Chinese Affixal Phonology:
Some Analytical and Theoretical Issues[*]

Yen-Hwei Lin

Michigan State University

Despite the fact that Chinese languages/dialects lack productive affixational morphology, the few existing cases that have been studied are of theoretical interest and provide a more complete picture of Chinese morphophonology, an area that is often misunderstood. This paper provides an overview and synthesis of Chinese affixal phonology by presenting the morphophonological alternations under diminutive/hypocoristic affixation in various Chinese languages/dialects and by discussing the relevant analytical and theoretical issues.

Key words: affixation, Chinese dialects, morphophonological alternations, Optimality Theory, phonological theory

1. Introduction

Chinese languages are often characterized as analytic languages and hence exhibit few alternations induced by affixation processes.[1] Segmental alternation under diminutive *er* suffixation in Beijing Mandarin has been the only well-known and well-studied case (e.g., Cheng 1973, Lin 1989, Yin 1989, Duanmu 1990, 2000, Wang 1993, Wu 1994, Li 1999, among others). Since the late 1980s, research in Chinese affixal phonology has expanded to dialects other than Beijing Mandarin and interesting new dialectal data have been analyzed within current theoretical frameworks of non-linear phonology/morphology and optimality theory (e.g., Lin 1989, 1993, 1995, 1996a, b, 1997, 1999a, b, 2001a, b, 2002a, Duanmu 1990, Yip 1992, Chen 1992, Da 1996, Zhang 2000, Feng 2001). These studies show that despite the fact that Chinese languages lack productive affixational morphology, the few existing cases are of theoretical interest and provide a more complete picture of Chinese morphophonology, an area that is so often misunderstood. Chinese segmental phonology has long been one of my major research interests, and I have been particularly intrigued by segmental alternations under

affixation. After all these years, the time seems ripe for an overview and synthesis of this area of inquiry, and in this paper I initiate this process by classifying different types of affixation and alternation patterns and discussing a few analytical and theoretical issues of Chinese affixal phonology.

This paper is organized as follows. The next section presents the major types of affixation and the resulting alternation patterns across Chinese languages. In §3, I address the analytical issues of reliability of the transcriptions of the sources, syllable structure in the affixed output, non-contrastive segments and features, phonetic versus phonological structures, morphology-based versus phonology/phonetics-based accounts, and stem internal alternations viewed as affixation of floating features. Section 4 discusses a few theoretical issues of phonology-morphology and phonology-phonetics interfaces in the analysis of these Chinese data. Specifically, I address the issues of structure preservation, universal ranking hierarchies, non-contrastive phonetic information in phonological analysis, the status of output templates, the nature of infixation, and absolute ungrammaticality in optimality theory (OT, Prince & Smolensky 1993). The last section gives the conclusion.

2. Chinese affixation and alternation patterns

Most Chinese affixes are monosyllabic and form separate syllables from the bases they are attached to, e.g., in Standard Mandarin: /wo/ 'I' + /mən/ 'plural marker' → [wo.mən] 'we'.[2] In this type of affixation, there are often no phonological alternations, but gemination may occur when a suffix is vowel-initial; e.g., in Taiwanese: /kam/ 'tangerine' + /a/ 'diminutive/hypocoristic suffix' → [kam.mã] 'tangerine'. Diminutive/ hypocoristic affixation is common in Chinese languages and is more likely to induce alternations than other affixation processes. Based on affix placement, four types of affixation are found in Chinese, as illustrated in (1) (Lin 1987:406). Suffixation is the most common type, and infixation and circumfixation are rare.[3]

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[2] Throughout the paper, tone is omitted unless it is relevant to the discussion. A dot is used to denote a syllable boundary.

[3] An anonymous reviewer points out that the cases of Yanggu and Pingding can be analyzed as suffixation plus leftward spreading (cf. Duanmu 1990, Yip 1992). If so, there are no cases of infixation and cirumfixation in Chinese. See sections 3 and 4.5, and footnote 19 below for more discussion.

(1) Affix Placement: prefixation, suffixation, infixation, circumfixation
    a. Prefixation: Taiwanese a - <u>mã</u>   'grandmother'
    b. Suffixation: Beijing   <u>pan</u> - *er* -> par 'board'[4]
    c. Infixation: Pingding   <u>xua</u> - *er* -> xlua 'flower' (Xu 1981)
    d. Circumfixation: Yanggu   <u>tu</u> - *er* -> tlur 'rabbit' (Dong 1985)

Some Chinese languages also exhibit stem internal alternations in a word forma-tion process called *bian yun* (rime change), where the sounds and/or tone in the rime of a root syllable are modified (e.g., Li 1963, Hou 1985, He 1981, 1989). Some examples are given in (2).[5]

(2) Jiyuan rime change (He 1981)
    <u>root</u>   <u>*zi* noun</u>
    pi   piːu   'nose'
    tɕin   tɕiːŋ   'gold'
    xua   xuɔ   'flower'
    pan   pã   'board'
    Yangcheng rime change (Hou 1985)
    <u>root</u>   <u>*zi* noun</u>
    tʰye $_{(31)}$ tʰyɔː $_{(313)}$ 'rake'

Lin (1989, 1993) analyzed rime change as affixation of a feature-sized affix. Based on this approach, Lin (1997) proposed a typology of Chinese affixation with three classify-ing parameters, as given in (3). Some examples are given in (4)-(9).[6]

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[4] In this paper, I use [r] to represent the retroflex approximant [ɹ].

[5] Tones are marked based on Chao's (1968) five-point pitch scale, with 1 indicating the lowest and 5 the highest pitch.

