The Superfluity of [Consonantal]

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1. Introduction

The status of the major class features has been brought into the theoretical limelight recently, with McCarthy's 1988 proposal that [sonorant] and [consonantal] are contained inside the root node, and so cannot spread or dissimilate. This proposal is challenged by Kaisse 1992 for the feature [consonantal], citing examples where that feature appears to spread. Cho and Inkelas 1993 challenge this challenge, reanalyzing certain cases of [consonantal] spreading. In this paper we approach the question differently, by questioning the assumption that there *exists* such a feature. The question of whether [consonantal] spreads then becomes meaningless, since it depends on 'consonantal' which we claim is not a distinctive feature at all.

In this paper, we review certain classes of evidence for [consonantal]. Such evidence could take various forms. For example, a feature might be necessary to describe changes that a sound or class of sounds undergoes; or it might be crucial in describing sounds as a natural class; or it might be needed to describe existing phonemic contrasts. Our conclusion will be that there is no such evidence for [consonantal], and, consequently, the feature should be dispensed with entirely.

Before examining the evidence, we need to be clear about what this supposed feature entails. For this, we draw on the SPE definition that consonantal sounds have a

[1] We would like to thank Abigail Cohn, Mohamed Guerssel, Ellen Kaisse, John Kelly, Patrick McConvell, Paul Newman, Glyne Piggot and Donca Steriade for discussion and examples which are relevant to this paper.

radical obstruction in the midsagittal region of the vocal tract (Chomsky & Halle 1968:302). The intent of this definition is to group vowels, glides, and laryngeal consonants as one natural class, and the remaining sounds as another. Thus when we address the question of [consonantal], this is the entity whose existence we question. We do not consider approaches such as that of Hyman 1985 where [consonantal] essentially becomes a stand-in for [syllabic], such that glides are specified as [+consonantal]. One of the main reasons to specify glides this way is to avoid certain classes of OCP violations, specifically the supposed violation incurred by glide plus homorganic vowel sequences such as *yi* and *wu*. We suggest that such sequences are not a problem given a detailed understanding of the OCP. It has been argued in Odden 1988 that the OCP is not inviolable, and therefore it is possible for *yi* and *wu* to be ruled out in Korean while being allowed in English. We thus claim that there is no compelling reason to modify the standard definition of [consonantal] based on OCP considerations.

2. Segments becoming [-consonantal]

Turning to the argument, we begin by considering evidence from the patterning of sounds. Our first examples involve cases in which the value of [consonantal] appears to change; that is, where a surface form differs from the corresponding underlying form in its value of [consonantal], as is the case in lenitions and hardenings. In each example we will show that reference to [consonantal] is unnecessary; this same conclusion holds for the many additional examples that we are unable to present due to space limitations.

To begin, we consider cases of lenition such as that found in Axininca Campa where /k/ and /p/ surface as [y] and [w̄][2] after a vowel (Payne 1981). In (1), the underlying stop is revealed in the uninflected noun on the left, while after the pronominal prefix *no*, /k/ becomes [y] and /p/ becomes [w̄]. Since this occurs only in the context of a vowel, one might consider it a good candidate to attribute to [-consonantal] assimilation. However, since the values of [sonorant] and [continuant] also change, lenition could equally well be explained as assimilation to the sonorancy or continuancy of the preceding vowel.[3]

(1)	kanari	'wild turkey'	no-yanari-ti	'my wild turkey'
	kosiri	'white monkey'	no-yosiri-ti	'my white monkey'
	pač^{h}aka	'gourd'	no-wač^{h}aka-ti	'my gourd'
	porita	'small hen'	no-worita-ti	'my small hen'
	yaarato	'black bee'	no-yaarato-ti	'my black bee'

Continuancy lenition is precisely what is required to handle weakening in the Australian language Djapu (Morphy 1983), where *p* and *k* become the labio-velar glide *w*, and dental *t̪* becomes the palatal glide *y* when preceded by vowels and liquids. This is illustrated in (2) with the dative suffix *ku* in (2a), the ergative suffix *t̪u* in (2b), and the associative suffix *puy* in (2c). The underlying stop values of *p, t̪, k* are motivated by the fact that lenition does not apply in pronouns and demonstratives, thus a stop can appear after a vowel, as in the two initial forms. When preceded by an obstruent stop or nasal, the underlying stop value of the suffix is revealed, and when the suffix is preceded by a vowel or liquid, the stop lenites. Since /r/ and /l/ also trigger this rule, it would be impossible to

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[2] Payne 1981 describes [w̄] as a bilabial approximant, lacking velar constriction.

