

Hierarchical Representation of Phonological Features

Author(s): K. G. Vijayakrishnan

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# HIERARCHICAL REPRESENTATION OF PHONOLOGICAL FEATURES

K.G. Vijayakrishnan

Central Institute of English and Foreign Languages  
Hyderabad, India

1. Of late it has been recognised that it is far from satisfactory to consider the 'phoneme' as a bundle of unordered features arranged in a single-column matrix as implied in classical generative phonological theory (i.e. The Sound Pattern of English). With the advent of the autosegmental, three-dimensional model of phonology, it is necessary to conceptualize a well-constrained structure of the 'phoneme'. This paper examines two distinct issues in the three-dimensional model of phonological representation offered in Clements (1985). Firstly, we take up the issue of the relative autonomy of the set of features pertaining to the manner of articulation (in 2) and secondly, the structure that is necessary and sufficient to explain all and only the phonological properties of phonemic systems (in 3).

2. Following Clements, we assume that the phonological representation has an 'internal hierarchical organization' and that features are grouped into fairly independent classes and arrayed hierarchically more or less as in (1).

The class tiers are the Root tier, Laryngeal tier, Supralaryngeal tier, Manner of articulation tier and Place of articulation tier (henceforth R, L, S, M and P respectively) and the phonological features  $-f...f-$  are componential in nature and are grouped under  $\bar{n}$  (immediately or otherwise) the Class tiers are illustrated in (1). The specific configuration of the class tiers in (1) is meant to reflect the degree of relative autonomy that obtains among the sets of features (we will question this assumption in 3). Clements (1985), while offering evidence to demonstrate the phonological independence of each of the class tiers, notes that perhaps "the manner tier is superfluous" and "that the so-called manner features could be linked directly to the supralaryngeal node." We present data from Tamil in this section to prove that similar to the features pertaining to the L and P class tiers, the features pertaining to the M class tier do also function as an independent unit.

## (1) Timing tier

Root tier

Laryngeal tier

 $f_a$ 

Supralaryngeal tier

Manner of Articulation tier

 $f_j$ 

Place of Articulation tier

 $f_n$ 

We begin the discussion with an inventory of the consonantal sounds of Tamil which concern us here.

## (2)

	stops	nasals	liquids
Labial	p/b	m	
Dental	$\underline{t}/\underline{d}$	$\underline{n}$	
Alveolar	$\underline{t}$	$\underline{n}$	l, r
Retroflex	$\underline{ɖ}/\underline{ɗ}$	$\underline{ɳ}$	$\underline{l}$
Palatal	c/j	ɲ	
Velar	k/g	ŋ	

Not all the sounds in (2) are phonemic in the literary dialect of Tamil which is the dialect examined and subsequently referred to as Tamil in this paper. The voicing of stops is predictable and hence not phonemic. Among the nasals there need be posited only three phonemes, i.e. m, n and n<sup>1</sup>. As for the liquids, apart from the non-controversial l and  $\underline{l}$ , most scholars, influenced by orthography, have claimed that there exist two 'r' sounds in Tamil (cf. Ladefoged (1971) for so-called phonetic evidence). As a native speaker of Tamil, I maintain that Tamil has only one 'r' sound (phone) though surface 'r's have two distinct underlying sources - r and the voiceless alveolar stop t (cf. Vijaya-krishnan (1982) and 2 below for justification). Tamil orthography more or less reflects the underlying distinctive sources of the surface 'r'.

We are now ready to look at the process of consonant sandhi (CS henceforth) in Tamil. CS is

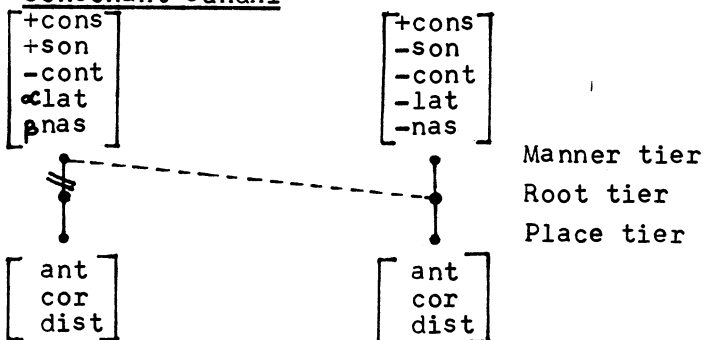
attested widely in compounds. It is also attested in a sub-set of lexical class of verbs when inflected and only sporadically in plural nouns. The compounds in (3) illustrate the process of CS which affects laterals and nasals, changing them to their corresponding stops.

