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On the Representation of Voice

Keren Rice
University of Toronto

Peter Avery
University of Toronto

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Keren Rice and Peter Avery

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In this paper we present an analysis of the relationship between sonorancy and voicing based on a theory of segmental structure which recognizes the possibility that voice may not be a unitary phenomenon. We propose that voicing has two distinct realizations. One is through the activation of laryngeal features (LV) and the other is spontaneous voicing (SV). We propose that sonorants involve a node which represents spontaneous voicing and that this may may also be present in obstruents.

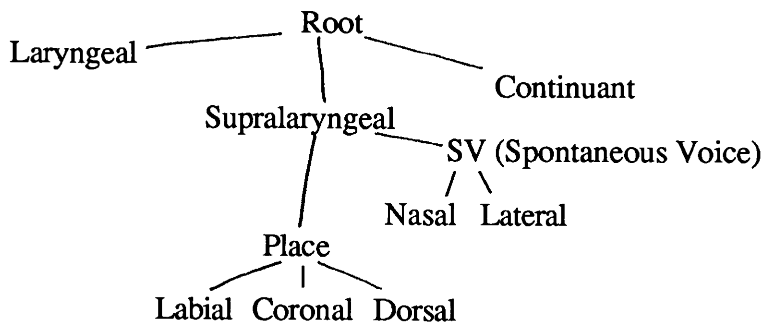
We claim two major advantages to our approach to voicing. First, the feature geometry that we propose allows for an account of sonorant-sonorant interactions, as sonorant features such as [nasal] and [lateral] are both dominated by the SV node. Secondly, in line with the thrust of much current work in linguistic theory, we shift the burden of explanation from the rule component to the representational component. More specifically, the recognition of two types of voicing, allows us to eliminate the use of redundancy rules in the specification of voice for sonorants as a method of accounting for phonological processes.

1. Assumptions

1.1 Feature Geometry

Following Clements (1985), Sagey (1986), Archangeli & Pulleyblank (1986), McCarthy (1988), and others, we assume that segments are not merely unordered feature bundles but that they have hierarchical structure. The model of segment structure that we adopt is shown in (1).

(1)



We distinguish two major node types, organizing nodes and content nodes. Organizing nodes (roughly equivalent to Clements' 1985 class nodes) serve to define major organizational units such as Supralaryngeal, Place and Spontaneous Voice. The content nodes are actual articulatory instructions.

1.2 Underspecification

We assume that underspecification is desirable in phonology. In the theory we adopt, unmarked values, which are determined by a universal markedness theory, are underspecified. Unmarked features can be present if contrasts within an inventory force their presence (see Avery & Rice 1989 for details). Crucially, underspecification is inventory-driven in the sense of Steriade (1987).

The role of default rules in our framework is less elaborate than that found in other work on underspecification theory (e.g. Archangeli & Pulleyblank 1986, Kiparsky 1982). We see default rules as being restricted to the phonetic implementation component. Thus, if a feature or node is underspecified in the phonology of a language, then that feature cannot play a role in the phonology of the language. Default rules merely supply articulatory instructions; for example, such rules specify whether a /t/ is dental or alveolar in a particular language.

Another assumption we make is that all features are privative, and that it is only presence versus absence that gives the appearance of binarity. (See Anderson & Ewen 1987, van der Hulst (1989), and Rice (1990) for work which argues for privativeness.)

1.3 Rules

We assume that the phonology is restricted to at most three operations, spreading, delinking, and OCP-based fusion.

Spreading is a language-particular operation which may include trigger and target conditions as well as a directionality parameter. The theory of spreading that we adopt is summarized in (2).

(2) a. Spreading can occur only if a structural target is present.
  b. A feature or node can spread only to an empty position.

(2a) disallows node generation through spreading and (2b) rules out cases of spreading triggering delinking. See Mascaró (1987a) and Piggott (1988) for similar views and Avery & Rice (1989) for further details.

