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Combinatorial Specification: Evidence from Fuzhou Vowels¹

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1. Introduction

This paper uses the model of Combinatorial Specification proposed in Archangeli and Pulleyblank (in preparation, henceforth A&P) as a theoretical framework to account for distribution and alternation patterns of vowels in the Fuzhou dialect of Chinese.²

Combinatorial Specification (henceforth, CSpec) claims that the reliance on the notion of segments (e.g. phonemes) should be abandoned. Instead, segments are derived through the combination of independent features. The CSpec analysis of Fuzhou vowels shows that rimes are derived from the combinations of features, not segments.

This paper is organized as follows. First, the theory of CSpec is introduced. Second, the CSpec analysis of Fuzhou is presented. Third, the diachronic implications of this theory are discussed, using as an example the comparison of the vowel systems of Fuzhou and Taiwanese.

2. Combinatorial Specification

2.1. Feature theory and CSpec

Since Jacobson, Fant, and Halle (1952), feature theory has been widely accepted by generative phonologists. For example, Halle (1962) and Chomsky and Halle (1968, henceforth SPE) claim that only features are real and that segments are derived. However, segments continue to be used as primitives in phonology. The original view of feature theory has not been taken seriously. For example, in many ways feature complexes in SPE are equivalent to segments. Each segment is uniquely defined by a block of features; for most purposes the segments and feature complexes are

¹I would like to thank Diana Archangeli, Tom Bourgeois, Nick Clements, Mike Hammond, Dah-an Ho, James Myers, Diane Ohala, Shaun O'Connor, Pat Pérez, and the anonymous abstract reviewers for helpful comments and discussions. Also thanks to James Myers for editorial help.

²It is more accurate to use "language", instead of "dialect" for the languages in the Chinese family, given the diverse differences among them. However, in order to avoid confusion with non-Chinese-family languages in China, the term "Chinese dialects" will be used to refer to languages within the Chinese family.

interchangeable. Thus the vowels in a hypothetical word "tusoli" can be written as in (1a) or as in (1b), with no significant difference in content.

(1)

a. t	u	ɛ	o	l	i
b.	+segment +vocalic -consonantal +high -low +back +round		+segment +vocalic -consonantal -high -low +back +round		+segment +vocalic +consonantal +high -low -back -round

Underspecification theory, in which segments are assumed to have fewer feature specifications underlyingly than on the surface, comes closer to assuming that feature complexes are not equivalent to segments.

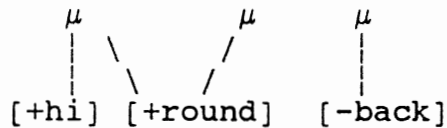
However, both Contrastive Underspecification (Clements 1987, Steriade 1987, Mester and Itô 1989) and Radical Underspecification (Kiparsky 1982, Archangeli 1984, Pulleyblank 1986, Archangeli 1988, Itô and Mester 1986, Archangeli and Pulleyblank 1989) derive underlying underspecified forms by comparing segments. In other words, segments are still considered primitive. Moreover, on the surface all features are filled in, making the feature complexes equivalent to segments, just as in the SPE model. For example, under this approach the vowels in the form in (1) appear as in (2).

(2)	+high +back +round	-high +back +round	+high -back -round
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Autosegmental theory (Goldsmith 1976, and later work) overcomes the view of segments as primary still further by showing that "feature complexes" do not really exist. Instead, features are autonomous; they float, link, delink and spread independent of other features. Again, however, in practice, autosegmental theory still assumes much of the segmental view: features start out in complexes, from which they may spread, delink, and so on.

A&P try to go back to the original view of feature theory, where features are primary. They assume that underlyingly there are only enough features to make the necessary distinctions between morphemes. The features link to prosodic timing units to form whole morphemes, not sequences of segments. Rules may rearrange or add to the set of features, but there is no need to fully specify everything, not even in the phonetics. Thus features remain the only significant phonological units throughout the derivation. In this view, the vowels in the form in (1) and (2) would be represented as in (3) (μ represents a mora).

(3)



There are two parts in CSpec: F-elements and combinations.