[6] As an anonymous reviewer correctly points out, the parameters in (3) should result in eight types of affixation, but some types are unattested. For example, there are no cases where a feature-sized affix becomes a separate syllable to derive a disyllabic affixed word. Lin (1997) suggests that the feature-sized affix, as being less than a segment, cannot form a syllable and therefore is in conflict with the requirement for a disyllabic output. See Lin (1997:416-417) for discussion on the missing cases and a proposal for possible explanations. The anonymous reviewer suggests that the affix be classified in terms of syllable/mora: if an affix is an independent syllable/mora, then there is no syllable contraction; if it is not, there must be contraction. The parameters in (3) then may require refinement in future research. For purposes of this paper, (3) serves to demonstrate the variation in types of affixes, processes, and output forms in Chinese affixation.

(3) a. Affix Form:
    full-segment affix
    feature-sized affix (degenerate affix in Lin 1993)[7]
  b. Stem-Affix Contraction:
    yes (incorporation of the affix into the stem)[8]
    no (affix as a separate syllable)
  c. Syllable Weight:
    a heavy bimoraic syllable in the affixed output
    a light monomoraic open syllable in the affixed output

The examples in (4) show cases where a full-segment affix constitutes a separate sylla-
ble. Gemination sometimes occurs as the Taiwanese examples in (4d) show. In cases
where the full-segment affix is incorporated into the root, alternations often obtain, as
illustrated in (5). The derived words may have long vowels, changed vowel/tone quality,
coda consonant deletion or changed coda consonants.

(4) Full-segment affix as a separate syllable
  a. *zi* suffixation in Beijing

| ʈʂuo | + | tsɨ | → | ʈʂuo | tsɨ | 'table' |
| pʰan | + | tsɨ | → | pʰan | tsɨ | 'plate' |

  b. *er* suffixation in Hangzhou (Li 1963)

| təŋ (44) | + | ɭ (213) | → | təŋ (44) | ɭ (213) | 'bench' |
| kʰuɛ (44) | + | ɭ (213) | → | kʰuɛ (44) | ɭ (213) | 'chopsticks' |

  c. *er* suffixation in Xining (Zhang & Zhu 1987)

| xua | + | ɛ | → | xua | ɛ | 'flower' |
| kɔ | + | ɛ | → | kɔ | ɛ | 'song' |

  d. *zi* suffixation in Taiwanese (Yip 1980, Zhang 1983, Chiang 1990)

| kam | + | a | → | kam mã | | 'orange' |
| ap | + | a | → | ab ba (~ a βa) | | 'box' |

(5) Full-segment affix incorporated into the root
  a. *er* suffixation in Yiwu (Li 1963, Fang 1986, 1993, cf. analysis in Lin 2001a)

di	+	n̩	→	diːn	'younger brother'
doŋ	+	n̩	→	doːn	'basket'
tsau	+	n̩	→	tsoːn	'table'

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[7] A degenerate affix is in the form of less than a full segment. It may consist of only one or a
  few features, a prosodic weight unit such as mora, or the combination of these two.
[8] For our purposes, I use "stem" and "root" interchangeably for the base of affixation.

b. *zi* suffixation in Zhengzhou (Li 1963)

ua	+	u	→	uau	'socks'
çyɛ	+	u	→	çyau	'boots'
pi	+	u	→	piəu	'nose'

c. *er* suffixation in Beijing (Cheng 1973, Li 1963, Lin 1989)[9]

i	+	r	→	ir	→	iər	'clothes'
pa	+	r	→	par			'rake'
pan	+	r	→	par			'board'
kʰuai	+	r	→	kʰuar			'lump'
iaŋ	+	r	→	iãr			'sheep'
kou	+	r	→	koᵘr			'dog'

d. *er* suffixation in Rongchang (Li 1963, Lin 1989)[10]

pei	+	ər	→	pər	'cup'
kaŋ	+	ər	→	kər	'cistern'
tau	+	ər	→	tər	'knife'
kuan	+	ər	→	kuər	'officer'
y	+	ər	→	yər (*ər)	'fish'

The rime change examples in (6) show that the derived output after affixation of a feature-sized affix is always a single syllable, which must be an open syllable in some processes, e.g., Huojia D rime change in (6b). The rime segments are often altered to accommodate the affixal features. For example, as shown in (6a), when the affix contains [+back, +round] features, the affixed output contains both features or one of the features.

(6) Feature-sized affix

a. *er* and *zi* rime changes in Jiyuan (data from He 1981, analysis from Lin 1993)

pi	+	[+bk, +rd] (*zi*)	→	piːu	'nose'
xua	+	[+bk, +rd]	→	xuɔ	'flower'
tçin	+	[+bk, +rd]	→	tçiːŋ	'gold'
pan	+	[+bk, +rd]	→	pã	'board'
pi	+	[-bk, +rd] (*er*)	→	piy	'nose'

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[9] Some researchers have considered the *er* suffix in Beijing to contain only a retroflex feature (cf. Wang 1993, Wu 1994, Duanmu 2000). Under this approach, the affixed output contains a retroflexed vowel without a coda consonant, e.g., /pa/ → [paʳ].