We view delinking as a neutralization process which delinks content nodes in neutralizing positions such as morpheme-final or syllable-final. A crucial assumption that we make is that laryngeal distinctions are universally neutralized syllable-finally, as shown in (3).

```
(3)         Root
             /
        Laryngeal
            ‡
            x
```

Fusion takes identical locally adjacent content nodes and fuses them. See Avery & Rice (1989) for discussion of the differences between fusion and spreading.

2. The SV node

Frequent place assimilation across languages has been taken as evidence for Place as an organizing node (Clements 1985, McCarthy 1988). We will present parallel arguments for an organizing node dominating the sonorant features, [nasal], [lateral], and [r-features]. We argue that a node is necessary based on assimilations found within the sonorant consonants. In addition, we present evidence that the node itself can spread and delink.

2.1 Klamath n-l assimilation

In Klamath, as in English level 1, /n-l/ becomes [l-l], as illustrated in (4). See Barker (1964) for discussion.

(4) honlina → hollina 'flies along the bank'
w'inl'ga → w'illga 'lies down on the stomach'[1]

Clements (1985) proposes that n-l assimilation in Klamath be analyzed as the spreading of lateral, with spreading formalized as in (5).

```
(5)    Root    Root            root tier
        ‡ - - - |
      [+son] [+lat]            supralaryngeal tier
      [+cor]
      [+ant]
```

The rule in (5) spreads a supralaryngeal feature on the right that dominates [lateral] to a supralaryngeal node on the left that is realized as a coronal sonorant, delinking the supralaryngeal node on the left. While Clements' rule is descriptively adequate, it offers no account of why such target conditions are found: a rule that spread [lateral] to a target with any random set of supralaryngeal features could just as easily be formulated. In addition, Clements' formulation of the rule is problematic given the theory of spreading outlined in (2) as this theory allows spreading to occur only if an empty structural target is present. In our terms, the [lateral] dependent of the SV node on the right spreads to the empty SV node on the left, as in (6).

(6) SV SV
lat

2.2 Ponapean assimilation

Ponapean is another language that exhibits assimilation within the sonorants. We illustrate the Ponapean assimilations with the n/l alternation.[2] In rapid speech, Ponapean exhibits the same assimilation found in Klamath and English, /n/ assimilates to /l/,as illustrated in (7).

(7)	nan-leng → nalleng	'heaven'
	pan lingan → pallingan	'will be beautiful'

This assimilation can be accounted for in the same way as Klamath, with the daughter of the righthand node spreading to the lefthand node.

2.3 Toba Batak assimilation

Toba Batak is another language with numerous sonorant-sonorant assimilations. These are shown in (8). Data is from Hayes (1986).

(8)	nn → nn	rn → rn	ln → ln
	nr → rr	rr → rr	lr → lr
	nl → ll	rl → ll	ll → ll

We assume the representations in (11) for the Toba Batak sonorants.[3]

(9)

/n/	/l/	/r/
Root	Root	Root
|	| \\	| \\
SV	SV [cont]	SV [cont]
	|	
	[lateral]	

/n/ is represented as a bare SV node. /l/ is an SV node with [lateral] as a dependent and the feature [continuant] as a daughter of the root. Finally, /r/ is a bare SV node with the feature [continuant] as daughter of the root.

Assimilation in the n-n, r-r and l-l sequences in Toba Batak is straightforward, being the result of either fusion of identical sonorant features (l-l) or the fill-in of default rules (n-n, r-r). The n-l sequences are analyzed in the same way as the n-l sequences in Klamath and Ponapean, with spreading of [lateral] (and continuant) onto the lefthand unspecified SV node. In the n-r case [continuant] spreads from the /r/ onto the /n/ and the entire sequence is realized as [r-r] as the nasal default rule will not insert [nasal] onto a continuant. Assimilation in l-n is blocked since /n/ has no specified features to spread to /l/ and /l/ has a dependent. In r-l, [lateral] spreads from the /l/ to the /r/, yielding [l-l]. Assimilation in l-r is blocked for the same reason that there is no assimilation in l-n: the left-hand SV node has specified features ([lateral]) and therefore spreading cannot apply.

