A Particle Analysis of *üi* in Chinese*

Hui-chuan Hsu
National Chiao Tung University

ABSTRACT

The issue concerning the underlying representation of *üi* in Mandarin Chinese has been hotly debated since early 1940s. This paper makes an in-depth exploration of the question extending the scope to Chinese in general. A particle analysis is proposed to resolve the unity and combination dilemma in the literature. Various phonological processes and dialect comparisons pivoting on the temporal arrangement of either *iu* or *ui* make the claims of a fixed vowel sequence untenable. Instead, *üi* is better treated as a single vowel segment which consists of two component particles *i* and *u*.

Key Words: particle phonology, vowel fusion, vowel fission

1. Introduction

In the literature, opinions are divided as to the underlying representation of the high front rounded vowel/glide *üi* in Mandarin Chinese.[1] Some linguists posit simply one underlying vowel segment *üi* (Cheng 1973, Lin 1989, 2002a, Duanmu 1990, 2000, Kuo 1994, to name just a few); others propose a combination of *i* and *u*. More precisely, *iu* is used in Hartmen (1944), Martin (1957), and Chao (1968), and *ui* is advocated in Wu (1994).[2] The current exploration of this issue is not limited to Mandarin Chinese, but extends to Chinese in general. At first

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1. Since high vowels (*i*, *u*, *ü*) and glides (*y*, w, *ɥ*) do not contrast in Mandarin Chinese, the latter are generally posited as high vowels underlyingly (Cheng 1973, Lin 1989, Duanmu, 1990, 2000, among others).
2. Bao (1997) also posits *ui* based on *l*-split words in Jin dialects.

glance, various phonological processes (such as vowel merger, vowel fission, and *er* affixation) and dialect comparisons argue for the combinatory position. Closer inspection reveals a serious theoretical drawback: if *üi* is underlyingly represented as a sequence composed of *i* and *u*, no unified analysis can be achieved. The temporal sequencing of either *ui* or *iu* is seen in a dialect or across dialects. In view of the fact, this paper sticks to the unity viewpoint and proposes a particle treatment (Schane 1984, 1995) to accommodate such disparities at surface.

The organization of this paper is as follows: section 2 gives a brief introduction of particle phonology. Section 3.1 presents how *üi* derives from a fusion of *u* and *i*, as evidenced by (a) rime changes in Zhengzhou and Huojia and (b) dialect comparison; section 3.2 interprets high vocoid friction in Hakka dialects, Pinhua varieties, and Jin dialects, *er* suffixation in Shouguang, and syllable contraction in Zhengzhou as evolving from the earlier fission of *üi* into *ui* or *iu*, and section 3.3 addresses decay through dialect comparison to further manifest the particle analysis of *üi*. Concluding remarks are given in section 4.

2. Theoretical Background

The theory of particle phonology (Schane 1984, 1995) is proposed in view of limitations of the binary distinctive features of generative phonology in expressing interrelationships between diphthongs and monophthongs. More precisely, the disadvantage of the standard notation, as presented in Chomsky and Halle (1968), to explicitly present processes such as the diphthongization of [ü:] to [iŭ] or the monophthongization of [aĭ] to [e:] reveals where particle phonology shall contribute to the advancement of phonological representation.

Particle phonology departs from the standard SPE framework in the choice of primitive phonological elements. Instead of distinctive features, three elementary particles, namely *a*, *i*, and *u*, establish vowel configurations.[3] "In isolation, they correspond to the vowels [a], [i], and [u]; in combination, they represent phonological traits—aperture or openness for *a*, palatality or frontness for *i*, and labiality or rounding for *u* (Schane 1984:131)". By reducing vowel

3. Pursuant to Schane (1984:131), the primitive phonological elements of particle phonology contain two types: elementary particles and punctuators. Among the three punctuators, a 'plus' sign is used between vowels from separate syllables; a 'space' between particles denotes length in vowels and diphthongs, and a 'half-moon' symbol beneath particles means nonsyllabicity. I shall not introduce punctuators any further since they have nothing to do with the consideration of this paper.

properties to expressions of tonality[4] (manifested by *i* and *u*) and aperture (signified by *a*), particles classify vowels in a highly abstract manner, which in turn makes possible a finer-grained interpretation of relevant phonological processes. As for the properties of elementary particles, the quotation below clearly illustrates.

> "Elementary particles are compositional, additive, multiple, and dependent. Complex vowels are composed of simpler ones; vowels are specified only for those components present; particles may occur multiply; and because of their different functions, the interpretation of particles is language-dependent." (Schane 1984:150)

Seven basic operations of particle phonology include fusion, fission, mutation, cloning, droning, accretion, and decay. In sections 3, a wide range of materials from Chinese dialects exemplifies how fusion, fission, and decay are at work on the part of *ü*. The reader is referred to Schane (1984) for other operations.

To familiarize the reader with the particle representations of a set of basic vowels, Table 1 in Schane (1984:131) is adopted here. (Traditional phonetic symbols appear in square brackets, whereas particle representations are unbracketed.)

(1) Particle Representations of Vowels[5]

[i]	i	[u]	u	[ü]	iu				[ɨ]	-
[e]	ai	[o]	au	[ö]	aiu				[ʌ]	a
[ɛ], [æ]	aai	[ɔ]	aau	[œ]	aaiu	[a]	a		[a]	aa

As displayed above, front vowels contain the particle *i*, rounded vowels have *u*, and nonhigh vowels exhibit *a*. Vowel height is indicated by the number of aperture particles. The more aperture particle a vowel contains, the more open it is.