[10] An anonymous reviewer points out that the suffix could be a light [r]. This requires further investigation.

	ma	+	[-bk, +rd]	→	mæ	'horse'
	çin	+	[-bk, +rd]	→	çĩy	'heart'
	pan	+	[-bk, +rd]	→	pø	'board'

b. D rime change in Huojia (data from He 1989, analysis from Lin 2001b, cf. Lin 1993)

	li	+	ə	→	liə	→	iɛ	'Li (surname)'
	sun	+	ə	→	suən	→	suɛ̃	'Sun (surname)'
	tiŋ	+	ə	→	tiəŋ	→	tiɔ̃	'Ding (surname)'

c. *zi* rime change in Heshun (data from Tian 1986, analysis from Lin 1993)

	lu	+	μ[11]	→	luː			'stove'
	tai	+	μ	→	taːi			'bag'[12]
	liŋ	+	μ	→	liːŋ			'collar'

d. *zi* rime change in Yangcheng (data from Hou 1985, analysis from Lin 1993)

	tʰi	+	μ ... [+bk, +rd]	→	tʰiːu	'ladder'
	pa	+	μ... [+bk, +rd]	→	pɔː	'rake'
	cin	+	μ... [+bk, +rd]	→	ciːŋ (ciːᵒŋ)	'heart'

e. Cantonese diminutive tonal change (Yip 1980)

	üüː (21)	+	[+H]	→	üüː (35)	'fish'
	tsœːŋ (53)	+	[+H]	→	sœːŋ (55)	'a surname'
	yuk (22)	+	[+H]	→	yuk (35)	'jade'

There are also mixed systems that exhibit two different types of behavior, which Lin (1997) considers to be transitional cases. The Mancheng examples in (7a) show that the suffix is merged with the root into one syllable unless the root ends in a [+back] segment. In Huojia *zi* word formation in (7b), an open syllable output is required for non-high vowels but a closed syllable output is required for high vowels. In Wuyi, some roots undergo tonal changes while some others undergo modification of the rime, as shown in (7c), and this division could be lexically determined. [13]

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[11] The symbol μ indicates a prosodic mora, and the mora is filled by the vowel to yield a long vowel. See Lin (1993) for details.

[12] An anonymous reviewer comments that the extra long syllables are probably the so-called 1.5 syllable.

[13] An anonymous reviewer suggests that some of these systems may involve literary versus colloquial styles. I leave this issue open for future research.

(7) Mixed systems

    a.   *er* suffixation in Mancheng (Chen 1988)

aŋ	+	ər	→	aŋ ŋər	'vegetable'
au	+	ər	→	au uər	'peach'
ü	+	ər	→	üər	'fish'
ɕin	+	ər	→	ɕiər	'heart'
pʰan	+	ər	→	pʰɐr	'plate'

    b.   *zi* suffixation in Huojia (data from He 1982, 1989, analysis from Lin 1993, 2001b)

ʂa	+	[+bk, +rd]	→	ʂɔ	'fool'
tɕʰye	+	[+bk, +rd]	→	tɕʰyo	'eggplant'
pʰyaw	+	[+bk, +rd]	→	pʰyɔ	'ticket'
faŋ	+	[+bk, +rd]	→	fɔ̃	'house'
tɕin	+	[+bk, +rd]	→	tɕiːŋ	'gold'
pi	+	[+bk, +rd]	→	piːu	'nose'
tɕü	+	[+bk, +rd]	→	tɕüu	'young horse'

    c.   *er* affixation in Wuyi (Fang 1993)

kau (44)	→	kau (43)	'dog'
ɕü (24)	→	ɕü (43)	'book'
dɤ	→	dən	'peach'
ɦia	→	ɦiaŋ	'shoes'

While Chinese diminutive/hypocoristic affixes are predominantly suffixes, there are cases where an infix seems to be present. Yanggu diminutive affixation (Dong 1985) exhibits suffixation and sometimes infixation, as shown in (8). However, this may be considered primarily a case of suffixation with complicated alternations, as discussed in Yip (1992) and Chen (1992). The only clear case of infixation then seems to be Pingding (Xu 1981), some examples of which are given in (9). Pingding infixation has been analyzed by Lin (1989, 2002a), Feng (2001), and Yu (2004), and I shall discuss some of the issues brought to light by Pingding infixation in §3 and §4.

(8) Yanggu diminutive affixation (Dong 1985)

    a. Suffixation (general pattern)

      <u>root</u>   <u>diminutive</u>

root		diminutive	
pu	→	pur	'cloth'
kua	→	kuar	'mellon'
uan	→	uɛr	'bowl'
pao	→	paor	'bun'

    b. Suffixation (when the nucleus is a high front vowel)

i	→	il̩	'clothes'
tɕy	→	tɕyl̩	'saw'
ɕin	→	ɕil̩	'heart'

    c. Suffixation plus infixation (when the root begins with a dental/alveolar consonant)

tsa	→	tslar	'yesterday'
san	→	slɛr	'three'
tuŋ	→	tluŋr	'cave'

    d. Suffixation plus infixation (when the root contains a diphthong that begins with a high front vowel)

ia	→	ilar	'duck'
iou	→	ilaor	'waist'
tie	→	tiler	'plate'
yan	→	ylɛr	'garden'
ɕyŋ	→	ɕylɤr	'bear'

(9) Pingding infixation (Xu 1981)

tsɒ + l̩	→		tsl̩ɒ	'plum'
ɕiɤŋ + l̩	→		sl̩ɤŋ	'apricot'
ɕiɒ pɤŋ + l̩	→		ɕiɒ p͡l̩ɤŋ	'small notebook'
ŋɤ + l̩	→		ŋ͡l̩ɤ	'moth'
ü + l̩	→		zl̩u	'fish'

       In this section, I have introduced the alternation patterns under Chinese diminutive/hypocoristic affixation. The affix can be in the form of full segment(s) or feature(s), and the affixed word may have restrictions on its prosodic shape: e.g., a disyllabic word, a closed/heavy single syllable, a single open syllable, or a syllable with a complex onset through infixation. One aspect worth noting is that in many cases, the syllabic and segmental structures in the affixed words are highly marked and generally not tolerated in these Chinese languages, e.g., nasalized vowels, high front mid rounded vowels, and

complex onset. That is, these marked and unusual structures are limited only to the output of diminutive/hypocoristic affixation.

