)

a. X is a constituent $\in$ string_1;

b. X is a set of feature specifications: $X = \{F_1, F_2, ...F_i\}$;

At least one node of every X in string_1 must be coindexed with a node of the same type in string_2.

The proposed correspondence is similar to Orgun's (1995) proposal:

(12) CORR(string_1, string_2, X) (Orgun 1995)

X is a constituent with any amount of information (e.g. features) specified. The **TOP NODE** in every X in string_1 has to be coindexed with a node of the **same type** in string_2.

Orgun's CORR constraints require a correspondent only for the TOP NODE (root node), rather than identity of all the structures specified in X, making it possible to have nonidentical correspondents. Nevertheless, this proposal is not clear enough to allow segment to feature correspondence, since each of the correspondents has to have a root node of its own. In contrast, my proposal requires a correspondent for any node having some generic relations with the input X. It follows that if the top node of X in string_1 is coindexed with a node of the same type in string_2, segment to segment correspondence is expected to occur. If a node of X in string_1 other than the top node is coindexed with a node of the same type in string_2, segment to feature correspondence is expected. If no node of X in string_1 is coindexed with a node of the same type in string_2, X is construed as deleted. The proposed CORR in (11) can handle deletion, segment to segment correspondence and segment to feature correspondence.

Together with the proposed CORR, I will use Orgun's MATCH, which encourages agreement between correspondents.

(13) MATCH($string_1$, $string_2$, X) (Orgun 1995)
For any pair $\langle X_I \in string_1, Y_i \in string_2 \rangle$, Y contains all the information in X. That is, elements of $string_2$ contain all specifications of their $string_1$ correspondents.

MATCH constraints do not require correspondents to be identical, but do require $string_2$ to contain at least all the information in its $string_1$ correspondent. As it stands, violations of MATCH are assessed only in cases of absent or differing specifications, but not when the output correspondent is more specified than the input. I also assume 'elements' in this definition as referring to $string_2$ correspondents, either segments or features.

3.1. Constraints

In the standard conception, the constraints are provided by Universal Grammar and claimed to be language Universal. Only the ranking of the constraints is language-specific. The constraints active in our task are as follows:

(14) NUCLEUS/V CONSTRAINT (NUCL/V)

'A higher sonority nucleus is more harmonic than one of lower sonority' (Prince and Smolensky 1993:16). This constraint can be construed as follows:

If two vowels compete for one nuclear slot, the more sonorant wins.

Sonority Hierarchy: a > o > e >ə > [+high]. (Yin 1989: 48)

MINIMAL WORD CONSTRAINT (MIN-WD)

Wd_{min}
|
ó
/ \
μ μ

The result of diminutive formation is a minimal word. A minimal word is comprised of a syllable, which has three slots. One is in the onset; the other two in the rime, equal to two moras.

ALIGN-RIGHT (Suffix, R, PrWd, R)

$]_{PrWd}\ ]_{Suffix}$: The right edge of the suffix coincides with the right edge of every prosodic word. (This constraint is an absolute wellformedness constraint: alignment is either satisfied or not.)

IDENT (i, o, /back V/): Every input back vowel has an identical output correspondent.

SPREAD [labial]: [labial] must spread to a nearby consonant: front vowel to onset; back vowel to coda.

CORR (i, o, /high, front V/): Every input high front vowel has an output correspondent.

CORR(i, o, /ŋ/): Every input /ŋ/ has an output correspondent.

MAX - IO: Every segment of the input has a correspondent in the output.

MATCH -OI: Every output correspondent of an input segment contains all specifications of the input. (Output correspondents refer to both segments and features.)

4. Analysis

In the following, I will demonstrate how these proposed constraints work to account for our data.

4.1. Syncope and Final Consonant Deletion

As high ranking constraints, ALIGN- R and MIN-Wd are seldom violated. An optimal output must satisfy both of these constraints. Since ALIGN-R and MIN-Wd do not conflict with each other, they are on the same level of the constraint hierarchy. Each plays an independent role in this task. (15) shows how ALIGN-R works to serve this purpose.

(15) Input /lan; ər/ 'basket'

Candidates	ALIGN-R	MAX-IO
>lar		**n,ə
lan	*	**r,ə
ran	*	**l,ə

In view that all the candidates in (15) makes equal violation of MAX, we now consider the other constraint ALIGN-R. ALIGN-R is required in the theory to assure the occurrence of the suffix boundary [-r] at the right side of every prosodic word. Both 'lan' and 'ran' in (15) are ruled out by ALIGN-R because of misalignment or failure of alignment. Without ALIGN-R, 'lar' would not be the winning candidate.

(16) shows that MIN-Wd plays a role in regulating the prosodic structure of the optimal candidate.

(16) Input /lan; ər/ 'basket'

Candidates	ALIGN-R	MIN-Wd	MAX-IO
>lar			**
lanr		*	*
lanər		*	

'lanər' in (16) satisfies ALIGN-R and MAX, but violates MIN-Wd, because it has two syllables and thus is not a minimal word. 'lanr' violates MIN-Wd by having a complex coda. 'lar' wins this competition by having minimal violation. MIN-Wd is crucial for this work, since without it, 'lanər' would be the winner. The ranking of the constraints so far is: ALIGN-R, MIN-Wd >> MAX.

