A Fresh Look at Putonghua Onset-Rime Pairs

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0. In this article I would like to present a revised analysis of Putonghua onset-rime pairs. I will present a revised set of Putonghua onsets and rimes.[1] These will be contrasted with some current assumptions about the content of each set. It will be observed that the set of onsets will be increased slightly whilst the number of Putonghua rimes will be significantly reduced. This analysis will be done within the framework of Government Phonology[2] (GP). This current work owes a great debt to the pioneering research of Goh Yeng-seng. He provided the first treatment of Beijing Mandarin segmental phonology within the GP framework Goh (1997). Further significant research on a variety of Han languages is going on at GDUFS[3] and has lead to a greater understanding of the phonology of Han languages in general. I have attempted to apply these recent findings to this reanalysis of Putonghua. I will begin with a brief summary of some theoretical points of GP to allow the reader not familiar with this framework to better follow the reanalysis.

1. In this section I present some theoretical concepts of GP. I will begin with the GP theory of phonological representations. This section is extracted from Kaye (in preparation).

A Phonological representation consist of zero or more combinations of elements. These elements are primitives of the theory and are deemed to be universally present in every human phonological system. They are assumed to correspond to characteristic acoustic signatures in the signal. Evidence for their existence comes to us from their phonological behaviour in accordance with (1) below.

(1) The Phonological Epistemological Principle
The only source of phonological knowledge is phonological behaviour.

The universal set of elements is given in (2).

(2) E = {A, I, U, H, L, §}

and an identity element, usually represented as "_" in phonological expressions. Each element is a monovalent, (potentially) interpretable phonological expression. Its actual interpretation depends on

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[1]Actually "rime" refers to a sequence of a nucleus and a following onset (if present).

[2]See Kaye, Lowenstamm and Vergnaud (1985, 1990), Kaye (in preparation), Goh (1997) and Ma (...,....).

[3]For example, Xu Zhuo (Harbin), Pan Ning (Yichang), Chen Jie (Kunming), Lin Qiuming (Cantonese).

i. what phonological constituent (see below) dominates it and

ii. whether it occupies a head or operator position within a phonological expression (see below). As a very rough guide to their interpretation, see (3) below. The reader is warned that (3) is not exhaustive nor theoretically significant.

(3) Some element interpretations (informal)

Element	Interpretation
A	non-high vowels, “r”, coronals
I	front vowels, palatals
U	round vowels, labials
H	high tone, noise, voiceless
L	low tone, nasal, (non-spontaneous) voicing
§	non-continuants (stops, nasals, “l”)
_	“V’, “?” lax vowels, velars

The final row in (3) represents empty headed expressions.

B. Phonological Expressions

A phonological expression is an ordered pair, (**O**perators, **H**ead), such that

i. O f E (O possibly empty)

ii. H 0 E (possibly the identity element)

iii. H ó O

C. The Han Template

All Han languages analysed within the GP framework have exhibited the same template for a minimal phonological word. The Han template consists of 2 Onset-Nucleus pairs as shown in (4).

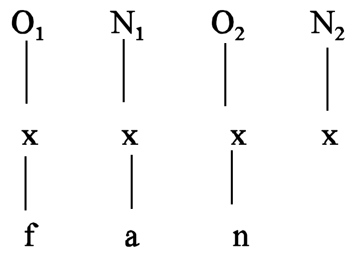
(4)

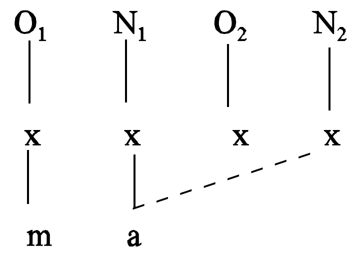
$$\begin{array}{cccc} O_1 & N_1 & O_2 & N_2 \\ | & | & | & | \\ x & x & x & x \end{array}$$

We add the further proviso that no unique lexical material (i.e. material not shared with another position of the template) may be associated to the N_2 position. As a consequence of this proviso for all Han words either O_2 or N_2 will be P-licensed (inaudible). This view differs somewhat from that of Goh (1997) in that we assume that the final expressions in words like *yao* and *mai* are associated with the O_2 position rather than the N_2 position.

Examples of the Han template applied to Putonghua are given in (5) below.

