Constraining Underspecification

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Authors	Avery, Peter;Rice, Keren
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Constraining Underspecification*

Peter Avery and Keren Rice

University of Toronto

1. Introduction

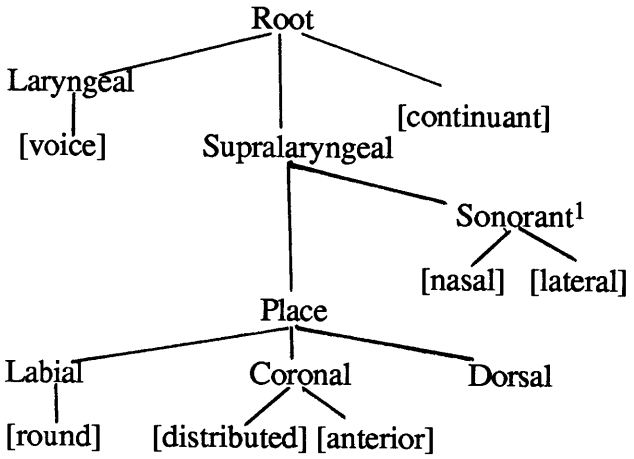
In this paper we will discuss some problems which arise in a theory of phonology which assumes a version of underspecification theory such as that found in Kiparsky (1982) or Archangeli and Pulleyblank (1986) and a model of segment structure along the lines proposed by Clements (1985). In the paper, we set out a theory of underspecification which is constrained by universal markedness conditions and a node activation condition. The theory attempts to deal with the problem of underspecification from the specification side. Therefore, we see the problem for the language learner as one of building up representations consistent with universal markedness conditions and the node activation condition.

The empirical focus of the paper is on the underspecification of coronals. We choose coronals as a starting point because of the special place which coronals appear to occupy in many of the world's languages (see for example Paradis and Prunet (this volume) Yip (1988) Lieber (1987) among others). In some languages coronals behave asymmetrically with respect to other consonants, while in other languages coronals pattern as do the other consonants. We account for the facts through the development of a constrained theory of underspecification. We also show that looking carefully at segmental representations sheds light on the question of the nature of phonological processes, although this is not the focus of the present paper.

2. Segment Structure

The model of segment structure that we assume is based largely on work of Clements (1985), Sagey (1986), and McCarthy (1988). While many of the details of segment structure are as yet unclear, it is primarily the consonantal place features that are relevant to our discussion. We assume the organization of segment structure given in (1).

(1)



3. Underspecification

Recent discussion of underspecification has questioned whether the distinctive features of a language need to be marked both plus and minus underlyingly or whether only a single value can be present. Two positions on underspecification have been espoused in the literature. Archangeli, (to appear) has termed these 'radical underspecification' and 'contrastive specification.' Under radical underspecification (see Kiparsky (1982), Archangeli and Pulleyblank (1986), Pulleyblank (1988)) only a single value of a distinctive feature is present underlyingly, the choice of the feature being supplied by universal markedness conditions or by language specific considerations. This is illustrated in (2a) with respect to the feature [voice]. Under contrastive specification (see Steriade (1987) and Clements (1987)) both values of a distinctive feature are present underlyingly as illustrated in (2b).

(2a) Radical Underspecification

	p	b	t	d	k	g	m	n	l	r
voice		+		+		+				

(b) Contrastive Specification

	p	b	t	d	k	g	m	n	l	r
voice	-	+	-	+	-	+				

While the workings of underspecification are relatively simple to contrast when we are dealing with binary features and feature matrices, certain complications arise when underspecification theory is extended to segment structure and in particular to nodes. Clements (1987) deals overtly with the issue of underspecification of class nodes, claiming that nodes must be present in underlying representation. He points out that the use of unary nodes allows for automatic underspecification as the presence of one node, such as Labial, implies the absence of the other articulator nodes. While this restricts the options available to a theory of underspecification, we argue that such a position cannot be maintained.