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4. Tonality constitutes a sub-class of the resonance features. It comprises three distinctive binary features capable of interacting with one another, including the gravity feature, the flattening feature, and the sharpening feature. The reader is referred to Jakobson et al. (1976:29-36) for more details.
5. We see an asymmetry in the vowel configurations depicted in (1), namely the absence of unrounded back vowels. To fill up the 'hole' created by the missing of the back counterpart of *ü*, particle combinations need to be modified as in (i) to accommodate a language containing both *ɯ* and *ü* (such as Turkish) on the one hand, and to take care of language variation on the other.

   (i) [ɯ] iuu [ü] iiu

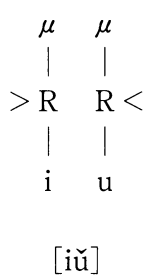
   Since the system-dependent particle representation of *ü* does not concern us, we will not get any further of the issue.

One point which merits attention is that the interpretation of particles depends on the system per se. For instance, the particle *a* represents [a] in a language with one central vowel alone, and [ʌ] in a language with three central vowels. The vowel [ɨ] is not an empty vowel. Vocalic just like all other vowels, it is unique in the absence of tonality and aperture (hence no elementary particles).

In Schane's (1984) work on particle phonology, fission and fusion act directly on the particles. With the progress of phonological representation, fission/fusion that characterizes diphthongization/monophthongization no longer operates on individual particles but rather on the root nodes that dominate those particles (Schane 1995:587). Though a multitiered representation with five distinct levels, namely a syllable tier, a nucleus tier, a timing tier, a root tier, and a particle tier, is adopted to present the syllable (Schane 1995), the latter three suffice to present monophthongization and diphthongization.

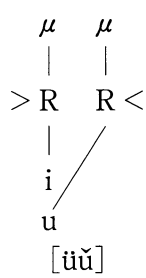
Let us now consider how monophthongization takes place. The converging arrow heads around the R nodes in (2a-b) denote the fusion operation that will lead to (2c). (2b) indicates the sharing of the particle u before the two root nodes completely overlap.

(2) (a)



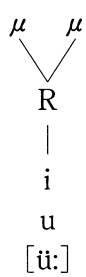
[iŭ]

(b)



[üŭ]

(c)



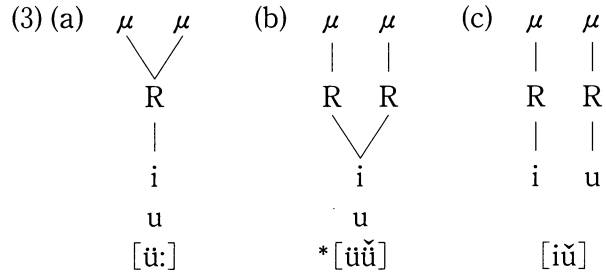
[ü:]

Different diphthongs may monophthongize to the same vowel. As will be presented later in this paper, both *iu* and *ui* which exemplify different distributions of the particles *i* and *u* fuse to *ü*.[6] It is clear that particle composition instead of temporal sequencing matters. If the internal structure of the above diphthongs is taken into consideration (i.e., which one between the two high vocoids serves as the nucleus vowel), anyone in [iŭ], [ĭu], [uĭ], and [ŭi] can fuse to *ü*. Though a rising diphthong is associated with one timing slot and a falling diphthong two timing slots (see Schane 1995:588), that fusion operates on the root nodes explains why the outcome remains the same.

Opposite to monophthongization which concerns the fusion of two root

6. Note that vowel length is ignored here for it is not crystal clear from the published Chinese data to be discussed.

nodes into one, diphthongization defines the splitting apart of one root node into two. As seen below, the fission of the root node of the monophthong in (3a) produces the ill-formed intermediate structure of (3b), where both tonality particles are doubly-linked to the root nodes. Since diphthongal differentiation demands that the two halves of a diphthong not have all particles in common, this OCP violation is resolved in (3c) by redistributing the *i* particle to the left root node and the *u* particle to the right root node.



A monophthong may split up to create different diphthongs. For example, the fission of *üi*: may yield four theoretically possible diphthongs, inclusive of [iŭ], [ĭu], [uĭ], and [ŭi]. As will be presented in section 3.2, the second and fourth diphthongs, which prepare for later high vocoid friction, are widely attested in Chinese dialects.

Note that before associated to the skeletal slots, autosegmental features are unordered, and some of them also represent phonological traits such as aperture, palatality, and labiality. An ensuing question concerns if autosegmental features are functionally equivalent to Schane's elementary particles.[7] The answer is negative in that particle phonology is adopted in this paper not only because of the irrelevancy of temporal sequence of the elementary particles but also because of representational simplicity. Specifically, any theory of feature geometry (Sagey 1986, among others) is not adequate in dealing with fusion and fission. We acknowledge that the tree metaphor is appropriate, and yet the details are messy, as stated clearly in Brasington (2003):

> "When two segmental positions linked to a single root node differentiate, the tree must split right up the trunk with both positions duplicating the major features but with some finer branches allocated to one position and some to the other. In fusion two adjacent trees grow together forming one root node. Assuming underspecification, the new segment contains just the marked features."

7. I thank one of the reviewers for bringing up this issue to my attention.

3. Data and Analysis

This section uses three phonological operations, namely fusion, fission, and decay, to elucidate the necessity of a particle analysis of *üi*. A wide array of data from Chinese dialects is presented to facilitate the reader's understanding of later argumentation.

3.1 Fusion

This section exploits Z rime changes in Zhengzhou and Huojia to show that *üi* derives from merger of *u* and *i*.

Zhengzhou (Lu 1991) is a Mandarin dialect spoken in Henan province. Its Z rime change[8] has important bearing on the underlying representation of *üi*. Consider the examples in (4) where all the stem vowels are high (Lu 1991:22, 138). Following Lin's (1993) analysis, we propose that Z rime change in Zhengzhou is created by *u* suffixation. Schwa insertion[9] occurs in order not to violate the general dissimilatory constraint in the Mandarin family banning two adjacent high vocoids, and then vowel assimilation to the postnuclear glide produces the desirable output, as demonstrated in (5).