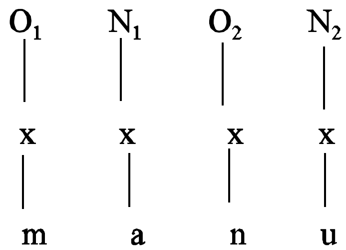
(5)





No form such as that in (6) qualifies as a possible Han word.

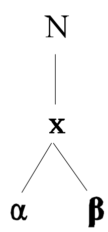
(6) Ill formed Putonghua phonological word



Contrary to the condition stated above, in (6) neither O_2 nor N_2 are P-licensed. Note in (5) above the first form contains 3 phonological expressions (abbreviated by letters): *f*, *a* and *n*. These are associated to the template positions O_1, N_1 and O_2, respectively. The second form contains only 2 expressions: *m* and *a*. Since no expression remains to identify the O_2 position, the nuclear expression of N_1 spreads to the N_2 position.

Finally, Han languages contain light diphthongs (cf. Kaye (1985)) whose structure is shown below.

(7) Light Diphthongs



where ß is the head of the diphthong

The expression, a, represents the “glide” portion of the light diphthong, while ß is the more prominent (head position) of the diphthong. Note that both expressions are associated to a single skeletal position. We are now ready to proceed with the reanalysis of Putonghua onset-rime pairs.

2. In this section I will present the reanalysis of Putonghua onset-rime pairs along with the arguments that justify these changes. These changes are principally motivated by the assumption shown in (8) below.

(8) **ASSUMPTION:** The Free Distribution Principle - Any onset should occur with any nucleus unless excluded by some explicit constraint.

A set of onset-rime pairs were extracted from the online Chinese database, CEDICT, the Chinese electronic dictionary (ftp://ftp.cc.monash.edu.au/pub/nihongo/cedict.html). Appendix A shows the data arranged in the traditional pinyin analysis of onsets and rimes. Appendix B is organised following the reanalysis of the onsets and rimes discussed in this section. The numbers in both appendices reflect the number of instances of each onset-rime pair (independent of tone) found in CEDICT. Since CEDICT contains phrases and sentences as well as individual words, the raw figures should be taken only as suggestive.

The rimes ua, uai, uang:

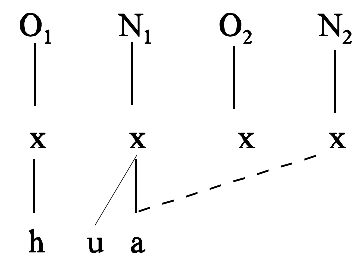
A glance at Appendix A shows that these rimes occur only after *k*, *g*, *h*, *ch*, *zh* and *sh*.

	_	b	c	ch	d	f	g	h	j	k	l	m	n	p	q	r	s	sh	t	w	x	y	z	zh
ua				1			33	277		15								12						10
uai				7			20	22		40								21						4
uang				49			98	85		62								28						89

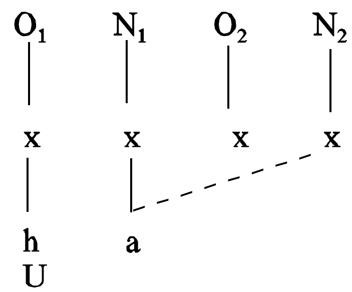
The Free Distribution Principle would lead us to expect that if *ua*, *uai* and *uang* were truly rimes, they would occur after any onset. Finding a set of rimes beginning with “u” following velars is highly suggestive of a labio-velar series of consonants, viz., k^w, g^w and k^w. In like manner we also posit a labio-palatal series of onsets, ch^w, zh^w and sh^w..[4] Thus, a pinyin form like *hua* is to be analysed as (9b) rather than the usual (9a).

(9)

a.



b.



[4]I believe scholars of Classical Chinese have postulated the labio-velar and labio-palatal series based on manuscripts and historical evidence.

The rimes *uai* and *uang* exhibit exactly the same distribution and are, accordingly given the same analysis. Thus, the rimes *ua*, *uai* and *uang* are eliminated from the rimal inventory and 6 new onsets are added: 3 labio-velars and 3 labio-palatals. The resulting rimes are analysed as the independently occurring *a*, *ai* and *ang*, respectively.