[3] One might expect the velar *k* to lenite to a velar approximant *ɣ*. Such a segment does exist in Axininca Campa, but as noted in Black 1991, *ɣ* cannot be morpheme initial and may only be preceded by a low vowel. Thus *ɣ* cannot appear in root initial position, and in its place one finds the nearest approximant, *y*.

treat this as [-consonantal] assimilation, even though [consonantal] seems to change. Instead, we analyze it as assimilation to [+continuant].[4]

(2)	a.	d̪iya-ku	'this'	ŋaṛa-k	'1 sg'
		buurutʸ-ku	'mosquito'	waayin-gu	'animal'
		bumbaru-w	'rock'	gaa-n̪aṛa-w	'give'
		ŋaymil-wu	'Ngaymil clan'	baṛukaŋuṛ-wu-nʸ	'fruit type'
	b.	balkurk-t̪u	'rain'	guuŋ-d̪u	'hand'
		maŋutʸi-y	'eye'	gaṛapa-y	'spear'
		miil-yu	'eye'	ŋaaṇar-yu	'tongue'
		gaaḷumay-u	'pelican'	(cf. gaaḷumay	'pelican nom.')
	c.	rawalk-puy	'sorcery'	guuŋ-buy	'hand'
		garrtʸambal-wuy	'kangaroo'	guuṇdirr-wuy	'antbed'
		riitʸa-wuy	'jungle'	d̪arpu-n̪ara-wuy	'spear-dnom'

A similar lenition of /p/ and /k/ to [w] exists in Gurindji (McConvell 1988 and p.c.); here, palatal /tʸ/ lenites to [y] only after vowels intermorphemically, as shown in (3).[5]

(3)	a.	tʸarrakap-katʸi	'tape-recorder, talkative'
		waḷu-watʸi	'fireplace'
		pamarr-watʸi	'money bag'
	b.	wankatʸ-pa-ṇiŋan	'the same bad one'
		tʸuwal-wa-ṇiŋan	'the same tall one'
	c.	wurrkaḷ-tʸawuŋ	'with green grass'
		miyaṭ-tʸawuŋ	'having an initiated man'
		miṭa-yawuŋ	'having a shield'

Treating the change as one of continuancy derives support from the fact that in these and many other Australian languages, the feature [continuant] plays a central role in the consonantal system. As shown in (4), the inventory can be divided into continuants and stops, with the latter dividing further into the oral and nasal stops. These languages lack obstruent continuants, so the labial and velar continuants are [w], the alveolar continuants are [l] and [r], the retroflex ones are [ḷ] and [ṛ], and the palatal and dental are [y].

(4)	Continuants	w	y	r,l	ṛ,ḷ	y	w
	Stops (oral)	p	t̪	t	ṭ,ḍ	tʸ	k
	(nasal)	m	n̪	n	ṇ	nʸ	ŋ

Similar kinds of lenitions can be found in many other Australian languages, the Tungusic languages Evenki and Negidal, and in the Gur language Lama (Ourso and Ulrich 1990), as shown in (5).

(5)	kpạp-ə̣	'to be similar'	kpạw-s-u̯	'to reconcile'
	yạp-ə̣	'to buy'	yạw	'buy!'

[4] Two other processes affect these examples. Final vowels may be deleted as long as a consonant cluster does not result, as in *ŋaṛak* from underlying *ŋaṛaku*. In addition, there is a process of degemination applying to *gaaḷumayu*, from *gaaḷumayyu*.

[5] It is possible that there are two lenition rules with different conditions, the one affecting /tʸ/ being more restricted.

We would claim that all of these cases involve [continuant] assimilation. What is crucial to note about this class of lenitions is that the languages in question do not have contrasts between the surface glides which are lenited stops, and obstruent fricatives at the same point of articulation. That is, the appearance of a [consonantal] glide is essentially due to a phonetic detail about the language.

A further example of apparent change in [consonantal] comes from Klingenheben's law in Hausa (Schuh 1972, Leben 1974, Inkelas and Cho 1993), illustrated in (6).