3. Some analytical issues

The majority of the data of Chinese diminutive/hypocoristic affixation comes from fieldworkers' notes and descriptions published in monographs, collections of dialect surveys or journals such as *Fangyan* (*Dialects*) or *Zhongguo Yuwen* (*Chinese Language*). Some descriptions include impressionistic phonetic detail whereas others provide broader transcription. With very few exceptions, e.g., Beijing Mandarin, instrumental phonetic information is generally unavailable. This state of affairs creates some analytical challenges and leads us to question the extent to which such transcriptions can be reliably used in phonological analysis. One could hold the view that these data are not reliable, and therefore any findings, analyses, or arguments based on them are questionable. On the other hand, advances in linguistic analysis and theorizing have made significant progress based on the data collected from secondary sources and fieldworkers' contributions. Although new instrumental phonetic data do correct some errors in the past and may play a decisive role in selecting better analyses or theoretical models among competing alternatives, the contributions of such data cannot be readily dismissed. In the area of Chinese affixal alternations, these data at least help us gain a broader and more complete picture of the possible patterns, and I have been in the position that before we can verify some of the questionable data with phonetic analysis, we should make the most out of the available information. Moreover, without a detailed analysis of the available data, one would not know which sets of data seem problematic and need verification or what additional data and information should be collected in future fieldwork or experiments. The basic general descriptions of these Chinese languages are essentially ready for analysis, although some of the phonological and phonetic information may need further confirmation.

One problem in analyzing Chinese diminutive/hypocoristic affixation is that in some cases it is not clear if the affixed output forms one syllable or two. For example, in the Wu dialects of Zhejiang Province, as described by Fang (1993), some affixed outputs contain a long vowel followed by a coda nasal: e.g., in Yiwu, /di/ + /n/ → [diːn] 'younger brother' (see (5a) above). Fang (1986, 1993) claims that the affixed word is monosyllabic. Heshun and Yangcheng are additional examples (see (6c, d)), e.g., in Heshun, /tai/ → [taːi] 'bag', whose diminutive affixed words are claimed to be monosyllabic. And yet, some believe that these words must be disyllabic (e.g, Duanmu 1990). Given that the maximal permissible syllable structure in these Chinese languages is CGVX (where C=consonant, G=glide or high vowel of a diphthong, X=C or G), a

CV:X syllable is indeed an anomaly. Another example that violates the phonotactics or cooccurrence restrictions of a permissible syllable comes from Zhengzhou ((5b)): e.g., /ua/ + /u/ → [uau] 'socks'. Like the majority of Chinese languages, Zhengzhou prohibits two rounded segments to appear simultaneously in pre-nuclear and post-nuclear positions. The affixed output [uau], if it is monosyllabic, then is a marked syllable not tolerated in other parts of Zhengzhou phonology. If one is to maintain the permissible syllable structure, one could consider these affixed words to be disyllabic. However, there may be reasons to believe that a CV:X syllable is phonetically somewhere in-between a single syllable and a disyllabic output. Zhengzhang (1980, 1981) shows that in Wenzhou, a Wu dialect, some affixed nouns have free variants. For example, the diminutive form of the noun 'vase' has four possible pronunciations, ranging from true disyllabic forms with a syllabic nasal to a true monosyllabic form with a nasal coda:

(10)   /beŋ/ + /ŋ/   →   be.ŋ   ~   bei.ŋ   ~   be:ŋ   ~   beŋ

Each of these variants appears in some Wu dialects, which seems to indicate that the direction of the change is going from a disyllabic to a monosyllabic form and the variant with a long vowel, [be:ŋ], is in a transitional stage. A CV:X syllable seems shorter than a disyllabic form but longer than a monosyllabic word, somewhat **sesquisyllabic**, i.e., a sort of "syllable and a half". More recently, Shi (2002) proposes that an affixed word like [di:n] in Yiwu forms a "compound" syllable that contains two subsyllables and three moras. It is not yet clear, however, whether a category like "syllable and a half" or "compound syllable" has a valid phonological status. Before evidence can be found to resolve this issue of syllable count, I suggest that a CV:X form or a form like [uau] in Zhengshou be tentatively treated as monosyllabic phonologically, following the fieldworkers' transcriptions. This suggestion seems reasonable given that non-canonical or non-contrastive structures are abundant in Chinese affixed words. First, as the cases of Pingding and Yanggu ((8)(9)) show, a highly unusual syllable structure with complex onset is created under diminutive/hypocoristic affixation. Second, non-contrastive or marked segmental structures are also common, as many examples in §2 show. Finally, even the tone of an affixed output is usually not one of the underlying citation tones or their corresponding sandhi tones.