In our theory of underspecification unmarked values, in the sense of markedness theory, are absent from underlying representation but we also capture the notion of distinctiveness in the sense of Steriade (1987). This means that two segments which are minimally distinct, i.e., are distinguished simply by the + or - value of a single feature, will be structurally identical except for the presence of the marked value on one of the segments. We are in full agreement with Steriade (1988) that there is a 'linguistically significant boundary ... separating distinctive and non-distinctive assignments of feature values' (page 358). However, we will take a somewhat different approach to the problem of constraining underspecification, claiming that it is not the +/- values that are significant, but the nodes which dominate these values. For example, if [voice] is distinctive in a system, we would like to maintain that [-voice] is absent at the level of underlying representation. The notion of distinctiveness can be captured if we require that nodes which dominate distinctive features in a system be present in underlying representation. We claim that a node which dominates a distinctive feature in a system is activated in that system and is thus present for its class.

Underspecification is constrained by two conditions: the Node Activation Condition and the Markedness Condition. The Node Activation Condition (NAC), stated in (3), determines the amount of structure that must be present for a given segment in a phonological system.

(3) Node Activation Condition
If a feature is distinctive for a class of segments in a phonological system, then the node which dominates that feature is said to be activated for that class of segments. Active nodes must be present in underlying representation. Inactive nodes are absent in underlying representation.

Notice that we draw a distinction between features and nodes. Features minimally distinguish sounds and force the presence of nodes while nodes do not create minimal distinctness in a system and thus do not force the presence of other nodes.

The second condition, the Markedness Condition (MC), determines which nodes and features appear in underlying representation.

(4) Markedness Condition
Marked nodes or values are present in underlying representations. Unmarked nodes or values are absent.

The MC is meant to capture generalizations about markedness in the sense proposed in Chomsky and Halle (1968). What characterizes particular segments are the marked features which must be present in underlying representation and the activated nodes within the system. For example, the marked feature value for [voice] is [+voice] and would thus be present in representations of voiced obstruents. What we will argue in this paper is that there is an unmarked articulator node and that this is the Coronal node.

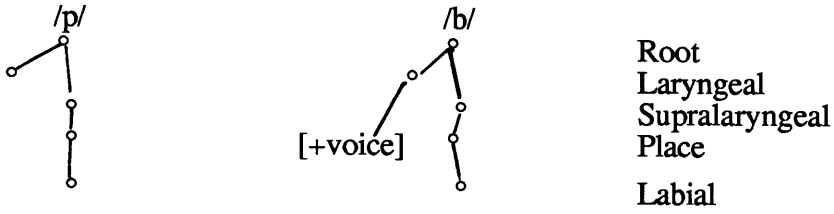
Our theory of underspecification is really a theory of specification. Thus, the simplest statement possible regarding the building up of a representation is given in (5).

(5) Specify

(5) is constrained by the NAC and the MC, thus yielding the most parsimonious representation. Note that the NAC serves to override markedness; markedness gives minimal structure and the NAC forces more structure as demanded by the inventory. Structure is added only as necessary to maintain distinctiveness within the system. From the point of view of the learner, as marked values are added, additional structure is created and nodes are activated in the phonology.

To see how these conditions work, consider a language in which /p/ and /b/ are distinctive with respect to the feature [voice]. This laryngeal contrast forces the presence of a Laryngeal node for /p/ by the NAC. Thus the segments would be represented as in (6) (irrelevant details have been suppressed).

(6)



Our theory requires that the Laryngeal node be present for both /b/ and /p/. These segments would remain distinct if the Laryngeal node were absent from /p/. However, a contrast at the Laryngeal node suggests that Laryngeal is active in the phonology and it would be expected that alternations may be found involving laryngeal features. If both /p/ and /b/ have a Laryngeal node, while other segments for which [voice] is not contrastive do not have a Laryngeal node, then the susceptibility of /p/ and /b/ to participate in voicing alternations is unsurprising. Likewise, the transparency of other segments to laryngeal alternations is predicted.[2]

In the remainder of the paper we examine evidence for the view of underspecification just outlined. We argue that class nodes can be underspecified and that this underspecification is determined by universal markedness conditions as well as by examining contrasts within an inventory. Universally the Coronal node may be absent; however, Coronal must be present for segments contrasting on a feature dominated by the Coronal node.

4. Absence of a Coronal node

4.1 Ponapean

Ponapean has the obstruent inventory given in (7).[3]

(7) Ponapean obstruents

p	t	k
p^w	ṭs	
	s	

(note - t = orthographic d, ṭs = orthographic t)

Rehg and Sohl 1981, p. 34

As there are no contrasts between places of articulation within the coronals in this inventory, the NAC and the MC do not require a Coronal node to be present. This is borne out by phonological processes of the language as well.