2.4 Korean SV spreading

We have argued for the SV node based on spreading of SV dependents. In all cases, the SV node organizes sonorant features and acts as a target for spreading. If SV is a node, one should find other node-like patterning, namely spreading and delinking. We will first consider spreading.

Spreading of the SV node is found in Korean. Stops assimilate in nasality to a following segment (10a-d) and t's to a following lateral (10e). This can be analyzed as the spreading of SV leftwards to a preceding consonant. (Data from Cho 1988 and from Iverson & Kim 1987.)

(10) a. kukmul → kuŋmul 'soup'
b. kakmok → kaŋmok 'wood'
c. napnita → namnita 'to sprout'
d. kat^{h}ni → kanni 'to be the same'
e. tikɨtlɨɨl → tikɨllɨɨl 'the letters t and l'[4]

Assuming that the nasals are characterized as SV and the lateral as SV dominating [lateral], the Korean process can be analyzed as spreading of an SV node on the right to an adjacent segment on the left which has no SV node. This assimilatory process is illustrated in (11).

(11) Root Root
SV

2.5 Yagaria SV delinking

Delinking provides a third argument type for node status. As discussed by McCarthy 1988, debuccalization can be viewed as delinking of the Place node. If SV is a node, one might expect to find desonorantization processes, where the SV node delinks. Some evidence for dosonorantization is found in the Move dialect of Yagaria, a language of East New Guinea. Alternations exist between sonorants and obstruents: /l/ alternates with /t/, /v/ with /p/, /y/ with /g/, and /m/ with /b/. The sonorant form occurs following a vowel and the obstruent is found after a glottal stop, which is subsequently lost (see Levin 1987). These processes can be viewed as strengthening, with a sonorant weakening to an obstruent of the same place articulation. We suggest that these alternations arise from a delinking of the SV node, which automatically yields the stops.

2.6 Summary

To summarize, we propose that sonorants have an SV node dominating sonorant features. We have attempted to show that this node displays typical node-like behaviour: it serves as a target of spreading (Klamath, Ponapean, Toba Batak), it spreads (Korean), and it delinks (Yagaria). In addition, we have suggested that [nasal] is the unmarked sonorant and is not present in the underlying representations of the languages discussed so far, but arises through phonetic default rules.

3. The representation of sonorants and obstruents

Sonorants often pattern with voiced obstruents, behaving as though the feature [voice] were present and at other times sonorants do not pattern with voiced obstruents, behaving as though the feature [voice] were not present. When sonorants do not pattern with voiced obstruents, the standard analysis is that [voice] is redundant for sonorants and is not visible in the phonology (see, for instance, Itô & Mester 1986, Hayes 1982, Kiparsky 1985, Mascaró 1987a). When sonorants do pattern with the voiced obstruents it is assumed that the process involved takes place after the specification of the redundant values for [voice] (see Mascaró 1987a). We propose that the difference between languages in which voiced obstruents and sonorants pattern separately and those in which they pattern together follows from the different representations of voiced obstruents in these languages. When voiced obstruents and sonorants pattern as a natural class, these sounds are characterized by the presence of the SV node. When voiced obstruents and sonorants do not form a natural class, the SV node is present only for sonorants; the voiced obstruents are distinguished from the voiceless obstruents solely by laryngeal features. This allows us to account for those languages in which voiced obstruents and sonorants pattern together without recourse to the ordering of redundancy rules.

We will propose a typology of languages where the classification of a language depends on the behaviour of nasals and voiced obstruents. We suggest two broad classes of languages. In class I languages, [nasal] is absent from underlying representation and we find sonorants and laryngeal obstruents, but no sonorant-obstruent interactions. When the language has voiced obstruents, voicing distinctions are neutralized in syllable-final position. In class II languages, [nasal] is present underlyingly and we find sonorants and laryngeal obstruents, but voiced obstruents and sonorants interact. In these languages we claim that the voiced obstruents and sonorants are distinguished at the SV node.