I will now demonstrate how the segmental structure constraints interact with faithfulness constraints to account for the syncope phenomenon occurring in either the stem or in the suffix. (7a) can be dealt with by the following tableau. It shows when the stem vowel and the suffix [ə] compete for the single nucleus position in the output form, the winning candidate is more sonorant. This fact justifies NUCLEUS/V CONSTRAINT.

(17) Input / p'a; -ər/ 'rake'

Candidates	NUCL/V	MAX
> p'ar		*
p'ər	*	*

In (17), both candidates violate MAX, but 'p'ər' also violates NUCL/V, a higher ranking constraint dominating MAX. This ranking of the constraint picks out 'p'ar' as the winner. (17) indicates when two vowels compete for a single nucleus slot, i.e. [a] and [ə] in this case, the winner is the more sonorant [a] in comply with NUCL/V.

Since NUCL/V is violable (see below), it is lower than ALIGN-R and MIN-Wd, but higher than MAX in the hierarchy. The constraint ranking is thus revised to:

ALIGN-R, MIN-Wd >> NUCL/V >> MAX-IO

4.2. High Front Vowel Gliding

(7b) differs from (7a) in that the high front vowels in the stem become the corresponding glides, which attach to the onset. The constraints: CORR (input, output, /high, front V/) and MATCH, are called for.

(18) Input /p'i; -ər/ 'skin'

Candidates	MIN-Wd	CORR(i,o,/high, front V/)	NUCL/V	MATCH	MAX
p'ir			*		* ə
p'ər		*			* i
p'i ər	*		*		
l^y ər				**	
>p'^{y} ər				*	

CORR(input, output, / high, front V/) requires that every input high front vowel have an output correspondent. In other words, CORR prevents the input [i] or [ü] from being deleted. However, NUCL/V forces the high front vowels out of the nucleus. The contradiction is reconciled by gliding, in which the vowels in question are represented as a secondary articulation of the onset. In (19), all the candidates except 'p'ər' satisfy CORR, since only 'p'ər' has no [i] correspondent. 'p'iər' violates MIN-Wd by its nucleus weight, and violates NUCL/V by its nucleus [i]. 'l^y ər' is the strongest rival to 'p'^{y} ər'. Nevertheless, [l^y] has two violations of MATCH in the sense that [l] has different specifications from the input [p'], and so is [y] from [i]. Without MATCH, 'l^y ər' would tie with 'p'^{y} ər'.

Some discussion should be given to the assessment of the violation in 'p'^{y} ər'. Forced by MIN-Wd, [i] in 'p'i ər' changes to [y], and is attached to the onset. [y] as a palatal feature has different specifications from the input full segment [i]. [y] is [-syllabic], while [i] is [+syllabic]. The feature changing from [+syllabic] to [-syllabic] constitutes a violation of MATCH. Thus [y] is construed as a nonidentical correspondent to the input [i]. Since [y] does not carry all the specifications of the input [i], it violates MATCH, but satisfies a higher ranking constraint CORR. In contrast, based on the definition of MATCH, the onset [p'ʸ] as a single segment is not a violation of MATCH despite its added vocalic glide, since its underlying feature specifications are the same. Therefore, 'p'ʸ ər' is the winner. This tableau shows that CORR must rank higher than NUCL/V, MATCH and MAX in order to eliminate 'p'ər'. In turn, NULC/V is higher than MATCH to reject 'p'ir'. The ranking of the constraints is now:

ALIGN-R, MIN-Wd >> CORR (i,o, /high, front V/) >> NUCL/V >> MATCH, MAX

In contrast, the treatment of [ɨ] in (8) is different from [i] as shown in (19).

(19) Input /ts'ɨ; -ər/ 'lyrics'

Candidates	MIN-WD	CORR(/high,front V/)	NUCL/V	MATCH	MAX
ts'ɨ r			*		*
> ts'ər					*
ts'ʸ ər				*	

CORR (i,o, /high, front V/) is irrelevant in this piece of work, because [ɨ] is not a high front vowel. As a high central vowel, [ɨ] should not occur in the nucleus as required by NUCL/V. Therefore, 'ts'ɨr' violates NUCL/V. I now focus on the last two candidates. 'ts'ʸ ər' violates MATCH by the segmental alternation from [ɨ] to [y][3]. [y] is a hypothetical glide correspondent to [ɨ]. 'ts'ər' violates MAX by the deletion of [ɨ]. Each candidate makes a violation of MAX. Nevertheless, by ranking MATCH higher than MAX, we get the ideal result: 'ts'ər' is the optimal candidate.