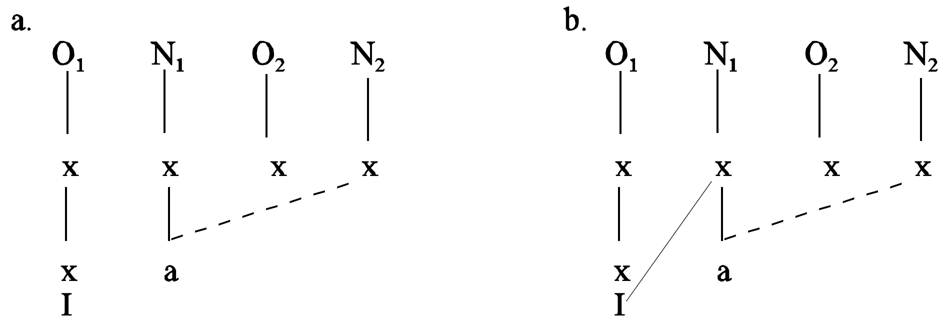
The rimes ia, iong, iang:

Returning to Appendix A, we see that these rimes occur only after the set of onsets, *q*, *j*, *x*, as well as *l* and *n* (to which we will return later). Furthermore, none of the above onsets (except *l* and *n*) occur before the rimes *a*, *ong* and *ang*.

	_	b	c	ch	d	f	g	h	j	k	l	m	n	p	q	r	s	sh	t	w	x	y	z	zh
ia									302		1				7						124			
a	56	188	19	91	314	200	11	21		23	82	116	54	22			23	61	55	33		162	21	50
iang									114		121		8		84						264			
ang	16	66	24	206	101	193	50	44		37	54	32	2	32		18	14	164	60	219		143	31	151
iong									14						15						48			
ong			45	80	174		280	68		71	58		44			78	74		245			161	62	249

Given these facts, it is clear that, say, pinyin *xia*, *xiong* and *xiang* should be reanalysed as *xa*, *xong* and *xang*, respectively. Looking at the phonological expressions associated with the pinyin characters *q*, *j* and *x*[5], we notice that *I* is present as an operator in each of them. This *I* may or may not spread from the onset position to the N_1 position forming a light diphthong. These possibilities are shown in (10) below. What is clear is that the rimes *ia*, *iong*, *iang* can be removed from the lexical inventory. They are replaced by the independently occurring rimes *a*, *ong* and *ang*, respectively.

(10)



In (10a) we see the version of xia without spreading. (10b) shows the same form with spreading. It is not clear which version is correct but either is compatible with our analysis.[6]

[5]See Appendix C

[6]Some interesting work on Putonghua fast speech phenomena has been carried out by Professor ???? at CASS. His results may well shed some light on this issue.

The Nuclear Inventory

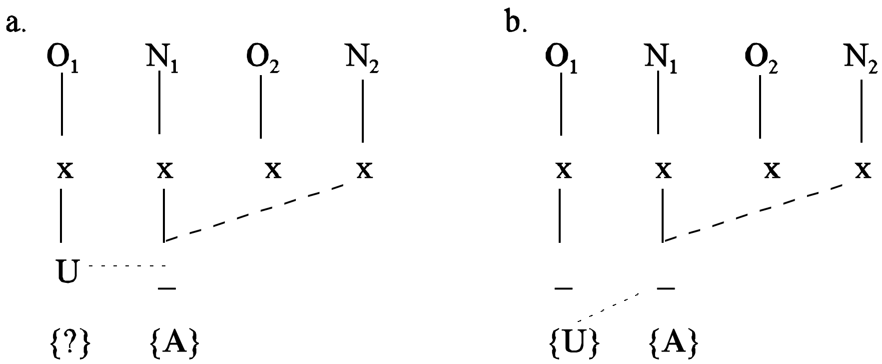
The proposed Putonghua nuclear inventory is given in Appendix D. The expressions correspond to the pinyin letters “a, i, u and e”. Following Goh (1997) we also find the empty nucleus which is rendered as either “i” or “u” in pinyin. It should be noted that pinyin “e” is sometimes pronounced [7], and sometimes as [e]. Again following Goh, I will consider only the [7][7], ({A},_), to be lexical. All cases of [e] will be derived. In like manner all cases of pinyin “o” and pinyin “ü” (or “uu”) are not lexical expression but are rather derived.