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8. Z rime change is a morphological operation functionally analogous with *ts1* suffixation in Beijing Mandarin, for instance, *tʂuo ts1* 'table' and *i ts1* 'chair'.
9. One referee pointed out that Z words in Zhengzhou exhibit a dichotomy of *a* and *o* in the nucleus which is attributed to the division between low and non-low in the stem counterpart. Therefore, schwa insertion is just a descriptive shorthand for this basic vowel contrast. We maintain that schwa insertion is indeed necessary. A large-scale survey of *er* suffixation in the Mandarin and Jin families (Hsu 2002) reveals that high nucleus vowels unanimously surface as the corresponding medials, as exemplified by the following Daning data (Hou and Wen 1993:472-474).

(i)	stems	*er* words	
a.	tɕi	tɕiər	'chicken'
b.	tʰu	tʰuər	'rabbit'
c.	ü	üər	'fish'

The generalization holds true of Z rime change in Zhengzhou (see (4) in the text) and secret languages in the Mandarin family (Bao 1990). Theoretically speaking, the nucleus vowel in the derived words in (4), can emerge due to vowel insertion or it exits underlyingly. The latter approach is given up here for it complicates the matter. Specifically, the problem rests with which one between *o*, *ə*, and *i* (cf. Hsu 2002, Hsueh 1986) is the underlying vowel and how the whole vowel system is built up. For explanatory elegance and presentational simplicity, schwa insertion is posited here to accommodate the data. The o in Zhengzhou Z words thus ensues from assimilation of an underlying or inserted *ə* to the following suffixal *u*.

(4)

	Stem	*Z* Words	
a.	ni	niou	'lass'
b.	ku	kuou	'drum'[10]
c.	tɕü	tɕüou	'foal'

(5) ni+u→niu→niəu→niou

In addition to schwa insertion, metathesis presents another strategy to avert the dissimilatory constraint against two executive high vocoids. Crucial examples are listed in (6). Two points merits attention here. First, Z rime change affects the underlying representation. From (7a-b), Z rime change targets the underlying [ə] rather than the surface [e] which is shown in the stem column for (6a) and (6c). Second, fusion between *u* and *i* in (7b-c) leads to *ü*.

(6)

	Stem	*Z* Words	
a.	pʰei	pʰiou	'raw product'
b.	pai	piau	'darnels'
c.	kuei	küou	'cabinet'
d.	kʰuai	kʰüau	'chopsticks'

(7) a. pʰəi+u→pʰiə+u (metathesis)→pʰiou (assimilation)
b. kuəi+u→kuiə+u (metathesis)→küou (fusion, assimilation)
c. kʰuai+u→kʰuia+u (metathesis)→kʰüau (fusion)

An important question arises as to why metathesis takes place. Theoretically speaking, there exist other ways of preventing the occurrence of two adjacent high vocoids. For one thing, vowel fusion between the stem coda *i* and the suffixal *u* gives rise to *ü* (cf. example (12)); for another, coalescence between the stem nucleus and the stem coda creates *e*. Yet, the former is rejected since *ü* never serves as an off-glide, and the latter fouls because *e* cannot be followed by *u*. (The phonotactic constraints also apply in Huojia to be discussed shortly.) In the last resort of avoiding possible adjacent high vocoids, metathesis becomes necessary.

Huojia (He 1989:12-19), another Mandarin dialect spoken in Henan province, behaves very much similar to Zhengzhou in Z rime change if vowel length is ignored. In addition to the above-mentioned metathesis, vowel assimilation,

10. As observed in Lin (2002b), *er* affixation may produce forms which violate the working constraints of Mandarin dialects. Therefore, finals such as *uou*, *üou*, and *üau* (see (4) and (6)) offending the labial constraint and *üu* in (8) contravening the ban against two executive high vocoids are realized.

and vowel fusion, two rules operate in Huojia: (a) *a* and *u* merge into *o*, and (b) *ə* deletes when sandwiched by two [+round] vocoids. Important data are given in (8). Once again, the derivational paths in (9c-d) witness the merger of *u* and *i* into *ü*.

(8)

	Stem	*Z* Words	
a.	kai	kio	'lid'
b.	pei	pi:ou	'back'
c.	k^huai	k^hüo	'chopsticks'
d.	suei	süu	'ear of grain'

(9) a. kai+u→kia+u (metathesis)→kio (merger)
b. pəi+u→piə+u (metathesis)→piou (assimilation)
c. k^huai+u→k^huia+u (metathesis)→k^hüo (fusion, merger)[11]
d. suəi+u→suiə+u (metathesis)→süəu (fusion)→süu (deletion)

The same vowel merger takes place in Jianou, as displayed in the following comparison with Fuzhou and Xiamen (Beijing University 1989:159-170). The derivational history in (11) treats Fuzhou as the point of departure for *-uei* is highly analogous to Wang's (1980) Middle-Chinese reconstruction *-uɒi* for *Xie* H-I[12] syllables. Nucleus vowel deletion[13] followed by vowel coalescence gives rise to *ü*.

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11. In fact, fusion and merger indicate the same phonological process. Different labels are used here to distinguish coalescence between *i* and *u* on the one hand and that between *a* and *u* on the other.
12. Hereafter, the italics indicates a Middle-Chinese rime group, K/H denotes the [-round]/[+round] distinction of the first segment in the final, and the Roman capital numeral stands for one of the four divisions.
13. Nucleus vowel deletion affects a wide range of Chinese dialects. The first witness comes from Yantai (Yin et al., 1993). A comparison with other thirty-five dialects in Shangdong reveals the phonological process.