(4) CSpec

a. F-elements (feature-sized elements): valued features (e.g. [-high], [+round]) and the content nodes (e.g. Dorsal, Coronal) of feature geometry (e.g. McCarthy 1988). All F-elements are phonologically motivated, i.e. active at different levels of representations in the language.

b. Combinations: F-elements are potentially freely combined.

However, languages usually use only a small subset of the logically possible combinations of the F-elements. A&P propose that combinations be constrained by physically grounded conditions. For example, the tongue body cannot be high and low at the same time. Hence a HI/LO Condition would constrain the cooccurrence of [+high] and [+low]. Examples are given in (5).

(5) Grounded Conditions

HI/LO Condition: If [+high] then not [+low].

LO/HI Condition: If [+low] then not [+high].

An example of an *ungrounded* condition would be "If [-low] then [-high]", since no physical constraint forces a nonlow tongue body to be high.

In summary, an analysis in CSpec would have the following steps. First, motivate F-elements -- only features that are active are present underlyingly. Second, combine F-elements. Third, constrain the combinations of F-elements by invoking grounded conditions.

A&P present much evidence that morphemes in languages are composed of F-elements, not segments. One of the languages they examine is Tiv, a Niger-Congo language of Nigeria.

2.2. Vowels in Tiv

2.2.1. Vowel harmony and vowel distribution

A&P's analysis of Tiv is based on data from Abraham (1940) and the analysis of Pulleyblank (1988). The six surface vowels in Tiv are given in (6). (ɔ is a low, round, back vowel.)

(6) Surface Realizations of Tiv Vowels (A&P)

i	u
e	o
a	ɔ

However, these vowels do not combine freely in bimoraic and trimoraic verb stems. The distribution of vowels in bimoraic verbs is given in (7).

(7) Vowel distribution in bimoraic verbs in Tiv (summarized from A&P. X marks the existence of examples; V1 = first vowel, V2 = second vowel)

\V2 V1 \	i	e	a	u	o	ɔ	
i	X	X	X				i..i i..e i..a
e		X	X				e..e e..a
a		X	X				a..a a..e
u		X	X	X			u..u u..e u..a
o					X		o..o
ɔ					X	X	ɔ..ɔ ɔ..o

Vowel harmony can explain the distribution where V₁ = V₂. Examples of these cases are given in (8).

(8) Tiv bimoraic verbs

- | | | |
|--------|-------------------------|---|
| a. [i] | ìi
bíhi
ndihil | 'bury'
'spoil'
'become lost' |
| b. [e] | tsèe
téhe
péese | 'mock'
'cough'
'be or become light in weight' |
| c. [a] | tsàa
tsáha | 'sift on a winnowing-mat'
'punish' |
| d. [ɔ] | kɔɔ
kɔhɔ | 'rub thing on to another'
'dig out with a pointed tool' |
| e. [o] | òo
gòho
nyóoso | 'slough skin'
'dart away'
'be fully grown' |
| f. [u] | pùu
gbúusu
njùhur | 'despise, think of no importance'
'be abundant'
'pucker up thing' |

Some generalizations can be drawn from forms where $V_1 \neq V_2$.

(9) Generalizations on V_1V_2 where $V_1 \neq V_2$

a. A low vowel must be initial unless following a high vowel:

tsáha	'punish'	
áser	'wrench off; break off'	
kùma	'suffice'	
vía	'become ripe'	
tímba	'thread'	(>témba by a later rule, High Lowering)

b. A low vowel can only be followed by itself or by a mid vowel that agrees in roundness:

ndáhar	'be small'
tsáase	'beat a knife with a hammer to sharpen it'
ndɔhɔr	'become wet'
yɔɔso	'chat'

An analysis should be able to capture these generalizations, in addition to accounting for the vowel harmony mentioned above.

2.2.2. CSpec analysis of Tiv

A&P argue that in Tiv there are no vowels specified at all underlyingly. Each morpheme comes with a combination of the free F-elements in underlying representation. By the application of rules, the free F-elements link and/or spread to the timing units (e.g. moras) and surface later as vowels. The CSpec analysis of Tiv in A&P is given in (10).