The rime “o”:

	_	b	c	ch	d	f	g	h	j	k	l	m	n	p	q	r	s	sh	t	w	x	y	z	zh
o		239				10						151		55						39				
e	90		56	88	141		189	232		258	39	13	5			30	74	131	53			179	48	222

The distribution of the “o” rime makes its origin obvious. The rime “o” occurs after all and only the onsets containing the element U in either operator or head position. It is equally clear that the rime “e” never following these “U-consonants” except in of pinyin “me”, where 13 instances occur. Inspection of CEDICT shows that all these cases involve the particle -me, which is toneless (“me5") and is not a Putonghua phonological word.[8] It seems clear that the rime “o” is derived from schwa (“e”) with U spreading from the onset to the nuclear position as shown in (11) below.

(11)



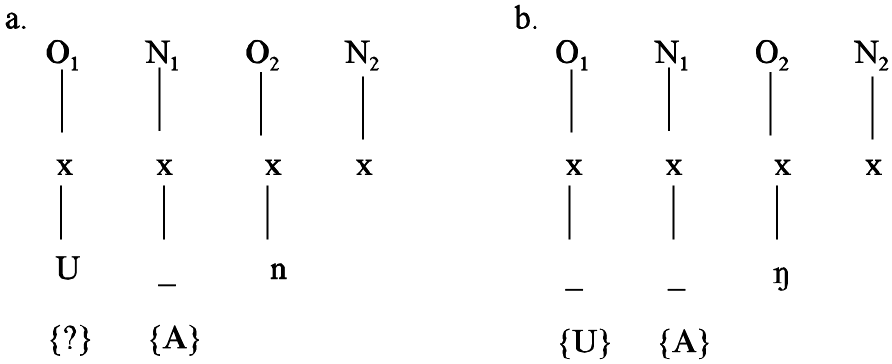
(11a) is the representation of “b7”. The U, head of the onset expression, spreads to the empty head position of the nucleus. This yields the expression ({A},U) which expresses “o”. In (11b) we present “w7”. In this case the U spreads from the operator position of the onset, again filling the vacant head position deriving “wo”. It is worth noting that U will only spread from the onset position if the O_2 is empty. Thus, we find “bo” but not *“b7” but “b7n” and “b7ng" and not *“bon” and *“bong”. U behaves exactly the same way when it is found in operator position of the onset. We get “wo” but not *“w7”,

[7]The sound [7] is called “schwa” in the literature.

[8]Cf. shen2me5, na4me5, zen3me5, etc. Note also these examples are sometimes spelt shen2mo, na4mo, etc.

"w7n" and "w7ng" but not *"won" and *"wong" The non-spreading environments are shown in (12).

(12)

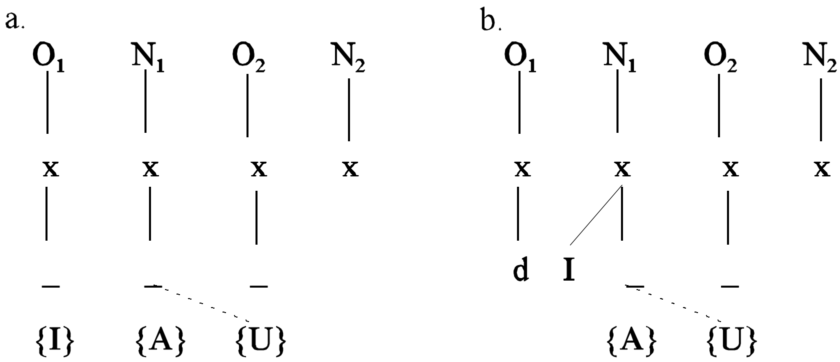


The forms "b7n" and "w7ng" are shown in (12a) and (12b), respectively. In both cases the O_2 position is filled and no spreading occurs. In sum, the rime "o" is simply "7" following an U-consonant.

The rimes "ou" and "iu":

Goh derives these rimes from "7u" and "i7u" with the U spreading from the O_2 position to the right of N_1 as shown in (13) below.

(13)



"you" is represented in (13a) with U spreading into the N_1 position to form "o". The representation of "diu" is shown in (13b) with the same spreading occurring. The element I is part of the light diphthong "ie". The rimes "ou" and "iu" should be replaced by "7u" and "i7u", respectively.