(i)

Other 35 Dialects	Yantai	
uei	ui	*Xie* H-I, II, III/ *Zhi* H-III (mostly)
iou	iu	*Liu* K-III

The correspondence between Xiamen and Guangzhou, seen below, lends further support for nucleus deletion. According to Zhan et al. (2002), this rule applies in quite a few Yue dialects other than Guangzhou.

(ii)

Xiamen (lit.)	Guangzhou	
iam/p	im/p	*Xian* K-III, IV
ian/t	in/t	*Shan* K-III, IV
uan/t	un/t	*Shan* H-I, II
uan/t, ian/t	ün/t	*Shan* H-III, IV

(10) Fuzhou	Xiamen	Jianou	
luei	lui	lü	'tired'
tuei	tui	tü	'team'
uei	ui	ŋü	'mast of a ship'

(11) uei→ui→ü

As component elements of *ü*, the two tonality particles *u* and *i* do not care about their temporal relation in the fusion operation. An arithmetic formula such as 1+2=2+1=3 illustrates. Consider reflexes of *Liu* K-III syllables in three modern Wu dialects Yongkang, Huangyan, and Baoshan (Qian 1992:243-248). Yongkang is posited as the start point of rhyme evolution due to its close match with Wang's (1980) Middle-Chinese reconstruction. Again, nucleus vowel deletion together with vowel fusion arrives at the end point *ü*, as demonstrated in (13).

(12) Yongkang	Huangyan	Baoshan	
liəu	liu	lü	'flow'
tɕiəu	tɕiu	tɕü	'nine'
ɲiəu	ɲiu	ɲü	'cow'
ʔiəu	ʔiu	ʔü	'excellent'

(13) iəu→iu→ü

To sum up, we have shown that both *ui* and *iu* yield *ü*. The combination positions in the literature which represent *ü* as fixed vowel sequences underlyingly fail to reflect the panorama of the empirical reality. In contrast, particle phonology has the merit of accommodating opposite vowel sequencings, as will be cogently corroborated in the next section.

Additional evidence obtains from *Zhen* K-III entering-tone syllables in Suzhou (Qian 1992), as compared to Yixian (Hirata et al. 1998) and Wenzhou (Qian 1992).

(iii) Yixian	Wenzhou	Suzhou	
iɛi	iai	iɪʔ	'one'
iɛi	iai	iɪʔ	'the second of the ten "Celestial Stems"'
tʃɛi	tɕiai	tɕiɪʔ	'auspicious'
tʃʰɛi	tɕʰiai	tɕʰiɪʔ	'beg'

From all the data above, the alternative of vowel insertion is rejected for the unpredictability of the epenthetic vowel. Note that nucleus vowel deletion occurs in the four Pinghua varieties in (19) as well.

3.2 Fission

Just as a fusion rule, fission rules reflect the particle composition of *ii*. This section demonstrates how the split of *ii* into two component particles[14] prepares for future high vocoid friction.

Before getting into the details, let us digress to introduce the pervasive high vocoid friction in Hakka dialects.[15] Take Sixian Hakka (Yang 1957) for instance. Syllables cannot begin with *u*, irrespective of its syllabicity.

(14) a. *u, *un, *uŋ, *ut, *uk
b. *ua, *ue, *ui, *uai, *uan, *uat, *uen, *uet

The asterisked forms in (14) emerge in disguise. As (15) indicates, if *u* serves as the nucleus vowel, there appears a *v* before it at surface. As a medial, it is replaced by *v* instead.[16]

(15) a. vu, vun, vuŋ, vut, vuk
b. va, ve, vi, vai, van, vat, ven, vet

The same thing happens to *i*. From (16), Hailu Hakka (Yang 1957) prohibits a syllable initiated by *i*, be it a nucleus vowel or a medial. The nucleus *i* in Sixian finds its counterpart in Hailu preceded by a [ʒ]. In contrast, the prenuclear *i* in Sixian is realized as [ʒ] in Hailu.

14. Though somewhat hard to believe from the angle of syllable structure in Chinese, that *Shan* H-III syllables are characterized by complex medial glides, *iu* or *ui*, is reported in Gan dialects (Huang 2003).

(i) Ruijin -iuoɛn 'soft' -iuoɛʔ 'moon'
Wantsai -uien 'far', 'abyss' -uieʔ 'joy', 'read'

15. Hakka dialects vary with the extent to which high vocoid friction operates. Both /i/ and /u/ are affected in Hailu without exception. Sixian allows /u/ to be the only target. In Zhaoan (Chen 2002), the output of /u/ friction is /b/ instead of /v/ due to dialect contact with Taiwanese Southern Min, and only reflexes of *Tong* H-III syllables undergo /i/ friction.

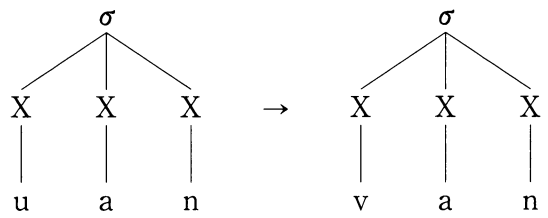
16. We acknowledge that a unified analysis of examples in (15) requires three rules, namely onset spreading, onset friction, and glide deletion due to the CG labial constraint (Hsu forthcoming). The surface description suffices for the current discussion though.