(10) CSpec analysis of Tiv (A&P)

a. F-elements: [+hi], [+lo], [+rd]

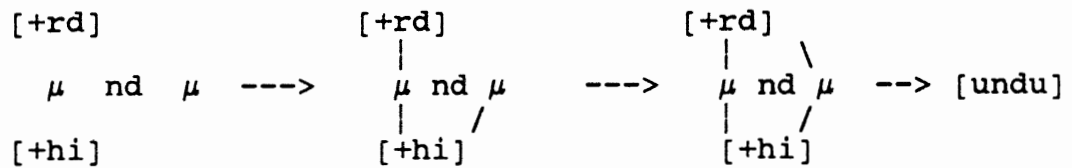
b. Combinations: 8 (2^3) logical possibilities, and the vowels they surface as

e	i	a	o	ɔ	u	? ₁	? ₂

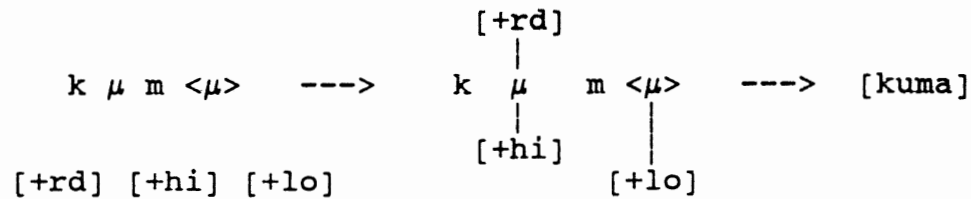
	+hi				+hi	+hi	+hi
		+lo		+lo		+lo	+lo
			+rd	+rd	+rd	+rd	+rd

c. HI/LO Condition: If [+hi] then not [+lo].
 LO/HI Condition: If [+lo] then not [+hi].

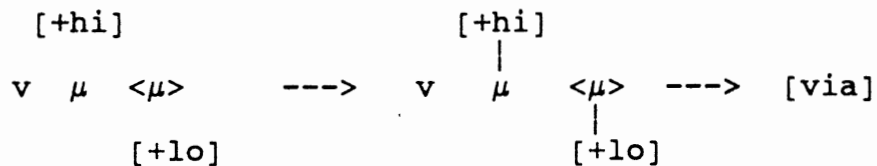
f. úndu 'leave person or thing behind' -- [+hi] Link/Spread;
 [+rd] Link and [+rd] Spread



g. kùma "suffice" -- combination ?₁: [+hi], [+lo], [+rd]



h. vía 'become ripe' -- combination ?₂: [+hi], [+lo]



Due to the HI/LO and LO/HI conditions, the last two combinations, ?₁ and ?₂, should not occur on a single vowel. However, they can show up in disyllabic forms like búsa 'break fragment off', kùma 'suffice', and vía 'become ripe', etc. Interested readers are referred to A&P for a detailed discussion.

2.2.3. Problems with the segmental approach in Tiv

If we were to assume the segmental approach, we would encounter many problems. First, the segmental approach cannot account for the gaps in (7). Second, it cannot capture the generalizations in (9) without requiring complicated individual rules. Third, it cannot account for the existence of the patterns under ?₁ and ?₂ in (10). Finally, the CSpec analysis makes it clear that all eight possible combinations of the three F-elements are allowed in morphemes. In a segmental approach, this generalization is unexplained, or worse, simply ignored.

2.3. Summary

We have seen that all the existing vowel patterns in bimoraic morphemes in Tiv are better analyzed in terms of F-elements rather than in terms of segments.

Besides Tiv, A&P have found many languages that support the CSpec model over a segmental approach. They are Ainu, Akan, Barrow Inupiaq, Chukchee, Haya, Javanese, Kinande, Maasai, Ngbaka, Nupe, Pulaar, Wolof, and Yoruba.

3. Fuzhou Vowels

3.1. Rimes in Chinese dialects

Rimes have played a crucial role in the history of Chinese languages. Evidence can be found in several places: (i) in the rhyming of poetry back to the tenth century BC (e.g. *Shijing*, the Book of Odes); (ii) in the transcription system "fan-qie", which was used in transcribing Buddhist bibles written in Sanskrit and in transcribing words in the rhyme books and traditional dictionaries; (iii) in the way the rime books were compiled, i.e. according to the rimes of the words (e.g. *Guang Yun*, the general rhyme book); and (iv) in language games (Chao 1931, Li 1985).