In Ponapean, consonant clusters are generally not allowed, and consonantal sequences are usually subject to epenthesis, as shown in the examples in (8).

(8)

a. /kitik - men/	→	kitik**i**men	'rat'
b. /ak - p^{w}uŋ/	→	ak**u**p^{w}uŋ	'petty'
c. /ak - suwei/	→	ak**u**suwei	'demonstrating boastfulness'

Itô 1986, p. 120

When labial-labial and velar-velar sequences occur a different pattern is found. Instead of epenthesis, a process which Itô (1986) refers to as fusion takes place. After fusion, the first consonant becomes a nasal by a separate process of nasal substitution (See Itô 1986 and Rehg and Sohl 1981 for details. For a different analysis, see Rice and Avery 1987.). Examples of such sequences are shown in (9).

(9) Labial + labial and velar + velar combinations [fusion]

a. /kehp - m^{w}ot/	→	keh**m**^{w}**m**^{w}ot	'variety of yam'
b. /ep - p^{w}oatol/	→	e**m**^{w}**p**^{w}oatol	'game'
c. /sap^{w} - paa/	→	sa**mp**aa	'world, earth'
d. /ak - keelail/	→	a**ŋk**eelail	'demonstrate strength'

Itô 1986, p. 137

Now consider what happens with a sequence of coronals. One might expect them to pattern like labial-labial and velar-velar sequences, with fusion and nasal substitution. However, this is not what occurs. When a sequence of coronal consonants arises, epenthesis rather than fusion takes place. This is illustrated in (10).

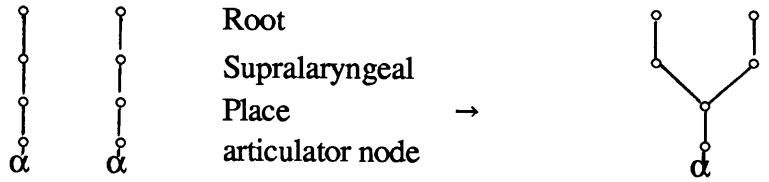
(10) Coronal consonants [epenthesis]

a. /weid - da/	→	weid**i**da	'proceed upward'
b. /lus - saŋ/	→	lus**i**saŋ	'jump from'
c. /daur - di/	→	daur**i**di	'climb downward'

Rehg and Sohl 1981, p. 63

Itô explains the asymmetrical behaviour of the coronals by underspecifying the feature [coronal]. If [coronal] is underspecified, fusion of place features cannot occur. Thus coronal sequences are treated like any other consonant-consonant sequences and epenthesis applies.

We analyse these facts in basically the same way as Itô. Fusion is an OCP-based process. It fuses nodes below the supralaryngeal node under certain conditions of identity and adjacency, along the lines in (11). We assume that place fusion can only fuse segments as high as the place node and that this need not be stipulated but rather follows from the nature of segmental representations.

(11) 

Note in the examples in (9a-c) that fusion is rightheaded, with all features of the righthand segment being maintained. Features of the lefthand segment that differ from those of the righthand segment are lost.

With labial-labial and velar-velar sequences, the structural description of fusion is met because a place node is present. With coronals, on the other hand, as no Place node exists, no fusion occurs and epenthesis applies.[4]

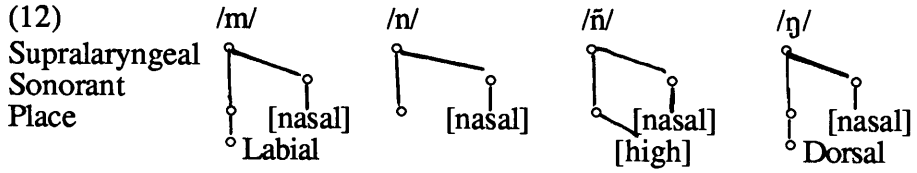
The argument for the absence of Coronal based on the Ponapean inventory is thus supported by the phonology: labials and velars pattern as if the Place node had content whereas coronals pattern as if they were totally unmarked for place. We thus can conclude, based on both inventory and phonological patterning, that in Ponapean the Coronal node is not present in underlying representation. These facts are an embarrassment for a theory which requires the presence of unary nodes, as some stipulation concerning the asymmetrical behaviour of coronals would be required.

