

“NON-UNIQUENESS” DIES HARD

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ABSTRACT

In this study, the problem of non-uniqueness in phonology is reviewed against the more recently developed notions of ‘simplicity metric’ and ‘partially specified matrices’ within the distinctive feature framework. The discussions center around the well-known case of the indeterminate phonemicization of the Mandarin palatalized obstruent series [tɕ, tɕ', ɕ]. As an application of the new notions to the Mandarin data appears to yield different results, it seems warranted to conclude that the problem of non-uniqueness in phonology, as first observed by Chao, still remains unresolved.

1. INTRODUCTION

In his classic article “The Non-uniqueness of Phonemic Solutions of Phonetic Systems” (1934), Chao cited for illustration the well-known case of the indeterminate phonemic status of the Mandarin palatalized obstruent series [tɕ, tɕ', ɕ]. The problem was summarized as follows:

- | | | | | | | | |
|-----|---|---|---|----|-----|---|---------------------------------------|
| (1) | ㄗ | ㄘ | ㄗ | tɕ | tɕ' | ɕ | always before [i] or [y] ¹ |
| (2) | ㄨ | ㄨ | ㄨ | k | k' | x | } never before [i] or [y] |
| (3) | ㄗ | ㄘ | ㄗ | ts | ts' | s | |
| (4) | ㄗ | ㄘ | ㄗ | tʂ | tʂ' | ʂ | |

Chao then noted: “It is therefore possible to identify the series (1) phonemically with any one of the other three series. Wade identifies it partially with

1. In my study of the system of Mandarin finals, the vowels [i] and [y] should be replaced by the glides [j] and [ɥ], respectively (See Fu 1979). But this does not affect our present discussions.

(4): he writes *ch*, *ch'*, *hs* for (1), and *ch*, *ch'*, *sh* for (4). The National Romanization (NR) identifies (1) with (4) completely by writing *j*, *ch*, *sh* for both. The French system of romanization for Chinese has (2) or (3) according to etymology, which was what (1) came from, and over-zealous adopters of the French system identify (1) with (3) completely, and write forms like *Sien Sien* for 獻縣, although both belonged to series (2)." (p. 48).

This situation posed a formidable problem for structural linguistics in the 40's and 50's. The three systems of romanization proposed for series (1) were all based more on orthographical than on phonetic considerations. It seems to me that Wade and NR identify (1) with (4) simply because the English alphabet (or, the Latin alphabet, to be precise) happens to have such versatile letters and letter sequences as *j*, *ch*, *sh*, which give a quite conspicuously more palatalized quality before high front vowels (e.g., *jeer*, *cheek*, *sheet*) than before other vowels (e.g., *jar*, *charm*, *sharp*) or a pause (e.g., *watch*, *wash*). English initial *sh* can give even a retroflexed timbre before certain consonants (e.g., *shriek*). Wade prefers *hs* before *i* (e.g., *hsi* 'west') because, otherwise, *shi* 'west' and his *shih* 'poem' would look too much alike. NR has no such trouble since its *shi* 'west' and *shy* 'poem' are distinct enough. The French system entirely bypassed the phonetic dilemma by appealing to etymology, thus giving differing representations for the same modern sound [ɕ]: /xi/ 希 vs. /si/ 西, which, as a writing system, is hardly more efficient than the original Chinese characters.

In traditional phonemics, complementarity in distribution is only one of two criteria for assigning two or more sound segments to the same phoneme. The other criterion is phonetic similarity. That is, the relevant sound segments must also be phonetically similar enough to each other. In English, for example, the velar nasal [ŋ] always occurs in syllable-final position whereas the laryngeal glide [h] never occurs in syllable-final position. Thus the two sounds are in beautifully complementary distribution, but since they are phonetically too far removed from each other, no phonemicist has ever seriously advocated that they be assigned to the same phoneme. Thus it becomes clear that, in our case, the

series (1) sounds could be assigned to the same phonemic units with whichever of the other three series is phonetically the most closely similar.

The principle of phonetic similarity is of course correct, but the crucial question is: How is the degree of phonetic similarity to be accurately measured? Traditional phonemics, it seems, did not provide such a measure, and thus certain *non-unique* solutions result.