Since so many non-canonical, non-underlying, and non-contrastive structures appear in the affixed words, one important task in the analysis of Chinese diminutive/hypocoristic affixal phonology is to decide what is relevant for phonological analysis and what should be considered low-level phonetic detail. Given the recent development of phonological theory in which the boundary between phonetics and phonology has become increasingly blurred and phonological patterns are often explained in terms

of non-categorical phonetic information (e.g., Borwman & Goldstein 1992, Flemming 2002, Kirchner 1998, Hayes 1999, Steriade 1997, 2000, 2001a, b, Zhang 2000, to name just a few), it becomes reasonable to try to analyze as much information as provided by the transcriptions. For example, when a nasal coda is lost under diminutive affixation, in some dialects the vowel in the affixed word is nasalized only when the lost nasal is velar, while in other dialects, the vowel is always nasalized or never nazalized; however, there are never cases where the vowel is nasalized only when the alveolar nasal is lost. Zhang (2000) has argued that phonetic differences in nasal flow are crucial in explaining the patterns, despite the fact that nasalized vowels and the degree of nasal flow are non-contrastive in those Chinese languages under study. Another example is the complex system of Yanggu diminutive affixation (cf. (8)): Interesting analytical and theoretical questions arise when the phonetic details of the output forms are considered (Yip 1992, Chen 1992, Yu 2004). These examples demonstrate that a detailed analysis of the patterns of non-contrastive structures in the affixed output can be fruitful and should be part of the investigation of Chinese affixal phonology.

Another interesting analytical issue is how to decide on a morphology-based versus phonology/phonetics-based account of some alternation patterns. One interesting example comes from infixation. The infixal lateral element in some Yangguo affixed words (see (8) above) has been analyzed either as morphological affixation of a floating lateral element (Yip 1992; cf. Lin 1989) or as phonological epenthesis of an excrescent lateral. More recently Yu (2004) argues that the so-called infix in Yanggu and Pingding ((9)) was originally a transitory lateral due to the abrupt acoustic transition from a coronal onset to a retroflex rime, and subsequently emerged as a segment due to speakers' misinterpretation of a coarticulatory effect as a purposeful gesture (cf. Ohala 1993). With the increased interest in phonetics-based explanations for phonological patterning, we may continue to find more examples that can be subject to the debate between a morphology-based and a phonology/phonetics-based account.

By adopting non-linear representation, Lin (1989, 1993) has analyzed several cases of rime change in terms of affixation of micro-morphemes that consist of either one or more features or a bare prosodic element. This affixational approach to stem internal alternations is a common practice of non-linear morphology and phonology, and is able to provide a unified analysis of rime change data that seem to undergo several unrelated processes (Lin 1993). In recent years, I have encountered a couple of rime change cases that are difficult to analyze because setting up a single uniform affix is not as obvious and lexically determined alternations seem to be involved. Consider the examples from Dinghai (Fang 1993) in (11). Some roots seem to take a full-segment suffix, either a

nasal or a vowel (11ab), and some others add nasal and/or fronting features as in (11c-m).[14]

(11)   Dinghai diminutive suffixation/rime change

	root	er-noun	
A. Full segment suffixation			
a.	soʔ	soŋ	'uncle'
b.	tɕiə	tɕiu	'spine'
B. Vowel fronting			
c.	ba	bɛ	'card'
d.	mɔ	mɛ	'cat'
e.	aʔ	ɛ	'duck'
C. Vowel nasalization			
f.	tɕi	tɕĩ	'chicken'
g.	tɕiaʔ	tɕiã	'foot'
h.	o	ɔ̃	'raven'
i.	kai	kĩ	'dog'
j.	kau	kũ	'fruit'
k.	hɔ	hɔ̃ or hɤ̃	'shrimp'
D. Vowel fronting and nasalization			
l.	ŋau	ŋɤ̃	'goose'
m.	pʰaʔ	pʰĩ	'handkerchief'

This diminutive suffix could be a combination of [+nasal] and/or [-back], but a [+back] rather than a [-back] vowel can show up (11b, j, k). Note that some identical root vowels/rimes may undergo different processes: compare (11d) with (11k), (11j) with (11l), and (11e) with (11g) and (11m). For (11e, g, m), it is likely that the glottal stop in each of these three roots is historically or underlyingly derived from a different oral stop, which determines the vowel quality of the *er* noun. The examples of (11j, l) seem to indicate that the vowel quality of the output may also be lexically determined: some /au/ rimes become [ũ], and some others become [ɤ̃]. This type of example not only presents an analytical challenge but also points to the need to take into consideration lexical information, morphological exceptions, historical residue, and synchronic variation in the analysis of more complex cases of rime change. Analytical and theoretical ap-

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[14] This is a subset of the examples presented in Fang (1993). The reader is referred to Fang (1993) for more examples.

proaches used in recent work on morphophonology such as cophonologies, lexical prespecification, and variation as free-ranking of constraints (e.g., Inkelas et al. 1997, Inkelas 1998, 1999, Itô & Mester 1995a, b, 1998, Reynolds 1994, Walker 2000, Rubach & Booij 2001, Anttila 2002) may prove to help further refine the analysis of Chinese diminutive/hypocoristic affixation and rime change.