4.2 Catalan

The behaviour of coronals in Catalan also presents evidence for the underspecification of the Coronal node. We will consider first assimilation of nasals.

In Catalan, four places of articulation must be distinguished underlyingly for nasals: labial, coronal, palatal and velar. The underspecified nasals are shown in (12). Under our markedness assumptions, the labial and velar nasals require specification for place. The treatment of the palatal nasal is, on the other hand, less obvious. We will follow Keating (1987) in considering palatals to be complex coronals which branch at the Place node. We represent specified palatals as Coronal and the feature [high]. By our assumptions the Coronal node in palatals is underspecified and is provided by a default rule. The feature [high] is not dominated by an articulator node, but links directly to the Place node. NAC forces the Place node for [ɲ] because of the presence of [high] in the palatal.[5]

(12)



Support for the underspecified system in (12) comes from a process of nasal assimilation that is found in Catalan. /n/ assimilates to all places of articulation, as in (13).

(13)			
	a. unassimilated alveolar	so[n] amics	'they are friends
	b. labial	so[m] pocs	'they are few'
	c. labiodental	so[ɱ] feliços	'they are happy'
	d. dental	so[n̪] dos	'they are two'
	e. alveolar	so[n] sincers	'they are sincere'
	f. postalveolar	so[n̠] rics	'they are rich'
	g. laminopalatal	so[n,] [ʒ]ermans	'they are brothers'
	h. palatal[6]	so[n,] [ʎ]iures	'they are free'
	i. velar	so[ŋ] grans	'they are big'

Kiparsky 1985, p. 95

The other nasals do not assimilate in the way that /n/ does; they assimilate only within their own articulator nodes. /m/ thus assimilates to a following labial (bilabial, labiodental) and the palatal and velar nasals do not assimilate at all since there are no place distinctions below their articulator nodes. This is illustrated in the forms in (14).

(14)			
/m/:	so[m] amics	'we are friends'
	so[m] pocs	'we are few'
	so[ɱ] feliços	'we are happy'
	so[m] dos	'we are two'
/ŋ/, /ñ/:	ti[ŋ] pa	'I have bread'
	a[ñ] feliç	'happy year'

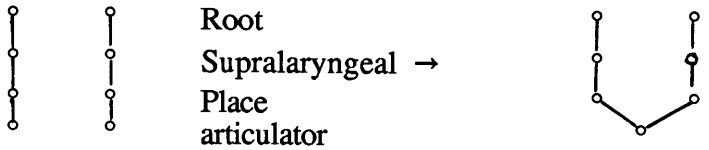
Kiparsky 1985, p. 95

There are two distinct phonological processes that result in the effect of nasal assimilation in Catalan. Fusion, shown in (15a), accounts for the examples in (14).[7] As discussed for Ponapean, fusion occurs no higher than the Place node. The second process resulting in nasal assimilation is spreading to an empty Place node, shown in (15b), accounting for the examples in (13).

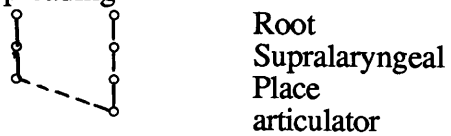
While spreading with labials and velars is straightforward, some explanation of the coronals is required. The structural description of neither fusion nor spreading is met with coronal sequences until the phonetic component because of the absence of the Coronal node. In the phonetic component, redundancy rules apply, filling in

marked values of the nondistinctive features that differentiate the coronals. Note that /n/ does not receive features at this time since it has no marked feature values. Once Coronal is filled in for these consonants, the structural description of spreading is met.

(15)a. Fusion



b. Spreading



Spreading as given in (15b) is a specific instance of a general spreading process in Catalan. In general, spreading occurs from as high a level as possible. In nasal assimilation, the articulator node of a segment on the right spreads to a Place node unspecified for an articulator on the left.[8]

Fusion and spreading differ in that fusion requires identity of nodes while spreading requires an empty node. Spreading does not generate nodes; a target for spreading must be present.

There is a process of stop assimilation in Catalan that also shows asymmetric patterning of coronals. We find full assimilation of the stops with a Coronal, as shown in (16a) and assimilation only within an articulator node with the labial and and velar stops, as in (16b). Note the similarities to the nasal facts.