(3)	i	pal	poḍi	patpoḍi
		tooth	powder	
	ii	waal	kuruwi	waatkuruwi
		tail	sparrow	bird of paradise
	iii	mul	ceḍi	mutceḍi
		thorn	plant	
	iv	aal	kaatṭi	aatkaṭṭi (wiral)
		person	pointer	the index finger
	v	pon	cilambi	potcilambi
		gold	anklet	
	vi	kaḥ	cewi	kaṭcewi
		eye	ear	snake
	vii	maḥ	kalam	maṭkalam
		mud	vessel	

On compounding, the final lateral/nasal segment of the first stem becomes a stop because of the initial stop of the following stem<sup>2</sup>. CS, then, is a case of regressive assimilation of manner of articulation. Notice that the specification for the place of articulation remains unaffected.

Following Clements' rule formalism along with the notion of feature percolation implied there and assuming that the L class tier for Tamil is not present underlyingly since voicing (and all other related features) is totally predictable (i.e. voicing of stops is rule governed and sonorants are always voiced), we can formulate CS as shown in (4).

(4) Consonant Sandhi



The M class tier participates in a phonological process independently of the P class tier, functioning as an autonomous unit just as the L and P class

tiers do in Clements (1985). Therefore the M class tier is not superfluous. We will present more evidence for the autonomy of the M class tier below.

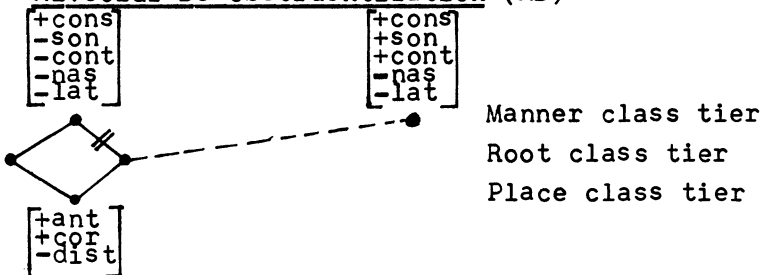
Before we look at another instance of the autonomy of the M class tier, we will briefly describe the phenomenon of progressive assimilation of the place of articulation in consonant sandhi in Tamil, exemplified in words like *mul+torad̥* *mutturad̥* 'flesh hook' and *kan+taRaL* *kātaRaL* 'fire from the eyes (of Shiva)'. That this rule of assimilation of place of articulation in coronal sounds (henceforth CA) is distinct from CS can be proved with data from inflection where CA takes place independently, because of the non-application of CS.

Going back to CS, we will now present further evidence for the autonomy of the M class tier. It would have been noticed that instances of CA cited above involved stems ending in retroflex sounds only. We will now look at stems ending in alveolar sounds. Examine the compounds in (5) where the first stem ends in an alveolar lateral or nasal and the second stem begins with a dental stop.

(5)	i	<i>kal</i>	<i>ta</i> ccan	*kattaccan	<i>kat</i> raccan
		stone	worker		stone worker
	ii	<i>kaḍal</i>	<i>ta</i> aRay	*KadattaaRay	<i>kaḍ</i> atraaRay
		sea	plant		seaweed
	iii	<i>pon</i>	<i>ta</i> amaray	*pottaamaray	<i>po</i> traamaray
		gold	Totus		

In (5), the application of CS is evident as the final sonorant of the first stem has become a stop. The application of CA would yield the geminated alveolar stop \*-tt; instead of which we find the cluster-tr- in all these cases. The second stop has become a liquid -r- and the specification for the place of articulation remains unchanged. If our analysis of Tamil is well-motivated, we now have another instance of a phonological operation affecting the M class tier to the exclusion of other class tiers-(6) referred to as AD.

(6) Alveolar De-obstruentization (AD) (AD)



AD implies that certain surface occurrences of r are derived from t. We will now present some additional evidence to support this point.