4. Some theoretical issues

4.1 Structure preservation

As mentioned earlier, many non-contrastive, non-underlying, and non-canonical structures and segments appear under affixation. The question on the validity of Structure Preservation (SP) then arises. The generally assumed principle of SP (Kiparsky 1982, 1985, cf. Archangeli & Pulleyblank 1986, 1994) is intended to capture the cross-linguistic tendency that lexical phonological output contains only the possible phonological units in the input, but the postlexical output may contain new types of structure. The common analytical practice is: (i) when a non-contrastive element is prohibited, it is blocked by SP; i.e., any rule that would produce such an element is blocked or the prohibited output is repaired; and (ii) when a non-contrastive element is allowed to surface, it can only happen at the postlexical level or any non-SP level (e.g., the word level). In the literature, some problems with SP have been pointed out: (i) some non-contrastive elements, structures, or feature combinations unexpectedly appear at a SP level (e.g., Mohanan 1984, Harris 1987, Hall 1993, Calabrese 1995), and (ii) some non-contrastive elements, structures, or feature combinations are prohibited at a non-SP level (e.g., postlexical SP effects in Hyman 1993). Lin (1995, 1996a, 1999a) shows that under Chinese diminutive/hypocoristic affixation, there are many violations of SP but there are also many alternations that are constrained by SP. That is, SP is both observed and violated at the same phonological level and under the same process. These problems highlight not only the intuitive and informal nature of SP but also the problem with a strict interpretation of constraints as being inviolable (Lin 1999a, 2000a). Lin (2000a) provides the following general observations: (i) SP is not an inviolable universal principle, (ii) there is a general tendency to observe SP, (iii) violations of SP may occur under limited circumstances, and (iv) the more marked a non-SP unit is, the less likely it would surface. A preliminary OT account of SP and non-SP effects proposed by Lin (2000a) is sketched in (12), (13), and (14). The basic idea is to rank FAITHFULNESS and/or other relevant constraints in-between fixed universal ranking hierarchies to account for the patterns and distribution of SP and non-SP effects. A more refined proposal is definitely needed as more empirical data and theoretical consequences are considered fully, but the validity of SP as a universal principle and how to derive SP

and non-SP effects in a principled way remain a theoretical issue. In this connection, the Chinese data are in a position to provide a testing ground.[15]

(12) a. SP and non-SP effects are derived by the interaction of markedness and faithfulness constraints.
   b. Violation of SP occurs when compelled by a higher ranked constraint along a set of ranked markedness constraints.
   c. Universal markedness ranking:
      M1 >> M2 >> M3
   d. The ranking schema for SP and non-SP effects
      SP effects: MARKEDNESS >> FAITH, ℂ
      Non-SP effects: ℂ >> MARKEDNESS >> FAITH

(13) Example:
   a. M1 >> M2 >> M3
   b. M1 >> ℂ >> M2 >> Faith >> M3
   c. A segment that violates M3 is part of the underlying inventory and hence structure-preserving.
   d. Segments that violate M1 and M2 are non-structure preserving.
   e. A segment that violates M1 is prohibited (SP effects).
   f. A segment that violates M2 is in general prohibited (SP effects) but is allowed to surface when compelled by higher-ranked constraints (non-SP effects).
   g. Gradient/partial SP effects: A segment that violates M1 is prohibited (SP effects) but a segment that violates M2 surfaces as the substitute (non-SP effects).

(14) An OT account of the observations related to SP
   a. SP is not an inviolable universal principle.
      ---   Constraints are ranked and violable.
   b. There is a general tendency to observe SP.
      ---   Faithfulness and its interaction with markedness.
   c. Violations of SP may occur under limited circumstances.

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[15] James Myers and Jie Zhang (personal communication) have both pointed out to me that the proposed OT schema cannot really capture all the properties that have been attributed to SP, with which I agree. There are indeed other aspects of SP, e.g., the tendency for SP effects to occur in the lexical phonology, that this OT schema cannot capture. There may not be a good OT account after all for the notion of SP, but what I intend to show at this stage is that the interaction of markedness and faithfulness to some degree produces SP and non-SP effects.

    ---   They result from conflicting demands within the grammar.

   d.   The more marked a non-SP unit is, the less likely it would surface.

    ---   Some markedness constraints are universally ranked.

4.2 Fixed universal ranking hierarchies

One theoretical issue that the Chinese data may contribute to is to discover a set of universal segmental ranking hierarchies similar to the sonority ranking hierarchies and the place feature hierarchy proposed by Prince & Smolensky (1993). Some possible fixed universal ranking hierarchies on vowels such as *ø >> *e, *o >> *i, *u >> *a, *ə have been suggested to account for SP versus non-SP effects (Lin 1995, 1996a, 1999a, 2000a) and to provide a simpler factorial typology for Mandarin mid vowel assimilation that can avoid impossible patterns (Lin 2002c, 2002b).

Another issue on universal rankings concerns the FAITH-ROOT >> FAITH-AFFIX fixed universal ranking proposed by McCarthy & Prince (1995). Lin (1999b, 2000b, 2001a, b) points out that many Chinese languages seem to constitute counterexamples to McCarthy & Prince's proposal that FAITHFULNESS constraints on roots are univer-sally ranked higher than FAITHFULNESS constraints on affixes because phonological alternations under affixation in many Chinese dialects prefer to realize the elements in the affixes at the expense of the stem elements (Yip 1992, Lin 1993, 1997). However, it has been shown recently that this proposed universal ranking can be retained, at least technically, if one adopts constraints such as REALIZEMORPH (a morpheme must have some phonological exponent in the output) or DISTINCTSTEM (The unaffixed stem must be distinct from the affixed stem) (Lin 2001c, 2003; see also Walker 2000). Some re-cent studies have questioned the universality of the FAITH-ROOT >> FAITH-AFFIX rank-ing (e.g., Noske 2000, Fitzgerald 2000). One possible solution is to analyze the data in terms of transderivational anti-faithfulness constraints that require a contrast between a base and its derivatives (Alderete 2001). Whether or not the Chinese data constitute counterexamples to the FAITH-ROOT >> FAITH-AFFIX universal ranking and how best to analyze the preference for the realization of the affix await further investigation.