(16)a. assimilation of coronal stops (Mascaro 1978, p. 43)

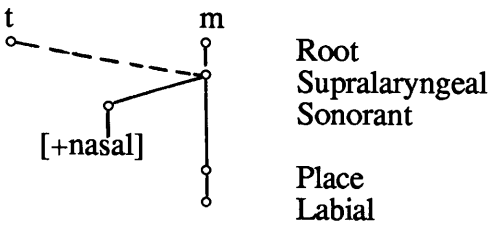
se[t]	'seven'
se[m] mans	'seven hands'
se[p,]focs	'seven fires'
se[l] linies	'seven lines'
se[t,] šais	'seven lambs'
se[λ] [λ]ibres	'seven books'
se[k] cases	'seven houses'

b. assimilation of noncoronals

ca[p]	'no'
ca[m] ma	'no hand'
ca[p,] foc	'no fire'
ca[p] signe	'no sign'
po[k]	'few'
po[k] pa	'few bread'
po[k] sol	'few sun'
po[k] šai	'few lamb'

Spreading can be from a Supralaryngeal node to a Root node in Catalan in coronal assimilation. We analyze 'se[m] mans' as in (17).

(17)



This is really the same rule as shown in (15b); it occurs at a different level because of the structure present in the representations rather than by stipulation.

As Kiparsky (1985) notes, it is the unmarked status of the coronals which allows for free assimilation. If the /n/ had a Coronal node, some special stipulation would be required about the assimilative behaviour of the coronals. On our account everything follows from the underspecification of Coronal, which in turn follows from markedness considerations.

5.0 Presence of a Coronal node

Ponapean and Catalan provide strong evidence that the Coronal node must be absent in underlying representation. In both languages, the MC requires that there be no Coronal node and the NAC does not force the presence of a Coronal node. As expected, phonological processes separate the coronals from the other places of articulation in both of the languages.

We now turn to evidence for the specification of Coronal. Now the NAC takes on rather more importance as it requires that a Coronal node be present. Coronal harmony processes found in these languages confirm the representations required by the NAC.

5.1 Sanskrit

According to Whitney (1889), dental and retroflex consonants are distinctive in Sanskrit.[9] The coronal inventory is shown in (18).

(18)

retroflex [-distributed]	ṭ	ṭh	ḍ	ḍh	ṇ	r	ṣ
dental [+distributed]	t	th	d	dh	n	l	s

Allen 1962, p.11

Assuming that dental and retroflex consonants are distinguished by the feature [distributed] and that this feature is dominated by the Coronal node, then the NAC requires that Coronal be present for those segments which are distinguished by [distributed]. Thus Coronal is activated in Sanskrit. That Coronal is an active node in the Sanskrit consonant system is borne out by phonological alternations found in Sanskrit.

Schein and Steriade (1986) discuss a rule of n-retroflexion (Nati) in Sanskrit. This process spreads the coronal features of retroflex /s/ and /r/ to a following /n/, creating retroflex /n/. The full range of the process can be seen in the examples in (19).

(19) i. -na- 'passive participle' pūr-ṇa- 'fill'
vṛk-ṇa- 'cut up'
cakṣ-āṇa- 'quake'

ii. but marj-āna- 'wipe' (blocked by coronal j)
kṣved-āna- 'hum' (blocked by coronal d)

Schein and Steriade 1986, p. 717

Schein and Steriade (1986) analyze this rule as spreading the Coronal node of a consonant to an adjacent coronal nasal, delinking the Coronal node of the nasal. As (19i) shows, noncoronal consonants are transparent to this rule. If a Coronal intervenes between the trigger and the target, as in (19ii), the structural description of the rule is not met since the trigger cannot see over an intervening Coronal. This phonological process requires the presence of a Coronal node as a blocker for Nati. The Node Activation Condition predicts that Coronal must be present thus explaining why it can block Nati.

Interestingly, Sanskrit nasal assimilation provides independent support for the analysis. Allen (1962) states that final /n/ assimilates only within its own place of articulation and is realized as /n/ otherwise. In (20 i-ii) a final /n/ does not assimilate to a non-coronal and in (20 iii-iv) it assimilates to a following coronal.