(16) Sixian	Hailu		Sixian	Hailu	
i	ʒi	'clothes'	iaŋ	ʒaŋ	'win'
im	ʒem	'sound'	ioŋ	ʒoŋ	'sheep
in	ʒen	'reason'	iok	ʒok	'appointment'
ip	ʒɨp	'juice'	iap	ʒap	'leaf'
it	ʒɨt	'benefit'	iet	ʒat	'read'
.....			iak	ʒak	'wave'
iu	ʒu	'have'	iun	ʒun	'cloud'
ia	ʒa	'wild'	iuŋ	ʒuŋ	'use'
ieu	ʒau	'monster'	iut	ʒut	'depression'
iam	ʒam	'salt'	iuk	ʒuk	'nurture'
ian	ʒan	'smoke'			

An ensuing question concerns why and how high vocoid friction takes place.[17] It is possibly motivated by the preference for an onset with lesser sonority. More precisely, Sonority Dispersion Principle (Clements 1990) which demands maximal and most evenly distributed rise in sonority between the onset and the nucleus is the rationale behind the sound change. As pointed out in Shi (1998), when initiating a syllable, a high vowel in many Chinese dialects exhibits strong friction without respect to syllabic position. High vocoid friction provides robust support for Duanmu's (1990, 2000) position that every syllable must have an onset. The mechanics of high vocoid friction varies from dialect to dialect depending on the belonging of the medial to either the onset or the nucleus. Take the medial *u* for instance. It is part of the onset in Beijing Mandarin (Bao 1990, 1996), and part of the rime in Sixian Hakka (Chung 1989). Though not widespread in Beijing Mandarin, some speakers have *u* friction as in *vei* 'taste' and *vən* 'smell'. Let us now give an autosegmental demonstration of how high vocoid friction occurs, adopting Duanmu's three-X syllable template (with the nucleus in the middle). As seen, (17a) presents *u* friction keeping the association between the melodic tier and the skeleton tier intact, while (17b) involves delinking and reassociation between *u* and the skeleton tier. Note that a rising diphthong occupies one X slot.

17. One reviewer of this paper is gratefully acknowledged for bringing up this issue to my attention.

(17) a.



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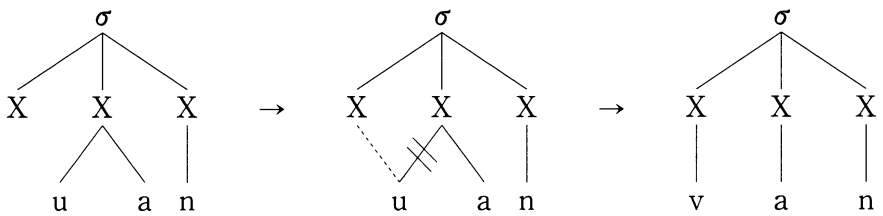

It is generally held by Chinese historical phonologists that Division III rimes and most Division IV rimes show the prevocalic *i*,[18] round rimes represent the prevocalic *u*. Consequently, Division III-IV round rimes feature the complex medial *iu*. Unless necessary, this paper will put historical development aside and focus on synchronic dialect comparison pivoting upon *ü* as the start point mainly because both *iu* and *ui* are attested in modern dialects, as will be shown shortly.

It is now time for us to examine through high vocoid friction how *ü* is split into two segments. First consider the correspondences of some *Shan* H-III syllables in (18). In the vocabulary of particle phonology, both Xiamen and Meixian (Beijing University 1989) have one of the complex component particles missing as a result of decay (see also section 3.3). Hailu is one step ahead Meixian due to *i* friction. The forms in Wuping and Yongding (Lan 1999:158) generate after *ü* is split up into *ui*, which in turn undergoes *u* friction. The *n*/*ŋ* distinction peripheral to our interest here is ignored. To set *ien* (the product of decay) aside, Pingjiang (Chen 2003:202) displays an opposite picture to Wuping and Yongding in that *ü* is first divided into *iu*, and *i* friction operates to achieve *ʒuan*. (Key: BJ=Beijing, XM=Xiamen, MX=Meixian, HL=Hailu, WP=Wuping, YD=Yongding, PJ=Pingjiang)

18. Li (1952), among others, advocates that Division IV spread rimes do not have the medial instead.

(18) BJ	XM	MX	HL	WP	YD	PJ	
üan	uan	ian	ʒan	vieŋ	viẽ	ʒuan	'round'
üan	ien	ian	ʒan	vieŋ	viẽ	ʒuan	'relationship by fate'
üan	uan	ian	ʒan	vieŋ	viẽ	ien	'feud'
üan	uan	ian	ʒan	vieŋ	viẽ	ʒuan	'yard'
üan	uan	ian	ʒan	vieŋ	viẽ	ien	'far'

In addition to Hakka dialects, Pinghua[19] (Li 2000:245, 249), one of the ten dialect groups in Chinese (Li 1989), exhibits quite the same picture regarding *Shan* H-III syllables.

(19) Nanning	Lingui	Fusui	Loongzhou	
ün	uin	vin	in	'round'
ün	uin	vin	vin	'yard'
ün	uin	vin	vin	'relationship by fate'
ün	uin	vin	in	'source'
ün	uin	vin	in	'wish'

In contrast with the temporal sequencing of *ui*, the reverse *iu* is detected in Jin dialects (Hou and Wen 1993).[20] Before proceeding to the main discussion about *er* affixation in Pingding (Xu 1981) and Xiyang (Hou and Wen 1993), another *i* friction reminiscent of what happens in Hailu Hakka requires an introduction. As displayed in (20), the nucleus *i* develops into *zɪ* due to *i* friction,[21]

19. Pinghua is spoken in Guangxi (mostly), Hunan, and Yunnan provinces.
20. Other than dialect comparison, English development vs. child phonology in Mandarin Chinese further manifests the irrelevancy of temporal sequencing of component particles in the underlying representation of *ü*. Borrowing of French /ü/ at the stage of Middle English constitutes one of the historical origins of modern /ju/. Schane (1984:135) states that "the complex particle configuration of a monophthong is split up to become a sequence of particles for the diphthong." Also "the not infrequent interpretation of cardinal vowel *ü* as [i͡u] by untrained English speakers," as observed by Roca and Johnson (1999:220), sheds important light on the vowel-prime analysis. The opposite vowel sequence is found in child phonology of my younger son who has mispronounced *tɕü* meaning 'tangerine' in Mandarin Chinese as *tsui* recently.
21. Sino-Vietnamese (Li 2000) lends robust evidence for the process of prenuclear *i*→*z*. The Middle-Chinese *Yi*-initial syllables ranging from Open-mouth Division III in *Jia, Zhi, Liu, Xian, Shen, Shan, Zhen, Dang, Zeng, Geng* rime groups to Closed-mouth Division III in *Yu* and *Tong* rime groups all start with *z* in Sino-Vietnamese. The reader is referred to Li (2000) for specific examples.

which then becomes the syllabic *ʐ̩*.[22] The data below are adopted from Hou and Wen (1993:157, 160).