4.3 Non-contrastive phonetic information in phonological analysis

One of the current major theoretical issues is the extent to which phonetic informa-tion should be formally included in phonological analysis. Much of recent OT research has argued that non-contrastive or gradient phonetic information must be included in the formalism in order to explain many phonological patterns (e.g., Flemming 2002, Kirchner 1998, Hayes 1999, Steriade 1997, 2000, 2001a, b). Zhang's (2000) work is

particularly interesting with regard to the alternation patterns under Chinese diminutive/hypocoristic affixation. He argues that if the phonetic differences on the degree of nasality are not encoded as a set of universally ranked constraints, the factorial typology for vowel nasalization patterns would be both overgenerating unattested patterns and undergenerating attested patterns. Given that many non-contrastive structures appear under Chinese diminutive/hypocoristic affixation, a rigorous exploration in this area could shed more light on the phonetic basis of phonological patterns and the issue of how phonetic information should be encoded in phonological theorizing.

4.4 Output template

In Prosodic Morphology (McCarthy & Prince 1986, 1995a), the notion of output template plays a crucial role in shaping the prosodic and segmental structures of an affixed or reduplicated word. A template could be a prosodic unit that serves as a target for segmental association (McCarthy & Prince 1996) or as a set of constraints that defines the structure of the output template (Steriade 1988). Lin (1993) analyzes Chinese rime change by adopting constraint-based output templates and argues that the target approach is less successful in accounting for Chinese diminutive/hypocoristic affixation (cf. Yip 1992).[16] Under the OT approach, my earlier analysis of the requirement for an affixed word to be monosyllabic or disyllabic assumes a TEMPLATE constraint requiring the affixed word to be monosyllabic. The disyllabic form is then obtained by ranking FAITHFULNESS constraints (requiring input-output identity) above TEMPLATE, and the open syllable template as in Huojia D rime change is accounted for by the interaction of FAITHFULNESS and *CODA (Lin 1995, 1996b).

However, Generalized Template Theory (McCarthy & Prince 1994, 1995b, 1999) argues that all morphological templates are derived from constraint interaction.[17] The validity of a constraint like TEMPLATE then becomes suspect. The question is then what constraints are involved in determining a monosyllabic versus a disyllabic output. In my recent work, I have suggested a constraint banning the diminutive affix to form an independent prosodic word (see (16b) below), and if this constraint is ranked high, a monosyllabic output would surface (Lin 2000b, 2001a, b, c, 2002a). The basic idea behind this constraint is that a common and frequently used affix tends to be prosodically bounded with the root more and more through time and eventually loses its ability to form a prosodic word by itself. There could also be segmental and syllabic reasons for

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[16] Steriade's approach has also been adopted by Bao (1990) to account for Chinese *fanqie* (secret) languages.

[17] See McCarthy (2002:182) and Kager (1999: Chapters 4 and 6) for more information and references.

the diminutive affix to become attached to the root: the affix usually consists of a single consonant or an onsetless syllable and resyllabification across a weak morphological boundary is common cross-linguistically. A different perspective is offered by Feng (2001), who proposes two ANCHOR constraints (which require the input-output matching of elements at the edges) to account for the templatic effects in several Chinese dialects. It remains to be seen which constraints and what interactions provide a simple and unified account of Chinese templatic effects.

4.5 The nature of infixation

McCarthy & Prince (1995a, b) have argued that there are no real infixes, and the so-called infixes are prefixes or suffixes that are minimally misaligned from the edge of the stem to avoid violations of higher ranked markedness and/or faithfulness constraints. In other words, infixation applies only to avoid marked structures. The example of Timugon Murut prefixing/infixing reduplication given in (15) shows that infixation applies to vowel-initial stems. McCarthy & Prince argue that in this example infixation avoids an additional onsetless syllable. The infixed output is less marked than the potential prefixed output in terms of syllable markedness.

(15) Timugon Murut
    a. bulud   →   bu-bulud   'hill/ridge'
        ulampoy →   u-la-lampoy   (no gloss)
    b. Infixation applies to minimize the number of onsetless syllables.

	RED + ulampoy	ONSET	LEFTMOSTNESS
	u̲.u.lam.poy	*!*	
☞	u.l̲a̲.lam.poy	*	u

Recall that the infixation process in Pingding (9) and Yanggu (8) result in highly marked structures that do not exist in the phonological systems of these two dialects and in other Chinese dialects. This fact seems to contradict McCarthy & Prince's claim that a less marked output would be created by infixation. An example of Lin's (2002a) analysis is given in (16), which shows that infixation occurs as a result of avoiding violations of higher ranked constraints.

(16) Constraints
    a. MAX: Every input element has a correspondence in the output.
        (no deletion)

b. Markedness constraint on the prosodic restriction on the *er* affix
   *[*er*-af]$_\sigma$ An *er* affix cannot form a single syllable.
c. Markedness constraints on syllable structure
   *COMPLEX   Syllables have at most one consonant at an edge.
   CODA-COND   Only a velar nasal or a glottal stop is allowed in the coda.
   SSP   Sonority Sequencing Principle.

		sɤu + l̩	MAX	*[*er*-af]$_\sigma$	CODA-COND	SSP	*COMPLEX
	a.	sɤu.l̩		*!			
	b.	sɤu	*!				
	c.	sɤul̩			*!		
	d.	l̩ɤu	*!				
	e.	l̩sɤu				*!	*
☞	f.	sl̩ɤu					*

Lin (2002a) then concludes that since some markedness constraints, such as CODA-COND and SSP, are fully satisfied and the infixed outputs indeed avoid those marked structures that violate these constraints,[18] Pingding infixation does not constitute a genuine counterexample to McCarthy & Prince's characterization of the nature of infixation. The surface unusualness of the infixed outputs in Pingding can then be attributed to the rigid demands of several high-ranking constraints, leaving Pingding with no choice but to adopt marked structures along a different dimension. Yu (2004), however, argues that infixation can occur with no markedness gains, provides a phonetics-based account of the development of the lateral infix, and concludes that Pingding infixation presents a genuine problem to the markedness-avoidance approach to infixation. As the debate continues, one can see that Chinese infixation provides an interesting case study for understanding the nature and properties of infixation in general.[19]

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[18] I thank Moira Yip (p.c.) for bringing this point to my attention.