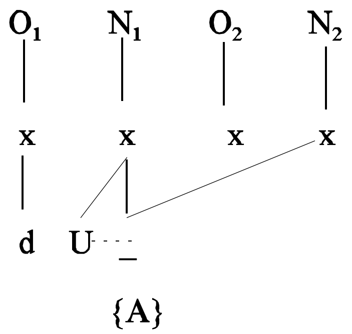
The rimes ao and iao:

This is simply a pinyin spelling convention. In reality "(i)ao" is "(i)au" with the "u" occupying the O_2 position of the template.

The rime uo:

This rime is an authentic light diphthong. It consists of U followed by schwa. Under normal conditions the U with spread into the empty head of the schwa creating an “o” as shown in “duo”, (14) below.

(14)



The rime “uo” can now be derived from “u7”.

The rime ong:

Recall that we have combined the rime “iong” with “ong”, with the former occurring following I-consonants (consonants having an I operator) and the latter occurring elsewhere. Notice that “o” and “u” never contrast before “n” and “ng”. We find “un” but not *“on” and “ong” but not *“ung”. In the absence of any clear reason to consider the nucleus of “ong” to be ({A},U) rather than ({},U), I assume that “ong” merely reflects a pinyin writing convention and that the “ong” rimes should be analysed as “ung”.

The rime e:

The pinyin letter “e” is confusing in that it is sometimes pronounced [e] and sometimes, [7]. In the reanalysis I prefer the letter “7” ({A},_) to avoid this confusion. I will now consider rimes containing the letter “e” pronounced [e] ({A},I).

The rime ie:

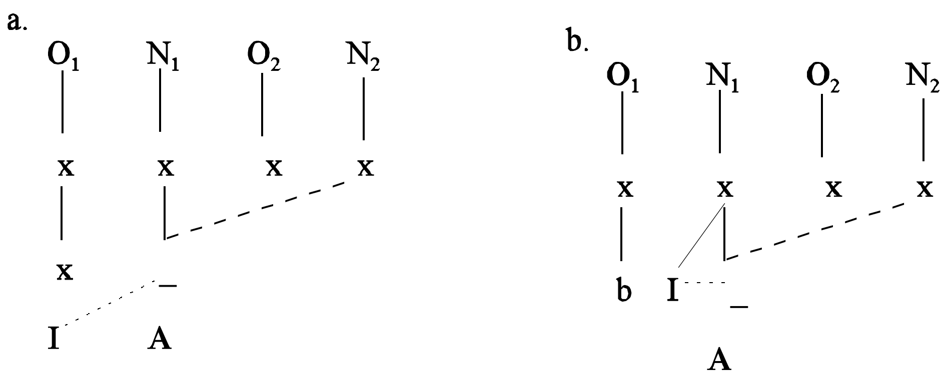
I analyse “ie” in two different ways according to whether “ie” follows an I-consonant or not. I will begin with the I-consonant case.

	_	b	c	ch	d	f	g	h	j	k	l	m	n	p	q	r	s	sh	t	w	x	y	z	zh
e	90		56	88	141		189	232		258	39	13	5			30	74	131	53			179	48	222
ie		56			37				391		65	16	26	7	47				31		174			

Comparing the distribution of the rimes “e, ie” following the I-consonants “q, j, x” shows that only “ie” occurs. “*qe, *je, *xe” are all impossible. As we saw above in the case of the rime “ia”, “ie” is merely a writing convention of pinyin. “ie” is simply the rime “7” following an I-consonant. The element I in the onset will spread to the vacant head position of N_1 creating the [e] sound.

“ie” also occurs after labials “p, b, m” and coronals “d, t”. It also occurs after “l, n” but this case will be discussed below. Since there is no source for I in labial and coronal onsets we must assume that “ie” has the structure of a light diphthong in these cases. There is no spreading involved; the I element is lexically present in the nucleus. It does spread to the vacant head of the light diphthong. Both cases are shown in (15) below.