CORR (i,o, /high, front V/) is also employed to account for the behaviour of [ü] in the same manner, which I do not discuss in detail. (19) gives rise to the following ranking of the constraints:

ALIGN-R, MIN-Wd >> CORR (i,o, /high, front V/) >> NUCL/V >> MATCH>> MAX

4.3. [labial] Spreading

The behaviours of final [w]/[u] are different from other segments as shown in (9). First, both spread a [labial] feature to the new coda: hu 'lake'→ hurʷ; kow 'hook' → korʷ. Second, in 'hurʷ' (lake), [u] remains in the nucleus, which is a violation of NUCL/V. This fact calls for additional constraints. IDENT (i,o, /back V/) and SPREAD [labial] are thus introduced to the analysis. IDENT(/back V/) ranks higher than NUCL/V in order to force [u] to stay in the nucleus. SPREAD [labial] is responsible for [labial] spreading.

(20) Input /lu; -ər/ 'deer'

Candidates	IDENT(/back V/)	NUCL/V	SPR[Lab]	MATCH	MAX
> lurʷ		*		*	*
lur		*	*		*
lərʷ	*			*	*

[3] Unlike [i], there is not a corresponding glide for central high vowel [ɨ]. According to a glide formation rule, Mandarin glides are specified for [-Approximant], while [ɨ] is [+Approximant]. [y] is the glide counterpart for [i], not for [ɨ].

[u] is specified for [high], therefore it should not be kept in the nucleus in accordance with the sonority hierarchy: a>o>e>ə > [+high]. However, IDENT(/back V/) requires every input back vowel have an identical output correspondent. The contradiction is resolved by ranking IDENT higher than NUCL/V. Then, [u] is kept intact in the nucleus as the faithful correspondent to the input counterpart. Since 'lər^w' violates IDENT, it is eliminated earlier. 'lur' has an equal score with 'lur^w' in terms of IDENT (/back V/) and NUCL/V, but violates SPREAD [labial]. SPREAD [labial] is crucial to rule out the undesirable candidate 'lur'.

Some discussion is necessary to be given to [r^w]. Based on the definition of MATCH, [r^w] as a single segment does not violates MATCH. However, the [Lab] on [r] as a feature output correspondent does not carry all the specifications of the input [u], and thus constitutes a violation of MATCH. MATCH in a way blocks spreading, therefore SPREAD [labial] must rank higher than MATCH to force the spreading.

Since IDENT(i,o,/back V/) does not conflict with CORR (i,o, /high, front V/), they are parallel with each other in the constraint hierarchy. In addition, NUCL/V parallels SPREAD [Lab]. Now the ranking of the constraints is:

ALIGN-R, MIN-Wd >> CORR (i,o, /high, front/), IDENT(i,o,/back V/) >> NUCL/V,
SPREAD [labial]>>MATCH >>MAX

4.4. [nasal] Stability

In this section, I will deal with the interesting phenomenon of stability (Goldsmith 1976), where features of a deleted segment are saved by relinking to another anchor.

(21) laŋ 'wolf' – lãr 'young wolf'

The output form in (21) shows velar nasal /ŋ/ is deleted, but its feature [nasal] is relinked to the nucleus vowel. In contrast, the deletion of coronal nasal /n/ never incurs [nasal] relinking. This asymmetrical behaviour between two nasals complicates the analysis and requires the introduction of CORR (i,o, /ŋ/). In previous analysis, I have shown that MIN-Wd forces stem coda deletion. Similarly, the fate of /ŋ/ is subject to this constraint. Nevertheless, CORR (i,o, /ŋ/) plays a role in preventing total deletion of the nasal velar. The result is that feature [nasal] is saved and relinked to another anchor.

(22) Input /laŋ; -ər/ 'young wolf'

Candidate	MIN-Wd	CORR(i,o,/ŋ/)	MATCH	MAX
laŋr	*			*ə
> lãr			*	*ə
lar		*		**ŋ,ə

'laŋ r' is a faithful input /ŋ/ output correspondent, but unfortunately, 'laŋ r' has a complex coda, thus violating MIN-Wd. Otherwise, it would be the winner. 'lar' is beaten by 'lãr' by the total deletion of /ŋ/, a violation of CORR (i,o, /ŋ/). 'lãr' satisfies CORR (i,o, /ŋ/) because the [nasal] on [a] is construed as the output correspondent of the input /ng/. This unfaithful correspondence is licensed by the definition of CORR in (11). CORR (i,o, /ŋ/) forces [nasal] to relink to the nucleus. Since 'lãr' makes the least violation, it is the optimal candidate.

In contrast, there is no correspondent constraint preventing the deletion of /n/. Therefore, /lãr/ is doomed as expected. Compare (22) with (23).

(23) Input /lan; -ər/ 'small basket'

Candidates	MIN-Wd	MATCH	MAX
lanr	*		*ə
>lar			*n *ə
lãr		*	*ə

'lãr' violates MATCH by having an unfaithful correspondent, i.e. [Nasal], and thus runs out of the competition.

5. Conclusion

In this paper I have proposed a segment to segment and segment to feature correspondence in the analysis of Mandarin deminutive formation. Controversial problems in this topic arising from derivational analyses have been circumvented or resolved by general constraints. The proposed analysis constitutes an argument for the two-level Optimality Theory, which abandons Containment, and permits non-identical input and output pairs. I have demonstrated alternations occurring in the optimal representations are motivated by the well-formedness of the grammar and licensed by the faithfulness constraints. The proposed framework requires refining, especially in MATCH. I leave the issue for further study.

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