(6)					
	/jibjii/	juwjii	'trash heap'	jibaajee	pl.
	/tafšii/	tawšii	'drum'	tafaašee	pl.
	/talakči/	talawči	'poverty'	talaka	'a poor one'
	/hagni/	hawni	'left side'	bahago	'lefthanded one'
	/fatke/	fař̃ke	'merchant'	fataake	pl.
	/maz-maza/	mař̃maza	'very fast'		
	/k'as-k'as-ii/	k'ař̃k'asii	'underside'		

In this case coda consonants become sonorants: labials and velars become *w*, and coronals become trilled *r̃*. Given the syllabification constraints of the language, the preceding segment is always a vowel, hence [-consonantal]. Notice that in the case of labials and velars the result is a glide, but in the case of coronals the result is the consonant *r̃*, so these changes could not be given a uniform characterization if this involved a change in [consonantal]. These changes are the result of a constraint on possible coda segments in Hausa: a coda segment must be a sonorant, either a continuant or a nasal which is homorganic with the following segment. Klingenheben's Law is therefore characterized as a way of bringing representations into conformity with this requirement, by insertion of [+sonorant]. The simplest structure-preserving change which brings codas into conformity with this condition is turning labials and velars into glides.[6]

3. Segments becoming [+consonantal]

The hardening of vocoids is also a possible test for the existence of [consonantal]. As this section shows, reference to this feature is not crucial for this phenomenon either. As noted in Kaisse 1992, in Cypriot Greek the palatal glide *y* is strengthened to [k^{y}] when it follows a consonant, resulting in a change in the values of [consonantal], [continuant] and [sonorant]. The data in (7), drawn from Newton 1972, provide alternations between the nominative and genitive, where stem-final /i/ becomes [y] before the affix [u], and then hardens to [k^{y}] after consonants, excluding [l] and nasals. It is important to note that glide-glide and laryngeal-glide clusters do not exist in the language, so we cannot properly test the relevance of [consonantal] here.

(7)	NOMINATIVE	GENITIVE	
	mantílin	mantilyú	'handkerchief'
	tiánin	tianyú	'frying-pan'
	psárin	psarkú	'fish'
	xoráfin	xorafk^{y}ú	'field'
	ammátin	ammaθk^{y}ú	'eye'
		~ ammatk^{y}ú	
	xáppin	xapk^{y}ú	'pill'

[6] Spreading of [continuant] would not be appropriate, since that would not explain the change of the fricatives /s/ and /z/ to [r̃] (a continuant r), and /f/ to [w]. While this could be described as spreading of [sonorant] from a preceding vowel, we avoid doing so since, following McCarthy 1988, there is little evidence that [sonorant] spreads.

While Kaisse accounts for this by spreading [+consonantal] from the preceding consonant, hardening never applies after the sonorants /m n l/, showing that this is not true across-the-board assimilation to the consonantality of all consonants. Cho and Inkelas 1993 attempt to relate this hardening to a general continuancy template in Greek which requires nonsyllabics to have the form fricative-stop. However, the existence of the stop-stop sequences [pk^{y}] and [tk^{y}] as in *xapk^{y}ú* and *ammatk^{y}ú* indicates that the continuancy value of the segments is not consistently relevant. A change in sonorancy or continuancy is sufficient to account for hardening, without recourse to [consonantal]. We suggest that glide hardening in Cypriot Greek is due to a general constraint, given in (8), prohibiting /y/ from being preceded by a consonant other than a sonorant stop.

(8) ***Cy (C ≠ [+son, -cont])**
The palatal glide *y* may not be preceded by a consonant, other than a sonorant stop.

A significant set of changes resulting in [+consonantal] involves geminate consonants. Selkirk 1993 cites an example from Tashlhiyt Berber in (9) where geminate [w] becomes [gg^{w}]. This we treat as assignment of [-continuant] to geminate /w/.

(9)				
	nwa	'eat (aorist)'	ngg^{w}a	'eat (intensive)'
	izʕwiɣ	'to be red'	azʕgg^{w}aɣ	'redness'

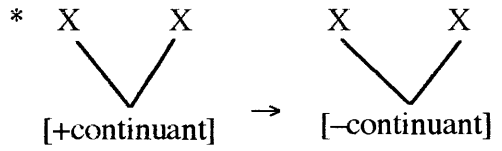
In Luganda (Cole 1967), geminate *w* becomes *gg^{w}*, geminate *y* becomes *jj* and geminate *l* becomes *dd*, as illustrated in (10) with the alternation between Class 5 singulars and Class 6 plurals. Gemination of the initial consonant occurs in the singular with concomitant hardening of approximants; the underlying consonant is revealed in the Class 6 plural. This too we would treat as hardening to [-continuant] under gemination. The irrelevance of [consonantal] to this process is underscored by the fact that /l/ is already [+consonantal].