(20) i. mahān + kaviḥ → mahānkaviḥ

ii. mahān + bhāgaḥ → mahānbhāgaḥ

iii. tān + janān → tāñjanān[10]

iv. tān + ḍimbhān → tāṇḍimbhān

Allen 1962, pp. 83-84

This provides further evidence for the presence of a Coronal node in Sanskrit and the correctness of the NAC. If the dental /n/ were missing a Coronal node, which is a possible analysis under a theory of underspecification without the Node Activation Condition then total assimilation as found in Catalan might be the expected result. However, the assimilation pattern in Sanskrit clearly shows that we do not find spreading but rather fusion and fusion requires identity of articulator nodes.

5.2 Chumash

Sibilant harmony in languages such as Chumash (Beeler 1970) and Navajo (Sapir and Hoijer 1967) also presents evidence for the presence of a Coronal node. The standard analysis of sibilant harmony is that all sibilants in a word agree for the feature [anterior], with the rightmost sibilant determining the anteriority of the preceding ones. We will focus on Chumash; similar conclusions can be drawn for Navajo.

The Chumash obstruent inventory is shown in (21).

(21)

plain	p t k q
glottalized	p' t' k' q' ʔ
aspirated	p^h t^h k^h q^h
sibilants	
anterior	s c
	s' c'
	s^h c^h
nonanterior	š č
	č'
	$š^h$ $č^h$

Beeler 1970, pp. 15-16

Note that while there are contrasts between /s/ and /š/ with respect to anteriority, no such contrast exists for the stops. Given the NAC, a Coronal node is required for the sibilants, while no Coronal node is necessary for the stops.

This analysis is supported by the facts of sibilant harmony in Chumash illustrated in (22).

(22) a. within morphemes
osos 'heel'
pšoš 'gopher snake'
b. between morphemes

i.	ksaqutinéan'us	vs.	šaqutinan'iš
	'I tell him a story'		'story'
ii.	kačkéaw	vs.	ačkáwiš
	'I sin'		'a sin'

iii.	kiš̲kín	vs.	kiš̲kinus
	'I save it'		'I saved it for him'
			Beeler 1970, pp. 16-17

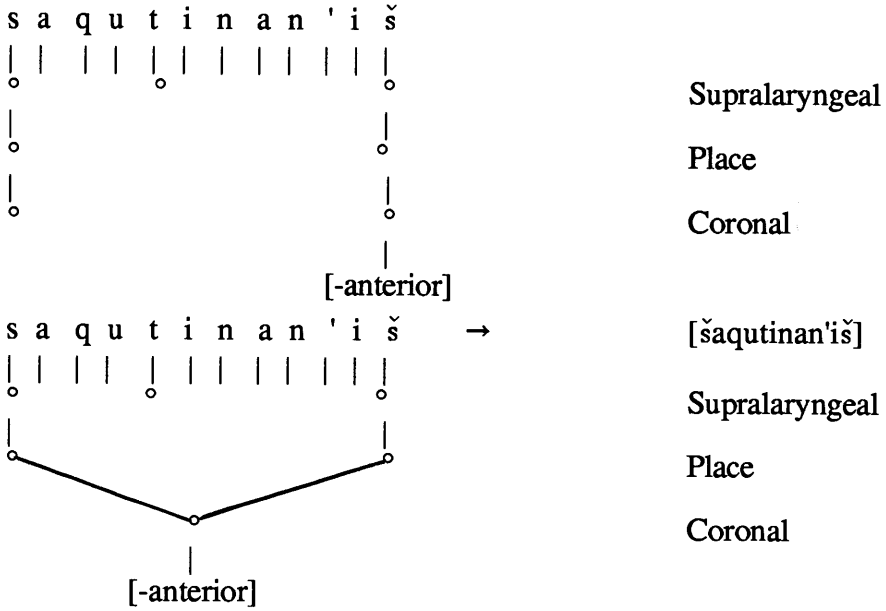
Noncontinuant coronals are neutral with respect to sibilant harmony, as can be seen in (22 bi). Thus, the rule acts as if Coronal were absent for the stops as they do not block the harmony process. The absence of a Coronal node for the stops is precisely the prediction drawn from the NAC.