(15)

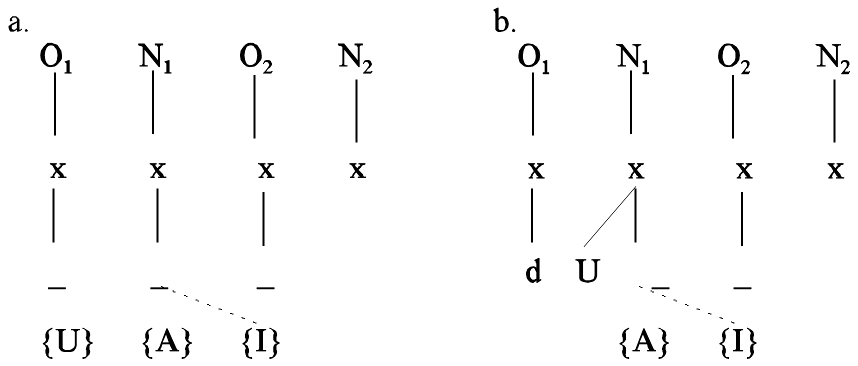


The I-consonant case is illustrated in (15a) using the word “xie”. In (15b) the light diphthong case, “bie” is shown. Note that both cases provide a local source for the I element which can then spread to the headless A (schwa) forming [e].

The rimes ei and ui:

These cases are exactly parallel to the “ou” and “iu” cases discussed in (13) above. They are derived from “7i” and “u7i”with the I element in O_2 spreading to the empty head in N_1

(16)

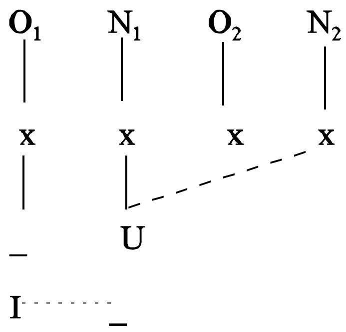


(16a) shows the derivation of “wei”; (16b), the derivation of “dui”. As indicated above we see the I element spreading to the vacant head position in N_1 forming ({A},I), i.e. [e].

The rime ü (uu):

A glance at the distribution of "ü" makes its source obvious. We can see that it occurs in place of "u" following I-consonants. The only site of apparent contrast occurs following "l" and "n". Note that although "yu, qu, ju, xu" are all spelt with "u", they are all pronounced as "ü" and not "u". In such cases the element I spreads from O_1 to occupy the operator position in N_1 thus forming "ü". This is shown in (17) below.

(17)



The derivation of "yu" [yü] involves spreading I from the onset to the operator position in N_1 forming the expression ({I},U), i.e. "ü".

This still leaves us with the cases of "lu" vs. "lü" and "nu" vs. "nü". It would make no sense to set up a lexical vowel, "ü" which only occurs following these 2 onsets. We also note that "ia, iang" only "contrast" with "a, ang" following these same 2 consonants. We will see below that "l" and "n" are the only onsets after which both "uo" and "ue" can be found. Putting these facts together leads to the unmistakable conclusion that there are 2 kinds of "l" and 2 kinds of "n". One set behaves like the set of I-consonants, the other set does not. Following the suggestion of Goh (1997), I include "l^y" and "n^y" in the set of onsets. Their phonological expression are ({I,A},?) and ({L,I,?},A) respectively. "l^y"and "n^y" show exactly the same spreading behaviour as any other I-consonant. Thus, "lü" is, in reality "l^yu", whilst "lu" is, indeed, "lu". Of course, the same analysis applies to the "n^y" cases as well.

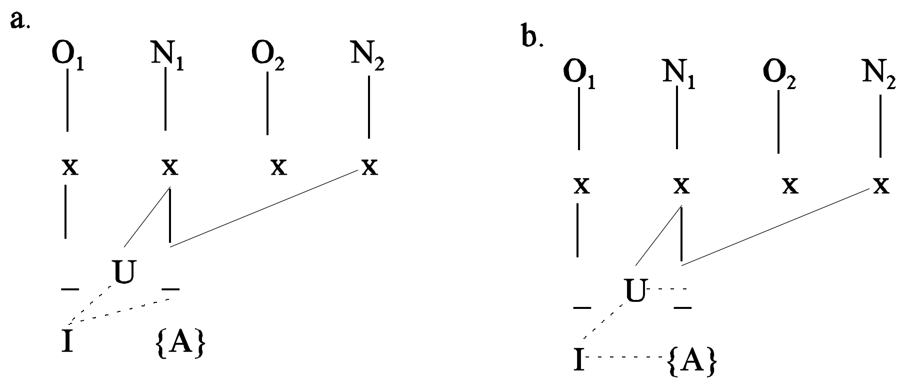
The rime ue:

The rime "ue" is derived from "u7". It has the same source as the rime "uo". This difference is that "ue" only follows I-consonants whilst "uo" occurs elsewhere. In fact, "ue" has 2 realisations,[9] [üe] and [üö].[10] In both versions the element I spreads from the O_1 position to U member of the light diphthong. In one case, [üö], the element U also spreads to the head of the light diphthong; in the other case it does not. Both possibilities are given in (18) below.

[9]Our thanks to Professor Wang ... for pointing out this facts to us.

[10]This is the version cited in Goh (1997).

(18)



In (18a), the element I spreads from the onset to both members of the light diphthong yielding [e]. The element I exhibits the same behaviour in (18b) but the element U also spreads into the head of the light diphthong creating the expression ({I,A},U) which is interpreted as [ö]. Thus, (18b) is pronounced [üö]. Apparently, in version (18a), the spreading of I from the onset impedes the more local spreading of the element U. As we have learned from examples like (14), U spreads obligatorily if I is not present in the onset.

In this section we have seen that all cases of "ü" can be derived from "u" via spreading of I from the onset. The rime "ü" can be removed from the set of lexical nuclei of Putonghua.

The empty nucleus and the rime i:

The empty nucleus ({},_) is pronounced as such (i.e [ɨ]) following the onsets "c, z, s, ch, zh, sh, r". The expression "i" ({},I) is found following U-headed expressions "p, b, m", A-headed expressions "t, d, l, n" (but see the discussion on "l" and "n" below). "i" is also found after all the I-consonants "y, q, j, x" and possibly "l^y" and "n^y". These latter forms could be analysed as "y_", "q_", etc. with the I from the onset spreading into the empty N_1 position. An OCP-type constrain would then prohibit a lexical I nucleus from occurring following an onset also containing I. This leaves us with a dilemma concerning "li" and "ni" (as well as "lin", "ling", "nin" and "ning"). A form like, say, "li" could be analysed as either "li" or "l^y_", with I spreading in the latter case. I consider this problem unsolvable at the moment. The labials are easier to treat. The existence of "pu, bu, mu, fu, wu" and the absence of *"pun, pung, bun, bung, mun, mung, fun, fung, wun, wung" indicate that U-spreading is indeed taking place. Recall that U (unlike I) will spread from either the head or operator position in the onset, and that this spreading is blocked if the O_2 position is occupied. Deriving, say, "pu" from "p_" via spreading of U from the onset head position.

It must also be noted that "_" can never surface as such when the O_2 position is occupied. So *"pun, pung, etc." are impossible just as *"cin, cing, etc." are excluded. Note, however that "qin, qing, etc." are perfectly well formed. "i" is also excluded from the N_1 position when U appears as the operator of O_1. Thus, *"wi, fi, ch^wi, zh^wi, sh^wi" are all ill formed. Likewise neither "i" nor "_" may occur after headless N_1's, *"ki, gi, hi, k^wi,

g^wi, h^wi”. Putting all these observations together gives us the following statements about the distribution of “i” and “_”.

(19) Distribution of the lexical rime “i”
  a. Occurs after U-headed and A-headed onsets only.

(20) Distribution of the lexical rime “_”
  a. Occurs unfilled if A is in the O_1 operator position.
  b. Cannot occur unfilled if the O_2 position is empty.
  c. Occurs filled if U is in O_1 head or operator position.
  d. Occurs filled if I is in O_1 operator position.

From the distributional facts of (20) if follows that the set of onsets “c, z, s, ch, zh, sh, r” have a formal property in common. Given that the phonological expression for “r” is ({A},_) and that for “s” is ({A},H), the best candidate for this property is that the above set of onsets all have the element A in their operator positions. Thus, they constitute all and only the set of onsets that allow an unfilled empty nucleus in their N_1 position.