3.1 Class I languages

We distinguish two types of class I languages, those without laryngeal distinctions (section 3.1.1) and those with such distinctions (section 3.1.2).

3.1.1 Class Ia - no laryngeal distinctions

3.1.1.1 Ponapean

Ponapean has voiceless obstruents and sonorants, as shown in (12) (from Rehg & Sohl 1981).

(12)

Labial	Coronal	Velar
p, pw	d, t	k
	s	
m, mw	n	ŋ
	l r	

(/d/ is a voiceless coronal stop and /t/ is a voiceless coronal affricate)

Rehg and Sohl (1981) characterize the non-sonorants in Ponapean as voiceless and the sonorants as voiced. There are no voicing contrasts within either the obstruents or the sonorants. We have already argued that Ponapean sonorants have an SV node, as in (13a). We propose the representation in (13b) for Ponapean obstruents.

(13) a. sonorant

```
Root
 |
 SV
```

b. obstruent

```
  Root
   |
Laryngeal
```

Only Laryngeal is present for obstruents and only SV is present for sonorants. The realization of obstruents as voiceless and sonorants as nasal is achieved through the application of universal default rules which fill in unmarked values.

3.1.1.2 Rotokas

Another language with representations like those in Ponapean is Rotokas. However, some significant differences between Ponapean and Rotokas show that the SV node may be realized as an obstruent as well as a sonorant. Rotokas is reported by Firchow & Firchow (1969) to have two dialects, one with nasal sonorants and one without sonorants. The dialects are illustrated in (17).

(14) Rotokas (Firchow & Firchow)[5]

	Dialect A			Dialect B		
voiceless	p	t	k	p	t	k
voiced	m	n	ŋ	ƀ	ř	g

We assume that these dialects do not differ in terms of underlying representation, but rather in terms of phonetic realization. In Dialect A, with sonorants, the feature [nasal] is filled in, the unmarked case, and the underlying SV node is implemented as a nasal. In dialect B, the nasal default rule does not operate and voiced obstruents result. The voiced obstruents contain the SV node, and are the sonorants of the language.

Other languages appear to show similar properties to Rotokas. Thompson & Thompson 1972 cite a number of nasalless Northwest Coast languages, including Nitinat and Makah of the Wakashan family, Quileute of the Chemukuam family, and Puget Sound Salish and Twana of the Salishan family. In all cases, these languages have /b/ and /d/ developing from *m and *n. The analysis which we would propose for such facts is that these languages are like Rotokas: the Nasal default rule simply fails to operate, with voiced obstruents resulting.

Rotokas demonstrates that SV can be present in obstruents; we will see in the next section that it is not a necessary feature of voiced obstruents.

3.1.2 Class Ib languages - laryngeal distinction

In class Ib languages we find both voiced and voiceless obstruents as well as sonorants. These languages, like Class Ia languages, are characterized by the absence of [nasal] in underlying representation. They also show syllable-final neutralization of laryngeal distinctions.

3.1.2.1 Dutch

Dutch has both voiced and voiceless obstruents as well as sonorants. Voiced and voiceless obstruents show alternations in Dutch, but the sonorants do not enter into this system.

Dutch exhibits syllable-final devoicing (data from Mascaró 1987a).

(15)	hui[z]en	'houses'
	hui[s]	'house'
	hui[s k]ammer	'living room'
	kie[z]en	'to choose'
	kie[st]	'you/she/he chooses'

Syllable-final obstruents are not always voiceless, however. If they are followed by a voiced obstruent, they are voiced.

(16)	hui[z b]aas	'landlord'
	kie[z b]aar	'eligible'

When followed by a sonorant onset, syllable-final consonants are phonetically voiceless.