[19] As mentioned in fn.3 above, one possible analysis of Pingding diminutive affixation is that suffixation plus leftward spreading and the so-called infix is just a transitional segment (cf. Chen 1992 for Yanggu inserted [l]). One piece of evidence for a non-infixation analysis, as argued by an anonymous reviewer, is that the whole rime of an affixed word in Pingding is retroflexed according to Xu (1981). It is not clear, however, why it is impossible for an infixed retroflex to spread the retroflex feature to the rime. It is also likely that the original affix was a suffix, but through various diachronic changes, the affix now appears as an infix synchronically (cf. Yu 2004). This issue is yet to be resolved and is left for future research.

4.6 Absolute ungrammaticality

Within OT, two major proposals have been put forward to account for absolute ungrammaticality. The first is the MPARSE analysis (Prince & Smolensky 1993), in which the constraint MPARSE (which demands that the output must have morphological structure) is ranked below relevant markedness constraints, and the Null Parse (an output that is phonetically unrealized because of the lack of morphological structure) is then selected. The other is proposed by Orgun & Sprouse (1999) in which a component called CONTROL acts as a filter to check grammaticality of the output selected by constraint evaluation in OT.

The general pattern of Huojia D rime change in (17a) (He 1989, see also (6b)) can be analyzed as affixation of /ə/ with an open syllable output restriction (Lin 2001b, c; but cf. Lin 1993). However, any root that ends in a non-high nuclear vowel cannot have a D-word, as the examples in (17b) show (Lin 2001c, 2003).

(17)		Root	D-word		
	a.	li	ljɛ		'Li' (surname)
		u	wə		'Wu' (surname)
		law	lɔ		'old'
		lin	ljɛ̃		'to rent'
	b.	ja	---	*ja, *jaə	'sprout'
		xə	---	*xə, *xəə	'box'
		tɕjɛ	---	*tɕjɛ, *tɕjɛə	'eggplant'
		xwa	---	*xwa, *xwaə	'flower'

The basic generalizations of Huojia D-word formation are that (i) a D-word cannot have a coda consonant/glide and (ii) a D-word must be distinct from its root. Lin (2003) shows that both the MPARSE and CONTROL analyses work technically but argues that a CONTROL account as illustrated in (18) and (19) is better able to capture the basic generalizations of Huojia D-word formation in a simpler and more revealing way: first, *CODA crucially selects the optimal output that lacks a coda consonant/glide (18), and second, DISTINCTSTEM makes sure that any D-word that is non-distinct from its root is ungrammatical (19).

(18) In the EVAL component

law + ə	*COMPLEX	MAX-RT	MAX-AF	*CODA
a. laəw	*!			*
b. laə	*!	*		
c. law			*	*!
d. ləw		*!		
☞ e. lɔ			*	

In the CONTROL component

law + ə	DISTINCTSTEM
☞ lɔ	

(19) In the EVAL component

xa + ə	*COMPLEX	MAX-RT	MAX-AF	*CODA
a. xaə	*!			
☞ b. xa			*	
c. xə		*!		

In the CONTROL component

xa + ə	DISTINCTSTEM
✂ xa	*!

Recently, Ganselow & Féry (2002) examine many cases of *ineffability* (which is defined as the failure of some input to find a surface realization) in phonology, morphology, syntax and semantics, and claim that the typology of ineffability is compatible with Orgun & Sprouse's CONTROL component. This study concludes that ineffability cases do not pose a problem for OT because they are located in domains of grammar outside of OT's architecture. D-word formation in Huojia then provides an example from the Chinese language family that is better analyzed under the CONTROL approach to absolute ungrammaticality or ineffability. In future research, it would be interesting to find out if there are examples or processes either in Huojia or other Chinese languages that can provide counterexamples to the MPARSE proposal and further support the CONTROL proposal.

5. Conclusion

In this paper, I have introduced the major types of alternations under Chinese diminutive/hypocoristic affixation and briefly discussed a few analytical and theoretical

issues in studying Chinese affixal phonology. Compared to tone, segmental alternations in Chinese have long received less attention, presumably because of the lack of productive affixational morphology and the simpler patterns perceived by many linguists. I hope this paper has been able to provide a broader picture of the patterns of Chinese morphophonology and show how those few cases of segmental alternations under Chinese affixation could be of much theoretical interest. I also hope that there will be continued efforts in obtaining more accurate and broader knowledge of the segmental and prosodic patterns of Chinese morphophonology and demonstrating how such data can inform phonological theory.

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Department of Linguistics & Languages
Michigan State University
A620 Wells Hall
East Lansing, MI 48824-1027
USA
liny@msu.edu

漢語詞綴音韻學：一些分析和理論上的討論

林燕慧

密西根州立大學

　　儘管漢語的詞綴構詞法並不多見，少數的例子仍有理論上的價值，並且也提供了常被誤解的漢語構詞音韻學的完整面貌。本文擬藉由漢語方言表小愛稱詞綴的構詞音韻交替的說明，及對相關分析和理論上的討論，對漢語詞綴音韻學提出一個整體性的綜述。

關鍵詞：詞綴，漢語方言，構詞音韻交替，優選理論，音韻理論