Cases of Ambiguous Onset-Rime Pairs

The reanalysis of Putonghua onset-rime pairs leaves certain issues of analysis open to question. It is clear that certain rimes are spurious and merely the results of onset spreading or pinyin writing conventions, or both. For example, the rime “ua” is clearly spurious. It only occurs following velar and palatal onsets. Assuming labio-velar and labio-palatal onsets, it is a simple matter to reduce “ua” to the rime “a” with the element U being found in the onset position. A similar reduction can be made for the rime “ia”, which only follows I-consonants. Several other rimes are subject to similar treatment. The same cannot be said for the rimes “uan” and “ian”. They are clearly genuine in that they both can follow A-consonants such as “t” and “d”. Since these A-consonants contain neither U nor I in their elemental makeup, the source for “u” and “i” in these rimes must be found in the nucleus and not the onset. “ua” and “ia” are legitimate light diphthongs forming part of the rimes “uan” and “ian”, respectively. A problem emerges when we consider forms like “huan” or “lian”. There are 2 possible analyses for these forms which are consistent with our analysis. For example, “huan” can be analysed as either “h^w-an” or as “h-uan”. In like manner, “lian” can either be “l^y-an” or “l-ian”. Recall that “uan”, “ian” and “an” are all independently motivated rimes of Putonghua. Some comparative data from Cantonese may be suggestive (but not conclusive) as to the correct path to follow. Consider the following data:

(21) a.

Putonghua	Cantonese	Gloss
han4	ham6	‘regret’
han2	hon4	‘cold’
he1	ho1	‘scold’
he2	ho4	‘river’

b.

hua1	fa1	'flower'
huang3	fong2	'bright'
huang1	fong1	'desert'

c.

huan1	fun1	'happy'
hui1	fai1	'brightness'
hui3	fui3	'repent'

In (21a) we see that Putonghua "h" frequently corresponds to Cantonese "h" and never to Cantonese "f". (21b) shows that Putonghua "h^w" often (but not always) corresponds to Cantonese "f". This is not surprising if one compares their elemental composition. It also makes sense that the change does not cross constituent boundaries but is limited to the onset position. The crucial cases are found in (21c). These are the ambiguous examples. If the Putonghua onset is "h", we would expect to find Cantonese "h" as well, reflecting a Putonghua "h-uan" and "h-u7i" analysis. If the Putonghua onsets are "h^w", then we would expect to find at least some Cantonese reflexes in "f". Such a state of affairs would point to a "h^w-an", "h^w-7i". (21c) shows that the onset analysis is the correct one. We find Cantonese "f" in both forms indicating that, at least historically, the Putonghua onset descended from a labio-velar and not a plain velar. If this evidence proves to be telling, it suggests the following resolution to our ambiguous cases.

(22) Ambiguity Resolution - Resolve ambiguous cases in favour of the onset position.

Obviously, more work on Putonghua and on other languages showing similar ambiguities needs to be done before we can have complete confidence in (22).

In this article I have presented a revised analysis of Putonghua onset-rime pairs. I have justified this analysis of the basis of empirical research with special emphasis on the phonological behaviour of certain sets of onsets and rimes. The GP theory of phonological representations allows one to capture certain generalisations in a natural and hopefully, insightful way. I should stress that this work is only the first part of the complete (re)analysis of Putonghua segmental structure. In a second article I will analyse many of the distributional constraints that we have observed here and attempt to make some theoretical sense out of them I will also propose licensing constraints that underlie the Putonghua nuclear system. I will further try to show what repercussions these licensing constraints have on the Putonghua onset system. Much work remains to be done but I hope the present offering presents an interesting extension to Goh's original work.

REFERENCES

Goh, Yeng-seng (1997) *The Segmental Phonology of Beijing Mandarin*. Taipei: The Crane Publishing Co.

Kaye, J.D., (1985) "On the syllable structure of certain West African languages", in D. Goyvaerts (ed.) African Linguistics: Essays in Memory of M.W.K. Semikenke, SSLS 6, John Benjamin:Amsterdam, pp. 285-308.

Kaye, J.D. (in preparation) “A users’ guide to Government Phonology”.

Kaye , J.D., Lowenstamm, J. and J.-R. Vergnaud, (1985) "The internal of structure of phonological elements: a theory of charm and government," Phonology Yearbook 2:305-328.

Kaye, J.D., Lowenstamm, J. and J.-R. Vergnaud, (1990) "Constituent structure and government in phonology", Phonology 7.2:193-231.

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