2. BY MEANS OF THE ‘SIMPLICITY METRIC’

With the advent of generative phonology and the distinctive feature theory (which treats sound segments as complexes of features rather than indivisible entities), there developed a sort of simplicity metric that can be used as a measure in determining which of several alternative phonological analyses is to be taken as the simplest and hence the most phonetically plausible. This simplicity metric consists of a method of measuring by feature counting. That is, wherever there are two or more competing phonological solutions expressed in phonological rules, the one rule that involves the least number of feature changes is the simplest. This new notion, it appears, brings great hopes to arriving at a *unique* solution to our problem.

Prior to applying the simplicity metric to our problem, let us assume the following distinctive feature matrix for Mandarin voiceless obstruents as given:²

(5)	p	f	t	s	ts	tʃ	ʃ	tɕ	ɕ	k	x
sonorant	—	—	—	—	—	—	—	—	—	—	—
anterior	+	+	+	+	+	+	+	—	—	—	—
coronal	—	—	+	+	+	+	+	+	+	—	—
continuant	—	+	—	+	—	—	+	—	+	—	+
del rel	—	+	—	+	+	+	+	+	+	—	+
strident	—	+	—	+	+	—	—	+	+	—	—
	ㄆ	ㄆ	ㄊ	ㄊ	ㄊ	ㄊ	ㄊ	ㄊ	ㄊ	ㄊ	ㄊ
	ㄆ	ㄆ	ㄆ	ㄆ	ㄆ	ㄆ	ㄆ	ㄆ	ㄆ	ㄆ	ㄆ

2. Aspiration is not specified since it does not play a role in our study. Retroflexion is indicated by [-strident].

With the feature description in (5) as well as the principles of generative phonology available, let us try to re-examine the phonetic data sketched in (1)-(4). In accordance with the customary fashion of generative phonology in expressing phonological processes by the rule schema "A→B/C___D," the phonetic facts listed in (1)-(4) may be transformed into phonological rules as in (6)-(8).³

- (6) a. $k \rightarrow t\epsilon / __ i, y$ b. $x \rightarrow \epsilon / __ i, y$
 (7) a. $ts \rightarrow t\epsilon / __ i, y$ b. $s \rightarrow \epsilon / __ i, y$
 (8) a. $t\zeta \rightarrow t\epsilon / __ i, y$ b. $\zeta \rightarrow \epsilon / __ i, y$

The meaning of these rules is transparent. Rule (6a) states that [k] becomes [tε] before [i] or [y] while (6b) says that [x] becomes [ε] before [i] or [y]. And similarly with (7a, b) and (8a, b). None of the rules (6)-(8) can be held to be superior to any of the others; each of them appears of equal simplicity (or complexity) as far as the symbols used are concerned. However, differences will emerge once the symbols are translated into distinctive feature matrices, as can be seen in (6')-(8').

- (6') a. $\begin{pmatrix} -ant \\ -cor \\ -cont \\ -del\ rel \\ -strid \end{pmatrix} \rightarrow \begin{pmatrix} \\ +cor \\ \\ +del\ rel \\ +strid \end{pmatrix} / __ \begin{bmatrix} +high \\ -back \end{bmatrix}$
- b. $\begin{pmatrix} -ant \\ -cor \\ +cont \\ +del\ rel \\ -strid \end{pmatrix} \rightarrow \begin{pmatrix} \\ +cor \\ \\ \\ +strid \end{pmatrix} / __ \begin{bmatrix} +high \\ -back \end{bmatrix}$