(17)	hui[s]raad	'household goods'

We account for these facts as follows. Voiceless obstruents are characterized by a laryngeal node, voiced obstruents by a laryngeal node dominating laryngeal voice (LV), and sonorants by the SV node.

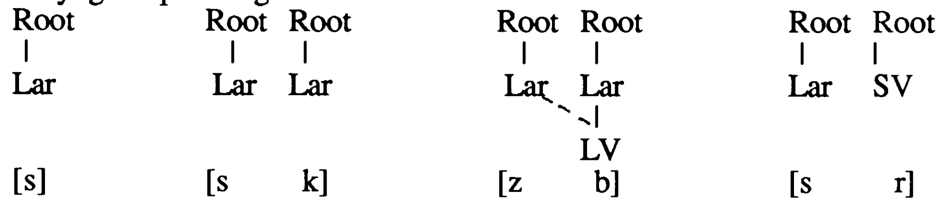
```
(18)  vcls obs        vd obs        sonorant

        root           root           root
         |              |              |
        Lar            Lar             SV
                        |
                        LV
```

In Dutch, syllable-final neutralization results in the loss of laryngeal contrasts. The voiced syllable-final obstruents achieve their voicing by spreading of the laryngeal dependent from the following consonant. Since sonorants are not laryngeal, they fail to trigger assimilation. (For a similar analysis see Mascaró 1987a.) Typical derivations are shown in (19).

```
(19) a. z]σ      b. z]σ   k        c. z]σ   b        d. z]σ   r
        Root        Root Root         Root Root         Root Root
        |           |    |            |    |            |    |
        Lar         Lar  Lar          Lar  Lar          Lar  SV
        |           |                 |    |            |
        LV          LV                LV   LV           LV
        Laryngeal neutralization
        Root        Root Root         Root Root         Root Root
        |           |    |            |    |            |    |
        Lar         Lar  Lar          Lar  Lar          Lar  SV
                                           |
                                           LV
```

Laryngeal spreading



All of the examples show syllable-final laryngeal neutralization, expressed as delinking of laryngeal dependents. In (19a) and (19b), the consonant is realized as voiceless. In (19c), delinking is followed by laryngeal spreading, which functions to revoice the syllable-final /z/. In (19d), spreading does not occur since the sonorant does not have a laryngeal node. Thus, the structural description of spreading is met only when the consonant on the right is a voiced obstruent and not when it is a sonorant.

Given these representations we predict that [nasal] is absent in underlying representation in Dutch. We do not have any positive evidence for this position as there are no examples of spreading to SV in Dutch that we know of. However, in the Teralfene dialect of Flemish, a language related to Dutch, it appears that [nasal] is absent underlyingly. Levin (1988) points out that under certain circumstances nasals become laterals.

(20)	/spe:l-n/	[spe:ll̩]	'to play'
	/smelt-n/	[smeltl̩]	'to melt'
	/vals-n/	[valsl̩]	'filings'

This spreading of [lateral] can be accounted for if nasals consist of just an SV node, without a nasal dependent. If we assume that the underlying representations in Teralfene and Dutch are the same, then Dutch is like Ponapean in that [nasal] is absent underlyingly.[6]

3.2 Class II languages

In the languages illustrated so far, the SV node is present only for sonorants and sonorants and voiced obstruents do not form a natural class. Languages in which sonorants and voiced obstruents do pattern together are our class II languages. In these languages, voiced obstruents contain the SV node. Furthermore, these languages maintain voicing distinctions syllable-finally and have [nasal] specified underlyingly.

3.2.1 Catalan

Catalan treats voiced obstruents and sonorants as a natural class. In Catalan, stops assimilate to the voicing of a following obstruent or sonorant, as in (21). In (21a), assimilation to the voicing of a following obstruent is shown, and syllable-final obstruent assimilating to the voicing of a following sonorant is shown in (21b). Data is from Mascaró (1987a) and Wheeler (1979).