Independent arguments supporting the same point have been made in Light (1976), who concludes that Chinese dialects are better analyzed in terms of rimemes, instead of phonemes. He points out:

"Modern studies of Chinese have explicitly recognized the separability of the Initial (a consonant or [0] onset) and the Tone from the rest [i.e. the rime -- JT]." (Light 1976, p.2)

"The Chinese themselves have insisted for centuries that their syllables be divided in this fashion. We know in linguistics that we defy native speakers' intuitions at our peril. An imperative question in any approach to Chinese should be: Does the traditional analysis have an internal justification which might conflict with a concept of analysis brought from outside?" (Light 1976, p. 3)

Light proposes that rimes are primitive in Chinese and that only a "rimemic" approach works for Chinese. Since Light assumes a segmental view of phonology, he is forced to give a typological explanation for the difference between alphabetic (i.e. phonemic) languages like English and non-alphabetic (i.e. rimemic) languages like Chinese.

However, this dichotomy is not necessary if we assume CSpec, which claims that all languages are non-alphabetical. Specifically, it will be shown how CSpec works for Fuzhou and how rimes are derived from a set of features, not segments.

Before analyzing the Fuzhou vowels, we have to look at the rime alternation and distribution first, in order to determine the underlying vowels. Rime alternation is discussed in Section 3.2, and rime distribution in Section 3.3. After these two issues, the underlying rimes will be analyzed under the CSpec approach in Section 3.4.

3.2. Rime alternation in Fuzhou⁴

The main source of my Fuzhou data is Wang (1969), where the transcriptions use the International Phonetic Alphabet. (For IPA symbols, see Appendix.) Other sources are Yuan et al. (1960), Hanyu Fangyin Zihui (1962, henceforth HYFYZH), Chen and Norman (1965).⁵ Data are from Wang (1969) unless otherwise noted.

Some Fuzhou rimes show an alternation which cooccurs with tone alternation (tone sandhi). An example is given in (13) (Wang 1969, p. 119). The word *tei* meaning 'ground' has a LML tone, as in (13a), while in (13b) it changes to a H tone because of the content environment. At the same time, the rime changes into *ti*.

- (13) a. *tei* (LML)
 'ground'
- b. *ti* (H) *huoN* (H)
 'ground' 'direction' (= 'place')

This alternation takes place when the tone alternation is from LM, LML, LM to H, HL, M, H.⁶ As Yip (1980, p.341) points out, the seven tones in Fuzhou can be divided up into two groups. In one group the tones begin with a relatively higher pitch ([+upper]), while in the other they begin with a lower pitch ([-upper]).

(14) Tone classes (following Yip 1980)

- a. Class I: H, HL, M, H (begin with a higher pitch, H or M)
 b. Class II: LM, LML, LM (begin with a lower pitch, L)

Rimes that show this alternation are *i/ei*, *y/æy*, *u/ou*, *ei/ai*, *æy/ɔy*, *ou/ɔu*.

⁴Since this paper focuses on vowels, the coda consonants (i.e. ʃ and k in this language) are not discussed.

⁵We would expect to find a distinction between the literary reading and the colloquial reading in Fuzhou, as in the South-Min dialects (e.g. Yang 1982). However, none of these sources on Fuzhou reports systematic study of this aspect.

⁶Underlined tones are checked (short) tones.

(15) Rime alternation⁷

Class I tones	Class II tones
i	ei
y	ɔy
u	ou
ei	ai
ɔy	ɔy
ou	ɔu

Following Yip (1980), we assume that there is a correlation of tone and vowel height. That is, higher vowels have higher fundamental frequency and lower vowels would have lower fundamental frequency (see also Hombert 1978, Maddieson 1979).

3.3. Rimes in complementary distribution

The distribution of rimes also shows the same correlation with tone as in alternation. That is, some rimes only appear with Class I tones, while others only appear with Class II tones. Some examples are given in (16), where "i" only appears with Class I tones and "ei" only appears with Class II tones.

(16) Complementary distribution of *i/ei*

a. *i* with Class I tones

piŋ (H)	"ice"
piŋ (HL)	"even"
piŋ (M)	"bright"
pik (H)	"develop"

b. *ei* with Class II tones

peiŋ (LM)	"sideburns"
peiŋ (LML)	"disease"
peik (LM)	"pen"

Rimes which show this distribution are given in (17). Note that all the rimes showing the alternation mentioned in the last section also appear in this distribution.