3. For ease of handling, affricates and fricatives are treated separately.

- (7') a.
$$\begin{pmatrix} +\text{ant} \\ +\text{cor} \\ -\text{cont} \\ +\text{del rel} \\ +\text{strid} \end{pmatrix} \longrightarrow \begin{pmatrix} -\text{ant} \\ \dots\dots \\ \dots\dots \\ \dots\dots \\ \dots\dots \end{pmatrix} / \text{---} \begin{bmatrix} +\text{high} \\ -\text{back} \end{bmatrix}$$
- b.
$$\begin{pmatrix} +\text{ant} \\ +\text{cor} \\ +\text{cont} \\ +\text{del rel} \\ +\text{strid} \end{pmatrix} \longrightarrow \begin{pmatrix} -\text{ant} \\ \dots\dots \\ \dots\dots \\ \dots\dots \\ \dots\dots \end{pmatrix} / \text{---} \begin{bmatrix} +\text{high} \\ -\text{back} \end{bmatrix}$$
- (8') a.
$$\begin{pmatrix} +\text{ant} \\ +\text{cor} \\ -\text{cont} \\ +\text{del rel} \\ -\text{strid} \end{pmatrix} \longrightarrow \begin{pmatrix} -\text{ant} \\ \dots\dots \\ \dots\dots \\ \dots\dots \\ +\text{strid} \end{pmatrix} / \text{---} \begin{bmatrix} +\text{high} \\ -\text{back} \end{bmatrix}$$
- b.
$$\begin{pmatrix} +\text{ant} \\ +\text{cor} \\ +\text{cont} \\ +\text{del rel} \\ -\text{strid} \end{pmatrix} \longrightarrow \begin{pmatrix} -\text{ant} \\ \dots\dots \\ \dots\dots \\ \dots\dots \\ +\text{strid} \end{pmatrix} / \text{---} \begin{bmatrix} +\text{high} \\ -\text{back} \end{bmatrix}$$

By counting the number of features that are required to change their value specifications in each rule, one easily finds that the rule set in (7') is certainly simpler than the others, since it is (7'a) and (7'b) that involve the least number of feature value changes—only one in (7'a, b), compared with two in (8'a, b) and (6'b), and three in (6'a). On this basis, we may conclude that the sounds [ts, ts', s] of series (3) are phonetically closer to those of series (1) than either series (2) or series (4). In this sense, those as Chao labeled "over-zealous adopters of the French system" of romanizing Chinese should definitely be congratulated, for it turned out that they had hit upon a more solid phonetic ground in identifying series (1) completely with series (3) and writing *Sien Sien* for 獻縣. Wade and other Western scholars prefer the forms *chi* (instead of *tsi*) 'chicken' and *ch'i* (instead of *ts'i*) 'seven' simply because, I suppose, the letter sequence *ts* does

not look nice in word-initial position, though we do find a number of Chinese place-names romanized with *ts* before *i* in word/syllable-initial position, as, for example: *Tsinan* 濟南, *Tsinghai* 青海, *Tsingtao* 青島, *Tientsin* 天津. Thus, the so-called non-uniqueness with respect to the phonemic membership of the affricate-fricative series [tɕ, tɕ', ɕ] of Mandarin may be claimed to have been properly resolved.

3. IN TERMS OF 'PARTIALLY SPECIFIED DISTINCTIVE FEATURE MATRICES'

Yet there is still another possibility for the distinctive feature theory to contribute toward a resolution of non-uniqueness encountered in phonological analyses.

In English phonology, there is also a well-known case of non-uniqueness—i. e., whether the voiceless unaspirated bilabial stop [p] in words like *spin* should be assigned to the same phoneme with the [b] of *bin* or the [p'] of *pin*. The simplicity metric does not help since [p] ([–voice, –tense]) is equally similar (or dissimilar) to either [p'] ([–voice, +tense]) or [b] ([+voice, –tense])—with only one feature change in each case.

Schance (1968:711) proposes that the bilabial stops in *pin*, *bin*, and *spin* be partially represented, within the distinctive feature framework, as follows:

(9)	pin	bin	spin
consonantal	+	+	+
vocalic	–	–	–
continuant	–	–	–
nasal	–	–	–
coronal	–	–	–
anterior	+	+	+
tense	+	–	()
voice	()	()	()

Schane argues that “in the phonological representations of morphemes, one indicated values only for those features which were contrastive in a given environment. Any features which could be predicted, either because they were always accompanied by other features or because they could be deduced from the surrounding phonemes, were left blank and were filled in (predicted) by redundancy rules (p. 711).” The redundancy rules in this connection would state roughly that (i) initial [+tense] stops are [–voice], (ii) initial [–tense] stops are [+voice], and (iii) stops after an initial *s* are to be specified as [–tense, –voice]. After the redundancy rules have been applied, the matrices will be fully specified. But the original partially specified matrix for the [p] of *spin* is a ‘unique’ representation.