(20) Taiyuan	Fenyang	Fenxi	
i	zɿ	ʐ̩/nʐ̩	'clothes'[23]
i	zɿ	ʐ̩	'mother's sisters'
i	zɿ	nʐ̩	'suspicion'
ni	nzɿ	nʐ̩	'mud'

When it comes to the nucleus *ü*, the previous occurrence of *iu* due to vowel fission explains why *zu* occurs in Lishi and *ʐu* occurs in Huozhou (see (21), adopted from Hou and Wen (1993:167, 169)). Note that the nasal initials for the example meaning 'fish' may result from an extension of the so-called "automatic onset,"[24] a widespread phonological process targets the medieval syllables with *Ying/Yi*-initials and open-mouth finals in many Mandarin dialects from Heilongjiang to Yunnan (Qian 2002, among others). Take *ai* 'love' in Beijing Mandarin for instance. Its counterparts in other dialects take an onset varying from *ŋ*, *n*, *ɲ*, *ɣ*, *ʐ*, to *ʔ*.

(21) Taiyuan	Lishi	Huozhou	
nü	nzu	ɲü/ʐu	'female'
ü	nzu	ü/ɲü	'fish'

The composite nature of *ü* also shows when it serves as the medial. Consider the correspondences between Taiyuan and Qinxian. As demonstrated in (23) below, the earlier split of *ü* into *iu* paves the way for both *i* friction which changes *iu* into *zu* and consonant merger whereby *tsʰ* derives from combining the affricateness, voicing, and aspiration of *tɕʰ* and the dental place of articula-

22. A mirror-image development happens to *u* (Wen and Hou 1993:166).

(i) Pingyao Taiyuan Fenxi
u vu β̩ 'black'

The same vowel development is seen in Hakka dialects in western Fujian (Lan 1999:146) and dialects in Anhui (Meng 1997:21, 460).

(ii) Beijing Shanghang Wuping
u vu ʋ̩ 'black'

(iii) Shouxian Fengyang Jixi
u vu ʋ̩ 'force, warlike'

23. The emergence of the onset *n* in Fenxi will be explained shortly.
24. I am indebted to Professor Kuang-yu Chang for the suggestion.

tion of z to comply with the negative constraint on complex onsets. An arising question concerns if *i* friction is necessary for the first two examples in Qinxian (see (22)). If it were skipped, we would pay costly for it. First, it is relatively unnatural for *tɕʰiuei* to become *tsʰuei*, whereas palatalization of *ts* triggered by the following *i* is widely seen. Second, we would miss the generalization that *i* friction is not limited to onsetless syllables, as manifested in Fenyang, Fenxi, and Lishi (see (20) and (21) above).[25, 26] Note that the same phonological processes take place in *er* affixation in Pingding and Xiyang to be presented shortly.

(22)

Taiyuan	Qinxian	
tɕʰüæ	tsʰuei	'complete'
tɕʰüæ	tsʰuei	'fist'
üæ	zuei	'yard'

(23) a. tɕʰüei→tɕʰiuei (vowel fission)→tɕʰzuei (*i* friction)→
tsʰuei (consonant merger)
b. üei→iuei (vowel fission)→zuei (*i* friction)

Since the publication of Xu (1981), *er* affixation in Pingding has invoked a few generative analyses (Lin 1989, 2002b, among others). Of particular interest to us is that *ü* in this dialect fits into the spirit of particle phonology. Three generalizations deduced from data in (24) through (26) which are adopted from Lin (2002b) are: (a) the affixing *l*[27] always occurs after *i* and before *u*,[28] be they

25. Sincere thanks go to one anonymous reviewer for raising the important point.
26. Another point to note is that irrespective of syllabic position, *u* friction is not confined to the case of zero onsets either, as seen in the correspondences between Beijing Mandarin and Wudu (Shi 1992) below.

(i)

Beijing	Wudu	
ʐu	zfu	'if'
ʐuei	zfei	'sharp'
ʐuan	zfan	'soft'
ʐuən	zfən	'moist'
ʐuŋ	zfən	'fluff'

That all the examples above descend from medieval H-III syllables implies the existence of an earlier form with the medial *ü*. To take a step further, the regularity that the *ri*-initial onsets all the examples suggests the derivational paths of vowel fission (*ü→iu*) followed by *i* friction (*iu→zu*). The interested reader is referred to Li (1982) for relevant details.

27. Yu (2004) maintains that the affixing *l* is actually an excrescent segment due to rhotic metathesis. The development in (30) clearly shows *l* suffixation rather than infixation.
28. Where *l* is placed seems related to the belonging of the two high vocoids. The issue awaits further study. In a syllable without a high medial or nucleus, *l* occurs right before the non-high nucleus, as seen below (Xu 1981).

the medials or the nucleus vowels, (b) the palatal onsets *tɕ*, *tɕʰ*, and *ɕ* convert into their dental counterparts *ts*, *tsʰ*, and *s* due to *i* friction followed by consonant merger,[29] and (c) *ü* is treated as a vowel configuration of *iu* when *er* affixation occurs.