(21) a. assimilation to voicing of obstruent

se[t]	'seven'	se[d d]ones	'seven women'
		se[b b]eus	'seven voices'
λar[k]	'large'	λar[g d]e cames	'long-legged'

b. assimilation to voicing of sonorant

to[t]	'all'	to[ɖ r]ic	'all rich person'[7]
se[t]	'seven'	se[d m]ans	'seven hands'
ca[p]	'no'	ca[b m]a	'no hand'
po[k]	'few'	po[g λ]ure	'few free'

Because Catalan voiced obstruents and sonorants both impart their value for voicing to an adjacent voiceless segment, they should share a common trigger feature. Rather than analysing this through the use of redundancy rules, we propose a rather different way of capturing the relationship between the voiced obstruents and sonorants. In Catalan voiced obstruents are characterized by the presence of a bare SV node. Given this, we assume that the representations for obstruents and sonorants are as in (22).

(22)

voiceless obstruent	voiced obstruent	sonorant
Root	Root	Root
|	|	|
Lar	SV	SV
		|
		(nasal, lateral ...)

Thus the assimilation is spreading of the SV node from the voiced obstruent or sonorant to the preceding voiceless obstruent. (This raises problems concerning the failure of the SV dependent to spread, this is discussed in the next section.)

Notice that in Catalan, where voiced obstruents have an SV node, we suggest that the other sonorants must be characterized by SV dependents underlyingly. This is different from the other language types examined so far, where features such as [lateral] are present underlyingly but [nasal] is realized by default. The feature [nasal] is necessary on the sonorants in Catalan in order to keep voiced obstruents and sonorants distinct: if [nasal] were not present, there would be no SV difference between these two classes, and one might predict that the default rule for [nasal] would fill in [nasal] in all instances. The proposed representation for Catalan nasals predicts that spreading of [lateral] onto a nasal should not occur since the target for spreading is not empty. This is true: Catalan exhibits place assimilation with nasals but nasals do not take on other sonorant features. This can be seen in (23), where nasal remains despite the fact that a sonorant follows.

(23)

so[ṇ] rics	'they are rich'
so[n,] [λ]iures	'they are free'

As [nasal] is specified underlyingly, spreading to SV is not allowed. Note that in Catalan spreading appears to be a very pervasive phenomenon. If [nasal] were not specified, we would likely find nasal-lateral assimilations.

This analysis makes predictions about the syllable-final devoicing of obstruents in Catalan. Our prediction is that Catalan will maintain voice distinctions syllable-finally, as voiceless and voiced obstruents are distinguished by the presence of an SV node in the voiced obstruents and the presence of a Lar node in the voiceless obstruents. There is controversy over the status of final devoicing in Catalan. Catalan obstruents are generally claimed to be devoiced syllable-finally (e.g. Mascaró 1987b). However, Dinnsen & Charles-Luce 1984, Charles-Luce & Dinnsen 1987 report that final devoicing in Catalan is not neutralizing, i.e., that the voiced and voiceless obstruents remain distinct phonetically. If the voiced obstruents in Catalan have SV, then we do not expect to find total neutralization. Obviously, more research needs to be conducted on the phonetics of final devoicing in order to sort out the conflicting claims found in the literature.

3.2.3 Sanskrit

Sanskrit is similar in nature to Catalan, treating voiced sonorants and obstruents as a natural class. Data is given in (24).