⁷There is a little confusion in the notation of the mid front vowel and the low front vowel. The four sources have different ways of handling it. I assume that the ϵ next to a high vowel is a mid vowel, probably [-ATR] (Advanced Tongue Root). I treat it as an alternate of e , while the ϵ which appears alone is a low front vowel notated E in this paper. The forms in ()'s are derived.

Wang	Chen & Norman	Yuan et al.	HYFYZH	This paper
ie (iɛ)	ie	ie	ie	ie (iɛ)
ei	ei	ei	ei	ei
eu (ɛu)	eu	eu (ɛu)	eu (ɛu)	eu (ɛu)
ɛ	e	ɛ	ɛ	E

(17) The distribution of Fuzhou rimes under different tones⁸

Class I tones	Class II tones
a. i	ei
b. u	ou
c. y	øy
d. iu	ieu
e. ui	uoi
f. E	æ
g. ou	ɔu ⁹
h. ei	ai
i. oy	ay ¹⁰

Since these pairs of rimes are in complementary distribution, one of each pair must be underlying. The question is: which one is underlying and which one is derived?

We notice that the mid vowels in this language are always next to a high vowel and share some feature(s) with that high vowel: *i* and *e* are both front; *u* and *o* are both round; *y* and *ø* are both front and round. In other words, mid vowels are predictable, hence can be derived. Therefore we can conclude that the rimes in the left hand column are underlying and the rimes in the right hand column are derived.

In addition to the 9 rimes given in (17) above, there are 12 rimes which do not show complementary distribution under different tones. We assume that they are also underlying. Hence there are 21 rimes in Fuzhou underlyingly: *i, u, y, ø, E, ɔ, a, ia, uo, ua, yo, ai, au, iu, ui, ie, eu, ou, ei, oy, uai*.

⁸The relationship between these two groups of rimes is actually more complicated than just lowering and/or diphthongization. In (17a-e), there is a lowering from a high vowel to a mid vowel and a diphthongization. In (17h-i), there is a lowering from a mid vowel to a low vowel. However, in (17f-g) the change is hard to describe due to the binary feature system of vowels, which allows only three degrees of vowel height: high, mid, and low. Actually, in IPA there can be up to five different degrees of vowel height. The proposal of a scalar feature system in Clements (1991) is an attempt to solve this kind of problem. An alternative solution would be to assume that it is a change from [+ATR] to [-ATR].

⁹Yuan et al. has *au* instead of *ɔu*.

¹⁰This alternation is not clear to me since one of the sources, Chen & Norman, does not have it and the other sources have different notations for it - HYFYZH and Yuan et al. give *øy/øy*, and Wang gives *ɔy/ɔy*. I assume the underlying form should be *oy* for the same reason as in footnote 7, that in an underlying form a vowel next to a high vowel is a mid vowel. As to which form is underlying and which form is derived, see the discussion below.

3.4. CSpec analysis of Fuzhou vowels

After having determined the underlying rimes, in this section, I derive the 21 Fuzhou rimes from three motivated F-elements -- [+front], [+round], and [+low].

The evidence that [+front] and [+round] are active in the phonology of this language comes from vowel harmony. As mentioned in the last section, in the alternations in (17a-e), *i* and *e* are both front; *u* and *o* are both round; *y* and *ø* are both front and round. Therefore, [+front] and [+round] must be present underlyingly, and cause vowel harmony by spreading. In the alternations in (17h-i) (and maybe (17f-g), too), there is a lowering effect on the derived forms. I assume that there is a rule of [+low] insertion. Hence, [+low] is proposed. These three F-elements give 8 (2³) logically possible combinations.