(24)	roots		*er* affixed stems		
	mən	tüɤŋ	mən	tɭuɤŋ	'hold on the door'
	ɕiɒɔ	suɤ	ɕiɒɔ	sɭuɤ	'small lock'
	ɕiɒɔ	tsʰuɤŋ	ɕiɒɔ	tsʰɭuɤŋ	'small scallion'
	xu	lu	xu	lɭu	'gourd'
		uɤ		ɭuɤ	'nest, den'

(25)	roots		*er* affixed stems		
		tɕiɤŋ		tsɭɤŋ	'today'
		tɕʰiɤu		tsʰɭɤu	'ball'
		ɕiɤŋ		sɭɤŋ	'apricot'
	ʂɤu	tɕüæ̃	ʂɤu	tsɭuɐ	'handkerchief'
		tɕʰüæ̃		tsʰɭuɐ	'circle'

(26)	roots	*er* affixed stems	
	iɤŋ	zɭɤŋ	'shadow'
	ü	zɭu	'fish'
	üe?	zɭuɤ	'moon'

Specific derivations are given in (27). In case when a syllable in Pingding begins with an onset consonant, *i* friction together with *l* affixation creates an output with an illegitimate tri-consonantal cluster (cf. Lin 2002b). Again, consonant merger operates to abide by a requirement on the onset size.[30] Note that rule

(i)

roots	*er* affixed stems	
tæɛ	tɭɐ	'bag'
tɤu	tɭɤu	'bean'
tɒɔ	tɭɒɔ	'path, road'
pɤŋ	pɭɤŋ	'base'
$k^hA?$	$k^hɭA?$	'shell'

29. The following *er* affixed examples in Pingding (Wen and Hou 1993:420) indicate that *i* friction occurs regardless of its syllabic position.

(i)

roots	*er* affixed stems	
ɕiɛ	sər	'few'
tɕi	tsər	'chicken'

30. Though offending the general constraint of no complex onset in Chinese, some *er* affixed words in Pingding survive since in addition to *lɭu* 'gourd,' the sequence of an obstruent followed by an *l* (an alveolar lateral) conforms to the Sonority Sequencing Principle (Kenstowicz 1994:254) anyhow.

ordering between *l* affixation and *i* friction does not matter since where to accommodate the retroflex lateral is fixed.

(27) a. tuɤŋ→tɭuɤŋ (*l* affixation)
b. tɕüæ̃→tɕiuæ̃ (vowel fission)→tɕiɭuɐ (*l* affixation)[31]→
tɕzɭuɐ (*i* friction)→tsɭuɐ (consonant merger)
c. ü→iu (vowel fission)→iɭu (*l* affixation)→zɭu (*i* friction)

One point worth mentioning lies in that consonant merger targets the palatals alone. Examples in (28), adopted from Xu (1981) and Wen and Hou (1993: 420), vindicate the inertness of consonant merger. The observation holds true in Xiyang (Hou and Wen 1993:424), as shown in (29).

(28)	roots	*er* affixed stems	
a.	tiæ̃	tɭɐ	'point'
b.	li	lɭ̩	'pear'[32]
c.	piæ	pɐr	'margin'

(29)	roots	*er* affixed stems	
	piæ	pɐr	'margin'
	miəŋ	mə̃r	'life'
	liɑŋ	lɑ̃r	'cool'
	tiəʔ	tər	'butterfly'
	tɕi	tsər	'chicken'
	tɕʰüæ	tsʰuɐr	'circle'
	ü	zuər	'fish'
	üəʔ	zuəɤ	'moon'

Why consonant merger simply affects the palatals calls for an account. We propose that the compatibility between the root onset and the *z* resulting from *i* friction provides an answer. Specifically, *z* shares more phonetic features with an affricate or a fricative than other consonants. Under the pressure of onset size requirement, *z* gets deleted if unable to coalesce with the root onset. That *l* is syllabic in (28b) gives strong support for *z* deletion, as demonstrated below. Note that *lil* presents a more unmarked syllable than the desired output. Without the application of *i* friction and *z* deletion, the question of what motivates the syllabicization of *l* remains open. In addition, the stage of *ll*, a degenerate

31. The *æ̃/ɐ* alternation due to *er* affixation is ignored here.
32. The retroflex lateral is syllabic in this example.

syllable without the nucleus, finds indirect witness in another subdialect pronunciation $l^{ə}l$ in which the schwa is a transitional sound.[33]

(30) li→li$\underset{\downarrow}{l}$ (*l* affixation)→lz$\underset{\downarrow}{l}$ (*i* friction)→l$\underset{\downarrow}{l}$ (*z* deletion)→l$\underset{\downarrow}{l}$

So far, we have shown that *ü* can be split up to become either *ui* or *iu*. The duality echoes with Schane's (1984:135) claim that "diphthongs that exhibit different sequences of the same combinations of particles must be linked to the same monophthong." Specifically, *ui* and its mirror image *iu* composed of the two tonality particles (*i* and *u*) are both linked to *ü*. Additional support for the unimportance of sequential arrangement of component particles obtains from reflexes of two *Shan* H-I syllables in four Pinghua varieties (Li 2000:238) and correspondences of some *Yu* H-III syllables in four Hakka dialects (Chen 2002: 120). Note that both *ui* and *iu* occur in Lunbei. Not only ultradialectal but also intradialectal variation occurs.