(7) a	Root	b	Stem
i	kaaṭ	i	kaaṭṭ
	forest		
ii	ooṭ	ii	ooṭṭ
	shell		
iii	wiiṭ	iii	wiiṭṭ
	house		
iv	cewiṭ	iv	cewiṭṭ
	deaf		

It is a fact of the language that only the nominative case (in this case  $\emptyset$ ) and the vocative case suffix may attach to noun roots (in a). It is the noun stem (in b) which can occur in compounds as well as in inflected forms (with cases other than nominative and vocative). For instance, kaaḍu (nominative) and kaaḍee (vocative) but kaaṭṭay (accusative), kaaṭṭukku (dative), kaaṭṭil (locative) and kaaṭṭumanidan (forest man - wild man).

To account for the alternation in (7), a rule of Final Onset Doubling (FOD) could be postulated. But not all final onsets in nouns get doubled as is clear from (8).

(8a) i	kaaṭ	b	i	*kaaṭṭ
	ear			
ii	milak	ii	*milakk	
	pepper			
iii	marap	iii	*marapp	
	tradition			

Consider now nouns which end in r as the final onset.

(9a) i	cuwar	b	i	cuwatr
	wall			
ii	coor	ii	cootr	
	rice			
iii	aar	iii	aatr	
	river			
iv	ceer	iv	ceetr	
	slush			

If we assume AD to have applied to the forms in (9b), prior to the application of the rule, the cluster -tr- would have been -tt- which can be accounted for by FOD, which in turn would imply that the final segment of the forms in (9a) must be underlyingly t. The derivative (surface) r in (9a) can be accounted for by a simple modification of AD - by making the left branch optional. We assume that FOD applies

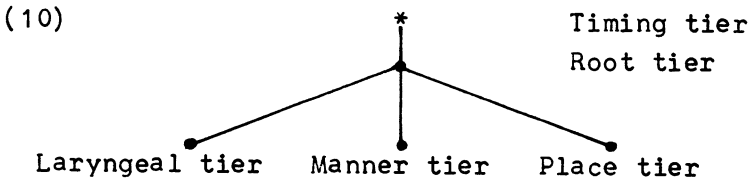
only to [+cor, -dist] onsets}.

However, if we do not account for the alternation in (9) as indicated above, we will be forced to say that FOD applies only to t and r in the onset (which do not constitute a natural class of sounds) and we would also require  $rr \sim tr$  rule in nouns in addition to AD which converts  $tt \sim tr$  in compounds!

Going back to the point of contention of this section, (whether  $t \sim r$  or  $r \sim t$ ), the phonology of Tamil attests at least two processes whose SC involve the M class tier to the exclusion of the P class tier thereby arguing for the autonomy of the M class tier on a par with the proven autonomy of the L and P class tiers.

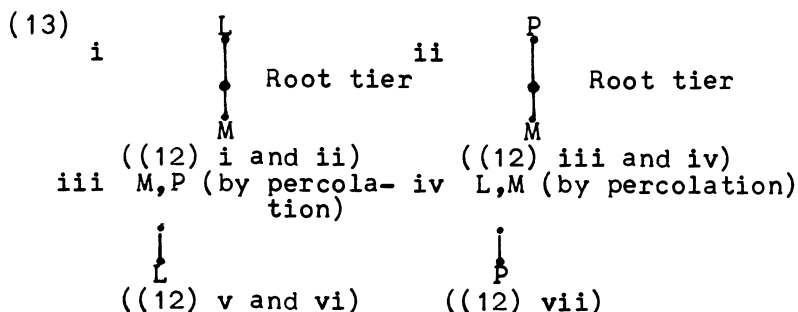
3. We had assumed the correctness of the hierarchical structure proposed by Clements (1985) to begin with. The claim made in Clements (1985) regarding this specific hierarchical structure is that "the relative independence of any two features or feature classes is correlated with the number of nodes that separate them". The geometry of the configuration reflects the claim by "postulating the highest degree of independence between the laryngeal features and all others, and the next highest between the manner and place features".

I propose that the hierarchical organization of the three autonomous class tiers is less 'articulate' than Clements' and is represented as a 'flat' structure as in (10) which reflects the claim that all the three class tiers are autonomous to the same extent.