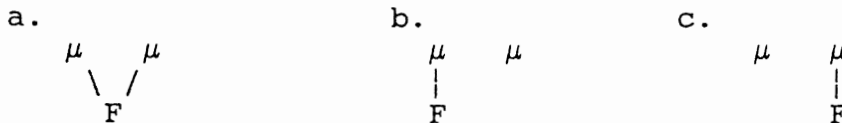
(18) Possible combinations of [+front], [+round], and [+low]

1	2	3	4	5	6	7	8
	+fr	+rd	+lo	+fr +rd	+fr +lo	+rd +lo	+fr +rd +lo

Before mapping these combinations to the timing units, we need to discuss the prosodic units in Fuzhou. I assume that the minimal word (McCarthy & Prince 1986) in Fuzhou is bimoraic. (A similar analysis is found in Myers 1990 for Mandarin and in Tsay 1989 for Taiwanese. See also Duanmu 1990.)

An F-element can be prelinked to both moras, the first mora, or the second mora.¹¹ This is represented schematically in (19).

(19)



The mapping of the combinations to the bimoraic morphemes gives the rimes in Fuzhou.

¹¹In the case of linking to two moras, it does not make any difference if the F-element is prelinked or is free to start with and associated later.

26 B

(20) Fuzhou rimes in CSpec

	1	2	3	4	5	6	7	8
		+fr	+rd	+lo	+fr +rd	+fr +lo	+rd +lo	+fr +rd +lo
$\begin{array}{c} \mu \quad \mu \\ \backslash \ / \end{array}$?	i	u	a	y	E	ɔ	œ
$\begin{array}{c} \mu \quad \mu \\ \end{array}$?	ie	uo	a	yo, iu	ia	ua	iau?
$\begin{array}{c} \mu \quad \mu \\ \end{array}$?	ei	eu(ou) ?	a	oy, ui	ai	au	uai

Note that there are no rimes corresponding to the first column. Obviously, this language does not allow morphemes to be completely unspecified in the underlying representation. The *ou* as an underlying form is reported by Chen & Norman and Yuan et al., but not in Wang. *iau* is only given by Yuan et al. The monophthongs under this proposal should be long, although vowel length is not distinctive in this language (see Clements 1983, following Chao 1934).

Underlying representations are given below. Surface forms are derived by inserting [+high] on the mora with the prelinked F-element, and then spreading this F-element but not [+high].

(21) [+front]

a. "i"

$$\begin{array}{c} \mu \quad \mu \\ \backslash \ / \\ [+fr] \end{array}$$

b. "ie"

$$\begin{array}{c} \mu \quad \mu \\ | \quad \mu \\ [+fr] \end{array}$$

c. "ei"

$$\begin{array}{c} \mu \quad \mu \\ | \quad | \\ [+fr] \end{array}$$

(22) [+round]

a. "u"

$$\begin{array}{c} \mu \quad \mu \\ \backslash \ / \\ [+rd] \end{array}$$

b. "uo"

$$\begin{array}{c} \mu \quad \mu \\ | \quad \mu \\ [+rd] \end{array}$$

c. "ou"

$$\begin{array}{c} \mu \quad \mu \\ | \quad | \\ [+rd] \end{array}$$

(23) [+low]

a. "a"

$$\begin{array}{c} \mu \quad \mu \\ \backslash \ / \\ [+lo] \end{array}$$

b. "a"

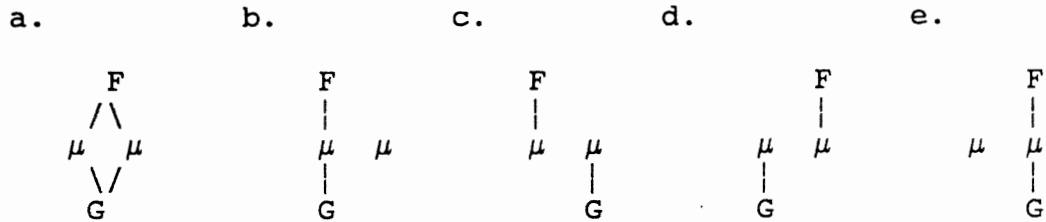
$$\begin{array}{c} \mu \quad \mu \\ | \quad \mu \\ [+lo] \end{array}$$

c. "a"