Poser (1984), Steriade (1987) and Lieber (1987) analyse sibilant harmony as an unbounded, directional, feature-changing process. These authors argue that [anterior] (or a similar feature) spreads from the right to the left, delinking the other value. We propose that sibilant harmony is an instance of fusion since identical articulator nodes are involved. As with Ponapean, fusion is right headed, so the features of the rightmost sibilant remain. The rule is given in (24).

(23) Fuse

As Coronal can see only Coronal nodes and Coronal nodes are present only for sibilants, this will give the correct results. A typical form is shown in (25). Only relevant structure is given.

(24)



In this form, fusion crosses the intervening coronal because the Coronal node is not present on /t/.

It is worth commenting on the difference between Sanskrit and Chumash. Recall that in Sanskrit the coronal stops block n-retroflexion, while in Chumash the coronal stops are transparent to sibilant harmony. The difference between Sanskrit and Chumash with respect to the other coronals is that in Sanskrit a Coronal node is required for the whole range of coronal segments, while in Chumash, it is only

distinctive for sibilants. Therefore, we do not expect to find stops blocking harmony in Chumash as they do in Sanskrit.[11]

6. Conclusion

Our data show that the articulator node Coronal is underspecified if no contrast exists under the Coronal node. This is predicted by markedness theory and also explains, in part, the special status of coronal consonants in the phonological systems of many of the languages of the world. A position which requires the presence of all privative features is too strong in that the special status of coronal consonants does not follow from anything and must be stipulated.

While we fcous on coronals in this paper, our claim is much broader. The NAC and the MC provide us with a theory of how phonological representations come to be specified in general. The success of this approach with coronal consonants is encouraging. A theory such as Clements which requires the presence of all privative features is too strong, as are Steriade's arguments for the presence of both values of distinctive features. For example, Steriade's arguments for Chumash can be reanalyzed in a way consistent with our theory. Steriade herself notes that the interaction between Rendaku and Lyman's Law in Japanese causes problems for her theory. We have also suggested, based on Sanskrit and Chumash, that a theory with maximal underspecification is inadequate. In both redundant and maximal underspecification there is no way to account for the special status of coronal consonants . It would be necessary to stipulate something special about coronal consonants for each language. In our theory, the special status of coronals follows from the MC and when coronals behave as other consonants, this follows from the NAC.

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[1]See Rice and Avery (1989) for arguments that a node dominates sonorant features such as [nasal] and [lateral].

[2]See, for example, the case of Rendaku and Lyman's Law in Japanese (Itô and Mester 1986).

[3] It should be noted that the Ponapean orthographic system is used in all examples.

[4] Itô claims, based on facts of reduplication, that there are two levels of word formation in the lexicon and that values for [coronal] are filled in at the end of level 1. She argues that affixation takes place at level 1. She points out that labials, velars, and coronals pattern identically in reduplication and she thus requires that [coronal] be filled in by level 2. We argue in Rice and Avery (1987) that even though coronals pattern with labials and velars with respect to reduplication, it is not the case that the Coronal node must be filled in when reduplication takes place.

[5] We supress the node dominating nasal in these representations. See Rice and Avery (1989) and Piggott (1989) for arguments that this node is actually a voice node related to spontaneous voicing.

[6]Note that the assimilation is incomplete when the nasal precedes a palatal, with /n/ becoming laminopalatal. We assume that this is due to the structure of palatals. For further discussion see Avery and Rice (1988).

[7]We assume that spreading is motivated by the Obligatory Contour Principle (McCarthy 1986). Furthermore, redundancy rules which distinguish labials from labiodentals apply late, perhaps at the level of phonetic implementation.

[8]Since we consider /ñ/ to be a coronal, it may be asked why /ñ/ does not assimilate in the manner of the other coronal /n/. There are a variety of answers that may be given. One possibility is that the rule does not apply because the structural description is not met, given the feature [high] on the Place node in the palatal.

[9] The vast majority of retroflex consonants are derived from dentals by retroflexion. However, they are distinctive in the underlying inventory.

[10]We assume that Sanskrit palatals are not like those found in Catalan. Possibly [high] is attached to the Coronal node rather than the Place node in Sanskrit. Otherwise we would expect no visible effect of assimilation.

[11] This conclusion is very similar to the one reached by Steriade (1987) in her discussion of Chumash. Steriade concludes that the feature [anterior] must be present for the sibilants in Chumash, with the alveolar sibilants marked [-anterior] and the alveopalatal sibilants [+anterior]. This feature is redundant for the other series and need not be specified. Our solution is thus identical to Steriade's with the exception that the introduction of the Coronal node allows maximal underspecification of features to be maintained.