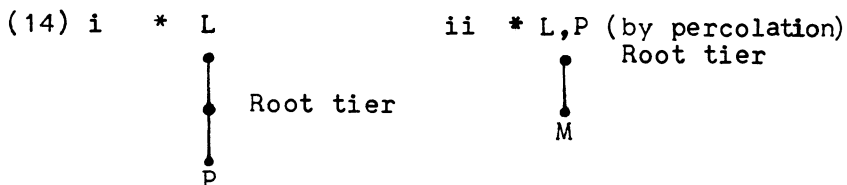


It has been widely accepted (including Clements (1985)) that the underlying phonological representation is only partially specified and that redundancy rules (which may even be ordered with respect to the phonological rules of the language (cf Archangeli (1985)) fill in the gaps. Moreover, the theory of Markedness may play a crucial role in defining the nature of these redundancy rules (cf Kayne, Lowenstamm and Vergnaud (1985)). It follows that in a particular language an entire class tier may be redundant and therefore unspecified (e.g. the L class tier in Tamil) or a specific feature may have a





To the best of my knowledge, the logically possible intra-set redundancy relations in addition to those in (12) do not seem to exist.



We will account for the facts in (14) shortly. We will now look at the Tonal features (presumably H and L) pertaining to the Tonal (T) class tier. It is quite well-established that the tonal features are quite autonomous with respect to other phonological features undergoing processes like spreading, deletion etc. We assume that the T class tier like the L, M and P class tiers is directly linked to the Root class tier.



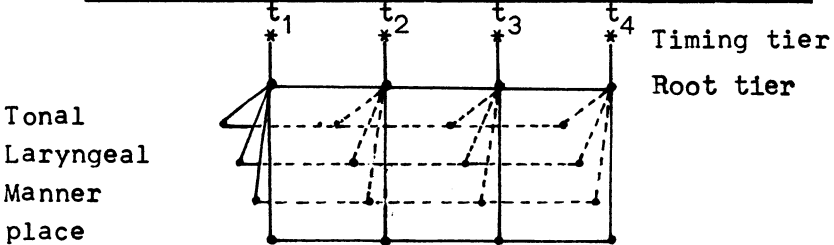
Looking at tonal phenomena, we find that laryngeal features like [voice], [constricted glottis], [spread glottis] and [subglottal pressure] may affect tonal features. For instance the loss of voiced aspirates induces a HL tone in Punjabi (cf Eliezer (1984)). This can be formulated as the intra-set relation in (16i). It is reported in Henderson (1982) that the loss of distinctive voicing in nasals and liquids may have given rise to a new tonal distinction in Bwe - a central dialect of Karen. This can be formulated as in (16ii).



consequence of the theory. It can easily be shown that, in fact, the latter is the case.

Granted that phonological representation is three-dimensional, (15) merely represents a cross-section of the three-dimensional structure which would be as in (19).

(19) Three-Dimensional Phonological Representation



Given that the class tiers T, L, M and P are on separate tiers on separate planes, using the analogy of a book where the root tier is the spine and the various planes the pages bound to the spine in a definite order, it is obvious that T, L, M and P would be ordered with respect to one another (18i). Extending the analogy of the book, only information on pages which face one another i.e. on adjacent planes will be accessible at a time. The stipulation in (18iii) is, once again, a consequence of ordering the planes with respect to one another i.e. selective percolation is possible only from adjacent planes.

We have just seen how it is necessary and sufficient to assume an equal degree of autonomy of all the sets of phonological features pertaining to the tonal, laryngeal, manner and place of articulation implied in a minimal structure that links all the sets with the root tier, which in turn, is linked to the timing tier.

However, as far as the member of each set are concerned, there are conflicting claims in the literature e.g. Archangeli (1985) Clements (1985) as in (1), Kaye, Lowenstamm and Vergnaud (1985) to mention just a few. We would merely like to point out that perhaps not all features which belong to a set have the same status. For instance, nasality among the manner features and coronal for consonant and high, back and advanced tongue root for vowels among place features, as potential 'spreaders', exhibit a greater degree of autonomy and this autonomy must surely get reflected in the hierarchical organization.

### Notes

1. These statements do not hold for other dialects of Tamil, for instance, in the Brahmin dialect of Tamil, due to heavy borrowing, voicing of stops is not always predictable and it may be that the palatal nasal could also claim phonemic status.
2. When the second stem begins with a nasal or a vowel or glide - the other possibilities in Tamil - CS does not take place.
3. We assume that the surface non-alternating r in forms like moor 'buttermilk' and teer 'chariot', like other final consonantal sonorants, is an extra-syllabic segment. We assume that moor and coor would be moor and coot respectively underlyingly.

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