Schane’s treatment of the English stops [p, p’, b] naturally suggests that we might also have to look at our Mandarin problem from a different point of view. Along the lines of Schane’s analysis of English, let us presume that the partially specified distinctive feature matrices in (10) would be adequate for representing the phonetic relations among the several affricate-fricative series of Mandarin.⁴

(10)	ts	s	tʃ	ʃ	tʂ	ʂ
sonorant	—	—	—	—	—	—
coronal	+	+	+	+	+	+
continuant	—	+	—	+	—	+
del rel	+	+	+	+	+	+
strident	+	+	—	—	(+)	(+)
anterior	(+)	(+)	(+)	(+)	(—)	(—)
	ʈ	ʡ	ʈʂ	ʃ	ʈʂ	ʈ
	ʈ		ʈʂ		ʈʂ	ʈ

4. The velar stop-fricative series [k, k’, x] is excluded, for the time being, to avoid extra complications.

To fill in the parenthesized spaces in the matrices in (10), the following redundancy rules are required:

$$(11) \quad \begin{bmatrix} +\text{cor} \\ \alpha \text{ cont} \\ +\text{del rel} \\ \beta \text{ strid} \end{bmatrix} \longrightarrow [+ant] / \text{---} \left\{ \begin{array}{l} [-\text{high}] \\ [+back] \end{array} \right\}$$

$$(12) \quad \begin{bmatrix} +\text{cor} \\ \alpha \text{ cont} \\ +\text{del rel} \end{bmatrix} \longrightarrow \begin{bmatrix} -\text{ant} \\ +\text{strid} \end{bmatrix} / \text{---} \begin{bmatrix} +\text{high} \\ -\text{back} \end{bmatrix}$$

Rule (11) states that a coronal affricate or fricative before all but high front vowels is [+anterior], whereas rule (12) asserts that a coronal affricate or fricative before high front vowels is [−anterior, +strident]. Thus we have been able also to arrive at a phonologically unique representation for the Mandarin obstruents [tɕ, tɕ', ɕ]. From a practical viewpoint, what this 'unique' solution actually boils down to is nothing more than to recognize [tɕ, tɕ', ɕ] as phonological entities (phonemes or segments or whatever) that are of equal status as either [ts, ts', s] or [tʃ, tʃ', ʃ]. In this sense, it eventually proves correct for the National Phonetic Notation (國語注音符號) to try to solve the problem by not solving it and to devise separate symbols (i. e., ㄗ < ㄘ) for [tɕ, tɕ', ɕ], without bothering about the difficulties that had plagued rigorous phonemicists of the time.

In connection with the phonemic status of the English stop [p] in words like *spin*, Schane (1968:712) observes: "Whereas traditional phonemic representations allowed for non-unique representations, the concept of distinctive features, when applied to phonemes, had the merit of overcoming this problem." But an important question is how this concept is to be applied. According to our study of the Mandarin case, it appears that the concept of distinctive features can be applied in more than one way—in terms of either the simplicity metric or partially specified matrices—and that with different results.

4. SUMMARY

As we have shown in section 2, by employing the simplicity metric as an evaluation measure of phonetic similarity, one must identify [tɛ, tɛ', ɛ] completely with [ts, ts', s] of series (3). At the same time, in section 3, we saw that the ambiguous series [tɛ, tɛ', ɛ], in terms of partially specified distinctive feature matrices, can also be assigned 'unique' phonological representations, just as [ts, ts', s] and [tʂ, tʂ', ʂ] can. That is to say, all three obstruent series can be treated as of equal phonemic status. If the two approaches should prove both theoretically valid, then wouldn't it be still the case that there are at least two possible solutions to our problem? Hence, after all, the only thing that one can be sure of is that the problem of non-uniqueness in phonology, as first noted by Chao half a century ago, still remains.

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