References

Allen, W.S. 1962. Sandhi. Mouton and Co. The Hague.

Archangeli, D. and D. Pulleyblank. 1986. The Content and Structure of Phonological Representations. ms. University of Arizona and University of Southern California.

Avery, P. and K. Rice. 1988. Underspecification theory and the Coronal node. Toronto Working Papers in Linguistics. vol. 9.

Beeler, M.S. 1970. Sibilant harmony in Chumash. IJAL 36.

Chomsky N. and M. Halle. 1968. The Sound Pattern of English. New York: Harper and Row.

Clements, G.N. 1985. The geometry of phonological features. Phonology Yearbook 2, 223-250.

Clements, G.N. 1987. Towards a substantive theory of feature specification. Paper presented at UCLA, October 1987.

Itô, J. 1986. Syllable theory in prosodic phonology. Ph.D. dissertation, University of Massachusetts.

Itô, J. and A. Mester. 1986. The phonology of voicing in Japanese: Theoretical consequences for morphological accessibility. Linguistic Inquiry 17, 49-74.

Kean, M-L. 1976. The theory of markedness in generative grammar. Ph.D. Dissertation, MIT. Distributed by Indiana University Linguistics Club.

Keating, P. 1987. Palatals as complex coronals: X-ray evidence. Paper presented at the 62nd annual Meeting of the Linguistic Society of America, San Fransisco, December, 1987.

Kiparsky, P. 1982. Lexical phonology and morphology. In I.S. Yang ed., Linguistics in the Morning Calm. Linguistic Society of Korea, Hanshin, Seoul.

Kiparsky, P. 1985. Some consequences of Lexical Phonology. Phonology Yearbook 2, 83-136.

Lieber, R. 1987. An Integrated Theory of Autosegmental Processes. Albany: SUNY Press.

Lieber, R. 1987. 'Morphology and the morphemic tier hypothesis.' ms. University of New Hampshire and MIT>

Mascaro, J. 1978. Catalan phonology and the phonological cycle. PhD Dissertation, MIT. Distributed by Indiana University Linguistics Club.

McCarthy, J. 1986. OCP effects: gemination and antigemination. Linguistic Inquiry 17, 207-63.

McCarthy, J. 1988. Feature geometry and dependency. To appear in O. Fujimura (ed.) Articulatory Organization: From Phonology to Speech Signals. Basel: S. Karger.

Paradis, C. and J.-F. Prunet (this volume). 'Markedness and coronal structure.'

Piggott, G. 1989. Transparency and opacity in nasal harmony systems. Paper presented at the Montreal-Ottawa-Toronto Workshop in Phonology, January 1989.

Poser, W. 1982. Phonological representations and action-at-a-distance. In H. van der Hulst and N. Smith (eds.) The Structure of Phonological Representations, Part 2, 121-58. Dordrecht: Foris.

Pulleyblank, D. 1988. Vocalic underspecification in Yoruba. Linguistic Inquiry 19, 238-70.

Rehg, K.L. and D.G. Sohl. 1981. Ponapean Reference Grammar. University Press of Hawaii.

Rice, K. and P. Avery. 1987. Underspecification and reduplication in Ponapean. Paper presented at the 62nd annual Meeting of the Linguistic Society of America, San Francisco, December, 1987.

Rice, K. and P. Avery. 1989. The organization of sonorant features. Paper presented at the Montreal-Ottawa-Toronto Workshop in Phonology, January 1989.

Sagey, E. 1986. The representation of features and relations in nonlinear phonology. Ph.D. dissertation, MIT.

Sapir, E. and H. Hoijer. 1967. The Phonology and Morphology of the Navajo Language. UCPL 50.

Schein, B. and D. Steriade. 1986. On geminates. Linguistic Inquiry 17, 691-744.

Steriade, D. 1987. Redundant values. Papers from the 23rd Annual Meeting of the Chicago Linguistics Society, Volume 23, Part 2, 339-62.

Whitney, W.D. 1889. Sanskrit Grammar. Harvard University Press.

Yip, Moira 1988. 'The OCP and phonological rules: a loss of identity.' LI 19.1, pp 65-100.