$$\begin{array}{c} \mu \quad \mu \\ | \quad | \\ [+lo] \end{array}$$

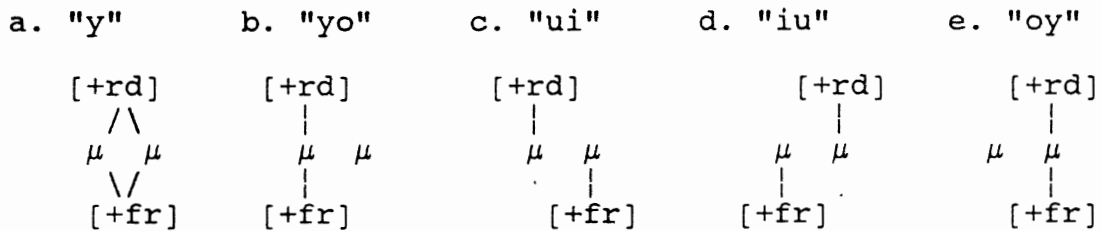
For cases where there are two F-elements, it is more complicated. There should be five possible ways of mapping two F-elements to two moras. This is presented schematically in (24).

(24) Two F-elements

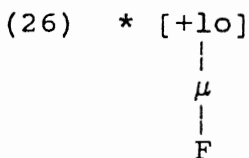


The mapping of the combination [+front] and [+round] to these prosodic units is given in (25).

(25) [+front] and [+round]

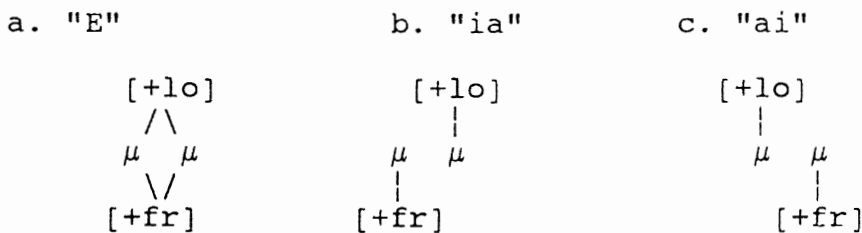


However, we do not have all five possibilities showing up with the other two-F-element combinations, where one of the two F-elements is [+low]. I propose that [+low] does not link up to a mora which is linked up to another F-element, unless these two F-elements are both doubly linked. That is, a structure like that in (26) is prohibited. This is a pure stipulation at this point.



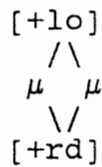
This constraint rules out two possibilities. Hence we derive three rimes from each combination.

(27) [+front] and [+low]

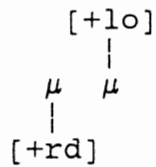


(28) [+round] and [+low]

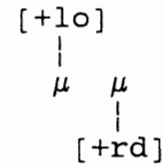
a. "ɔ"



b. "ua"



c. "au"



3.5. Problems with the segmental approach in Fuzhou

Recall that there are 21 rimes underlyingly: 7 monophthongs (*i, u, y, ə, E, ɔ, a*), 13 diphthongs (*ia, uo, ua, yo, ai, au, iu, ui, ie, eu, ou, ei, oy*), and 1 triphthong (*uai*).

If we were to assume that Fuzhou rimes are composed of segments, we would expect the diphthongs and triphthong to be composed of the monophthongs. However, this is not what we see in Fuzhou.

(29) The distribution of phonemes in monosyllabic morphemes

V1 \ V2	i	u	y	E	ə	ɔ	a
i		X					X
u	X						X
y							
E							
ə							
ɔ			X				
a	X	X					

There are many problems with this segmental (phonemic) approach. First, only 7 out of the 49 possible V_1V_2 sequences are attested. How does it account for the lack of so many logically possible diphthongs? Second, some diphthongs (*ie, uo, yo, ei, eu, ou*) are not composed of the given segments. Third, it does not explain why 'uai' is the only triphthong in this language, out of the 343 ($7 \times 7 \times 7$) possible $V_1V_2V_3$ sequences.

3.6. Typological dichotomy?

We come to the same conclusion as in Light (1976), namely that rimes, instead of segments, are the basic phonological units for Chinese. This conclusion seems to bring up a question as to why Chinese dialects are different from other languages, which do not use rimes as basic units.

Light proposes a typological dichotomy wherein languages in the world are divided into alphabetic and non-alphabetic types. Chinese dialects are non-alphabetic languages, hence they are different from other languages typologically in that rimes are preferred.