(31) Nanning	Lingui	Funing	Binyang	
ün	uin	vin	iun	'finish'
ün	uin	vin	iun	'dumpling'

(32) Xiuzhuan	Lunbei	Nanxing	Yaoping	
ü	kui	ki	ki	'sentence'
ü	kui	kui	ki	'ditch'
$k^hü$	k^hui	k^hui	k^hiu	'go'
$k^hü$	k^hiu	k^hi	k^hi	'area'

Besides high vocoid friction and dialect difference, *er* suffixation in Shouguang (Zhang 1996), a Mandarin dialect in Shandong province, further embodies fission of *ü*. Two rules are at play to achieve the desirable outputs in (33): (a) fusion of the prenuclear *i* and the nucleus vowel and (b) vowel nasality deletion. The *er*-suffixed form in (33d) generates only if the morphophonemic process operates after *ü* has split up to become a sequence of *ui*, as shown in parentheses.

(33)	Stem	*er* word	
a.	tiã	tɛr	'spot'
b.	$t^hiã$	$t^hɛr$	'sky'
c.	tsiã	tsɛr	'sharp'
d.	$ts^hüã$ ($ts^huiã$)	$ts^huɛr$	'spring'

33. See footnote 3 in Xu (1981).

Additional force to *üi* fission lies in syllable contraction in Zhengzhou (Lu 1991:25-27). Every syllable in Chinese presents a three X-slot template, with the nucleus in the middle (Duanmu 1990, 2000). To create the desired contracted form in (34), four steps are in order. As demonstrated in (35), syllable contraction first turns two syllables into one. Edge-in association (Yip 1988) then associates the onset of the first syllable and the coda consonant of the second syllable with the edge X-slots of the contracted output. Third, the most sonorous ə emerges as the output nucleus. Syllabification ensues and the CG labial constraint eliminates ill-formed syllables.

(34) pu+uiəŋ (<üŋ)→piəŋ/*puəŋ/*püəŋ→piŋ 'no need'
no need

(35) UR pu uiəŋ

XXX XXX
Syllable Contraction pu uiəŋ

XXX
Edge Association pu uiəŋ
XXX
Nucleus Association pu uiəŋ
XXX
Glide Association pu uiəŋ
XXX
Surface piəŋ→piŋ

One thing to note is: syllable contraction takes place at deep where *üi* is represented as *ui* and ə serves as the nucleus. From the contracted counterpart in Beijing Mandarin, the underlying existence of ə crucially explains how the output derives.

(36) pu+üəŋ (<üŋ)→pəŋ/*puəŋ/*püəŋ 'no need'
no need

Chen's (1984) rhyming study also argues that in *Dongzhongche* (東中轍), the

requirement of identity of the nucleus plus the coda is met in the phonemic representation which contains *ə*, as further justified by the comparison of Beijing with Fenyang (Hou and Wen 1993:200-204) and Peizhou (Hu et al. 1998:279-288). With the background knowledge, the conversion of *iəŋ* into *iŋ* at the end of (35) is without question.

(37) Beijing	Fenyang	Peizhou	
ʂəŋ	ʂəŋ	ʂəŋ	'rope'
iŋ	iəŋ	iəŋ	'camp'
nuŋ	nuəŋ	nuəŋ	'farming'
üŋ	üəŋ	üəŋ	'use'

To sum up, the output of *ü* fission can be *ui* and/or *iu* within or across dialects. The inconsistencies at the surface cannot be captured if the underlying representation of the high front rounded vowel is posited as a fixed vowel sequence.

3.3 Decay

This section employs decay, a process in which one or more of the component particles disappear, to further argue for the particle analysis of *ü*. Since the front high rounded vowel possesses a dual tonality structure, two avenues of decay are expected. Cases witnessing this operation of particle phonology are too many to be exhaustive. As is self-explanatory in (38), decay applies to *Yu* H-III syllables of the Hakka dialects except Xiuzhuan (Chen 2002:120). The comparison of *Shan* K/H-III syllables in three Yue dialects (Zhan et al. 2002:310-358) further highlights decay of *ü*, displayed in (39). Given that *ü* consists of *i* and *u*, it falls out naturally that either component particle decays, but not both to be able to trace back the compositional nature of the origin.

(38) Xiuzhuan	Lunbei	Nanxing	Yaoping	
tʃü	tʃi	tsu	tʃu	'pig'
tʃʰü	tʃʰi	tsʰu	tʃʰu	'chopsticks'
ʃü	ʃi	su	ʃu	'book'

(39) Guangzhou	Doumen	Taishan	
lün	lin	lun	'fall in love'
sün	sin	ɬun	'choose'
lüt	lit	lut	'bad'
süt	sit	ɬut	'snow'

4. Concluding Remarks

In an attempt to resolve the dilemma of opposite vowel sequences *ui* and *iu* attested in various Chinese dialects, this paper appealed to a particle analysis of *ü*, which in essence accords with the position of positing *ü* as a single vowel segment underlyingly. Three phonological operations such as fusion, fission, and decay were demonstrated to argue for the particle analysis.

A theoretical implication of the particle analysis of *ü* concerns the syllabic position of the medial in Chinese. In the literature, the behavior of *ü* varies: it is indeterminate (Bao 1996), specifically exhibits a *-u[i-* picture (Bao 1997) where the square bracket indicates the division between the onset and the rime, or is assigned the structural interpretation of *-i[u-*, with *-i-* part of the onset, and *-u-* part of the rime (Ting 1979). Though the discrepancies with respect to the syllabic position of *ü* may stem from the various data and subject matters the previous studies deal with, the particle combination of the high front rounded vowel itself somehow foreshadows the incongruity.

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漢語前高圓唇元音的粒子分析

許慧娟
國立交通大學

摘　要

北京話前高圓唇元音的底層表式素來意見分歧。本文擴大討論範圍重新審視該議題。各種音韻現象及方言比較顯示 iu 或 ui 的固定組合都不足爲取。根據 Schane (1984, 1995) 的粒子音韻學，前高圓唇元音由 i 和 u 兩個元素組成，時間順序不拘，用以詮釋諸多音韻現象及方言比較恰如其分。

關鍵詞：粒子音韻學，元音融合，元音分裂