(24) a. assimilation to voicing of an obstruent
ap 'water' + ja 'born of' → abja 'born of water, a lotus'

b. assimilation to voicing of a sonorant
tat namaḥ → tad namaḥ 'that name' (from Allen 1962, p.92)

Based on these assimilations, it appears that voiced obstruents and sonorants pattern as a natural class in Sanskrit. We propose the representations in (25).

```
(25) voiceless unasp   voiceless asp   voiced unasp   voiced asp
         Root              Root            Root          Root
          |                 |              /  \          /  \
         Lar               Lar           Lar   SV      Lar   SV
                            |                           |
                            SG                          SG
```

The aspirated and unaspirated stops are distinguished by the presence of [SG] on the aspirates, but not on the unaspirates. In addition, the voiced stops have an SV node.[8]

The devoicing of syllable-final consonants is potentially problematic in Sanskrit since our analysis predicts a phonetic difference between underlyingly voiced and underlyingly voiceless consonants. While Sanskrit, like Catalan, is generally reported as showing syllable-final devoicing, Whitney (1889) makes an interesting comment on this topic, reminiscent of the debate on Catalan final devoicing. He reports that 'there was some question among the Hindu grammarians as to whether the final mute (stop) is to be estimated as of surd or sonant quality, but the great weight of authority, and the invariable practice of the manuscripts, favor the surd' (section 141b). Thus, as in Catalan, there is the possibility that subtle phonetic differences distinguished final stops derived from voiceless stops and final stops derived from voiced stops.

4. Formalism

We have presented no formal way of capturing the relationship between voice and sonorancy in the assimilation cases of Catalan and Sanskrit. If we analyze these cases as spreading of SV, we encounter rather serious difficulties as the SV dependent does not also spread. Consider the spreading shown in (26).

(26)
```
      t       n
   Root    Root  →  *n n  ([dn])
       ` - - |
            SV
             |
           nasal
```

One way to account for this would be to give up the dominance relationship between [nasal] and SV. While this is a possible way out of the dilemma, we would prefer to allow for the generalization concerning Klamath, Ponapean, and Toba Batak to stand with the solution given. Furthermore, we would lose any possibility of capturing the sonorant-voice relationship.

Before turning to a solution, let us consider the Catalan and Sanskrit data in (27) and (28).

(27) Catalan

a. /cap ma/	b. [cab ma]	c. [camma]
/set mans/	[sed mans]	[semmans]

(28) Sanskrit

a. /tat namas/	b. [tad namaḥ]	c. [tan namaḥ]
/tristup numan/	[tristub numan]	[tristum numan]

These data differ in an interesting way from the data considered so far. As (27) and (28) show, two possibilities exist concerning the assimilation of a stop to a following sonorant: assimilation can result in either a voiced stop (27b, 28b) or a sonorant (27c, 28c).

We propose the following account of these facts. In Catalan and Sanskrit, voiced stops and nasals have representations such as those in (29). Laryngeal features are omitted.

(29)
```
voiced stop      nasal
Root             Root
 |                |
 SV               SV
                  |
                 nasal
```

We suggest that in (27) and (28) the SV node is copied, not spread. We propose that the choice of copying or spreading follows from the level of structure involved, and suggest that there is a general prohibition on the spreading of organizing nodes: organizing nodes copy and content nodes spread. If we assume that a copied node does not copy any dependents, then the two possibilities shown in (27) and (28) can be accounted for. Avery & Rice (1989) propose that organizing nodes cannot fuse while content nodes can. If this position is correct, an analysis where organizing nodes copy and content nodes spread is expected: it appears that organizing nodes cannot be shared across segments. Thus, in Catalan and Sanskrit copying of SV produces the results in (27b) and (28b). An optional process spreads the daughter of SV onto an empty SV node, yielding the forms in (27c) and (28c).[9]

5. Summary

We claim that the typology of languages with respect to voicing and sonorancy is as in (30).

(30)

<table>
<tr><th></th><th>Lar</th><th>SV</th><th>t</th><th>d</th><th>n</th><th></th></tr>
<tr><td>Class I</td><td>x</td><td>x</td><td>Root
|
Lar</td><td></td><td>Root
|
SV</td><td>Ponapean, Rotokas</td></tr>
<tr><td>Class II</td><td>√</td><td>x</td><td>Root
|
Lar</td><td>Root
|
Lar
|
LV</td><td>Root
|
SV</td><td>Dutch, Klamath, Korean</td></tr>
<tr><td>Class III</td><td>x</td><td>√</td><td>Root
|
Lar</td><td>Root
/ \
(Lar) SV</td><td>Root
|
SV
|
nasal</td><td>Catalan
Sanskrit</td></tr>
</table>

x - no contrast at this node, √ - contrast at this node
(t, d, n used as representative of voiceless, voiced, and sonorant at a particular place of articulation.)