Our solution is different from that of Light's. CSpec claims that all languages are non-alphabetic, just like Chinese, and that morphemes in all languages are derived in the same way. The typological distinction proposed by Light to distinguish languages like Fuzhou from languages like Tiv does not exist. It is not only unnecessary, but it also misses the generalization that these two seemingly different languages are similar in deriving their morphemes directly from features, not segments. The only relevant difference between Tiv and Fuzhou is in prosodic structure: the morphemes in Tiv are polysyllabic, while the morphemes in Fuzhou are monosyllabic.

4. Implications for diachronic linguistics

CSpec analysis has some interesting implications for comparative reconstruction.

In comparative reconstruction, if we were to compare the phonemes of Fuzhou (a North Min dialect of Chinese) and Taiwanese (also known as Amoy, a South Min dialect of Chinese) (Ting 1970), we see that Fuzhou has seven phonemes and Taiwanese has six, and that four of the phonemes are the same in both dialects.

(30) Phonemes in Fuzhou and Taiwanese

Fuzhou	i	u	ɔ	a	y	æ	E		
Taiwanese	i	u	ɔ	a				e	o

This does not give us much information with respect to the vowel change, since the vowels that overlap are among the world's most common.

If we compare the rimes, we get an even messier picture.

(31) Rimes in Fuzhou and Taiwanese

a. Monophthongs

Fuzhou	i	u	a	ɔ	y	æ	E
Taiwanese	i	u	a	ɔ	e	o	

b. Diphthongs

Fuzhou	ia	iu	ua	uo	yo	ie	eu
	ai	ui	au	ou	oy	ei	
Taiwanese	ia	iu	ua	io	ue		
	ai	ui	au				

c. Triphthongs

Fuzhou	uai	
Taiwanese	uai	iau

The traditional rhyme books can provide information to help pair up corresponding rimes in these two languages. However, the analysis of the change would be still very descriptive, and not explanatory at all.

The picture that CSpec analysis can provide is much more specific.

(32)

a. Fuzhou in CSpec

?	i	u	a	y	E	ɔ	æ
?	ie	uo	a	yo,iu	ia	ua	iau?
?	ei	eu(ou)	a	oy,ui	ai	au	uai

	+fr			+fr	+fr		+fr
		+rd		+rd		+rd	+rd
			+lo		+lo	+lo	+lo

b. Taiwanese in CSpec

e	i	o	a	ɔ	u	*	*
e	i	o	a	ɔ	iu/ue	ia	ua/uai
e	i	o	a	ɔ	ui/io	ai	au/iau

	+hi				+hi	+hi	+hi
		+rd		+rd	+rd		+rd
			+lo	+lo		+lo	+lo

We can approach the differences between Fuzhou and Taiwanese by comparing (i) the F-elements (ii) the prosodic structure (iii) constraints (i.e. what grounded conditions are invoked) (iv) rules. For example, the contrast in F-elements in these two dialects is [+front] vs. [+high].

(33) F-elements: Fuzhou [+front] [+round] [+low]
 Taiwanese [+high] [+round] [+low]

This explains the lack of some combinations in Taiwanese (i.e. the *'s in (32b)) because [+high] and [+low] can not link up to the same mora due to the HI/LO Condition. Hence the change of a single

F-element results in the invoking of a grounded condition, which in turn results in the change of combinations (rimes).

As is clear from the sketchiness of this discussion, these ideas are still preliminary. The point of bringing it up is merely to start a discussion. Further research needs to be done.

5. Conclusions

In this paper, I presented the model of Combinatorial Specification proposed in A&P, which claims that the reliance on the notion of segments should be abandoned. I have shown how segments do not work for Tiv and Fuzhou, and how morphemes of these two languages can be derived in the same fashion without invoking the topological dichotomy proposed in Light (1976). The CSpec analysis accounts for the distribution and alternation of vowels in Tiv and Fuzhou very well. Another desirable result of the CSpec analysis is to provide an alternative approach to the comparative linguistics.

Appendix: IPA symbols (Hartmann, R.R.K. and F.C. Stork 1972)

i	y	i	u	w	u
e	ø			ɣ	o
ɛ	œ	ɔ		ʌ	ɔ
	æ		ɛ		
	a			ɑ	ɔ

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