In (30) the underlying contrasts and representations in the two language types are shown. In general, sonorants are characterized as SV and voiceless obstruents as Lar. Voiced obstruents may be either laryngeally voiced or spontaneously voiced; when they are spontaneously voiced, [nasal] must be specified underlyingly and we should not find assimilation of a nasal to a following sonorant.

6. Conclusion

Following from our assumptions about spreading and the universal nature of final laryngeal neutralization, we have made the following points in this paper:

(a) A node, SV, dominates the sonorant features.
(b) Voicing in obstruents may be marked at the Lar node or at the SV node.
(c) [Nasal] is absent underlyingly unless voiced obstruents have an SV node.

We have proposed that languages differ with respect to their representations of voiced obstruents and nasals. This account treats as related a constellation of effects that could not otherwise be related. It accounts for assimilation of nasals to following sonorants, for the presence/absence of [nasal] distinctively, and the the presence/absence of final voicing neutralization in a language. These differences do not require any stipulation beyond the putative universal rule of final laryngeal neutralization. We have not had recourse to the ordering of redundancy rules in the grammar, nor to any special parameters to account for the differences. Furthermore, the system which we have proposed presents few problems for a theory of learnability. The child would assume the least marked system, class I, with only obstruent/sonorant contrasts. Once a contrast is introduced with obstruents, the learner would posit a class II language with final devoicing. Evidence for class III must be positive in that the learner would need to hear final spontaneously voiced obstruents. Thus, the system itself is built up based on contrasts found within the inventory, but the precise nature of the contrast may require reference to a universal neutralization process.

While many problems concerning the nature of final devoicing, the role of copying and the geometry of the laryngeal features and SV remain to be worked out, we believe that the results that we have achieved in this paper give grounds for continuing along the lines proposed.

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1 Note the syllable-final laryngeal neutralization in this form, consistent with (3).

2 Ponapean shows a wider range of assimilations within sonorants than we discuss. See Rice & Avery (in preparation) for discussion.

3 We follow Hyman (1975) in assuming that both /l/ and /r/ are continuant.

4 See Cho (1988) and Rice and Avery (forthcoming) for discussion of why lateral spreads only to the coronal place of articulation.

5 Firchow & Firchow (1969) report variation in the realization of voiced consonants in dialect B as follows: /ƀ/: [ƀ], [b], [m]; /ř/: [ř], [n], [l], [d]; /g/: [g], [ǥ], [ŋ].

6 Levin (1988) takes these data as an argument that [lateral] is a Coronal dependent as, in this Flemish dialect, the spreading of [lateral] occurs just in case the intervening consonant is a coronal; it is blocked by a labial or velar. We suggest that the transparency of the coronals is due to their unmarked status. See Rice and Avery forthcoming for a detailed analysis of the relationship between laterality and coronality.

7 Notice that [continuant] does not spread in this form. In Catalan, all features spread except for [continuant]. It is for this reason that we have made [continuant] a daughter of the Root node and SV and Place sisters, daughters of the Supralaryngeal node, in (1).

8 There is apparent assimilation of /n/ to /l/ in Sanskrit. For instance, /asvan labhate/ becomes [asvaml labhate] 'he receives horses' (m represents anusvara). However, it is more likely that [lateral] is spreading to an empty consonant position following the /n/ rather than to the node dominating [nasal] (Kiparsky personal communication).

9 This solution requires a revision of the Korean analysis in section 2.4 along the lines proposed in this section. SV copies, followed by the operation of the nasal default rule.

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