(10)	CLASS 5 (SING.)	CLASS 6 (PLURAL)	
	ggi	magi	'egg'
	ddaala	madaala	'ladder'
	zzike	mazike	'chimpanzee'
	jjuba	mayuba	'dove'
	gg^{w}aanga	mawaanga	'nation'
	ddaanga	malaanga	'lily'

Similar hardening of geminate glides to obstruent stops exists in Fula, where geminate /w/ hardens to [bb] and geminate /y/ hardens to [jj]. As the examples in (11) show, hardening affects all continuant consonants, not just glides.

(11)	Single C	Geminate C	
	saw-ru	cabb-i	'stick'
	wuy-ɓɛ	gujj-ɔ	'thief'
	sof-ru	copp-i	'chick'
	kɔs-am	kɔcc-ɛ	'milk'

Geminate continuants which would have been created by morphological processes are repaired by the strategy in (12), from Paradis 1992. Analogous hardenings of geminate glides exist in historical North and East Germanic.

(12) 

A preceding nasal consonant can also trigger hardening as exemplified by Kimatuumbi where, as shown in (13), the glides /y/ and /w/ surface a [j] and [g^w] after a nasal consonant. The underlying quality of the stem initial consonant is revealed in the infinitive on the left. Hardening takes place after the Class 9 nasal prefix on the right. As in the cases just presented, we attribute this to a change in continuancy. Support for this comes from the fact that the lateral continuant /l/ also hardens to [d] after a nasal, showing that [consonantal] is not relevant; thus, sonorant continuants assimilate to the [-continuant] value of the nasal.

(13)	INFINITIVE	CLASS 9 ADJECTIVE	
	yʊ́kʊta	n-jʊkʊ́tá	'full'
	wá	n-g^wáá.á	'dead'
	lí́ma	ndimá.á	'cultivated'

The same post nasal hardening exists in Luganda (Cole 1967), as shown in (14); in this language, labial /w/ hardens to [p].

(14)	ndele	'thongs'	lulele	'thong'
	njuza	'I tear'	kuyuza	'to tear'
	mpaande	'measures of cloth'	luwaande	'measure of cloth'
	mpulila	'I hear'	kuwulila	'to hear'

Sesotho and Setwsana have similar hardenings; interestingly in these languages, not only does /w/ harden to [k^w], but fricatives become aspirated plosives, as illustrated in (15) with data from Setswana (Cole 1955). What drives these changes is a constraint on nasal-plus-consonant sequences; the consonant in such a sequence must be a voiceless plosive.

(15)	wɛla	'fall on'	xo-n-k^wɛla	'to fall on me'
	sexa	'cut'	xo-n-ts^hexa	'to cut me'
	dirɛla	'do for'	xo-n-tirɛla	'to do for me'

Hardening may also be due to syllable position and again, reference to [consonantal] is not crucial. For example, in Lango (Okello 1975) seen in (16), word-final postvocalic /y/ becomes a palatal obstruent [c]; this we analyze as assignment of [-continuant] to a coda consonant, pursuant to a general prohibition against coda continuants in the language.

(16)	INFIN	AGENT NOMINALIZATION	
	cɔɔyɔ	acɔ́c	'write'
	yeeyo	ayéc	'carry on head'

A further case occurs in Porteño Spanish, in (17), where the glides /y/ and /w/ surface as homorganic obstruent fricatives [ž] and [$ɣ^w$] in syllable-initial position (Lozano 1979, Morgan 1984).

(17)	ley	'law'	ležes	'laws'
	ir	'to go'	yendo → žendo	'going'
			cf. aun ǰendo	'even going'
	orfanato	'orphanage'	werfano → ɣʷerfano	'orphan'
	bibir → βiβir	'to live'	bibyendo → βiβyendo	'living'

We suggest that this change involves onset glides becoming voiced stops, hence a change in the value of [continuant]. The appearance of fricatives in (17) is the result of a general lenition of all voiced obstruent stops in Spanish, which applies everywhere except after homorganic liquids and nasals. As Lozano points out, hardened glides appear as stops in these contexts, which is precisely the environment where obstruent stops cannot be lenited.

4. [Consonantal] triggering rules

Next we turn to the possibility that [consonantal] is crucial for characterizing natural classes. While it is possible to find many cases in the literature where [consonantal] is used to characterize classes of segments, it is quite difficult to find cases where it is apparently crucial. For example, rule (18) from Tibetan, given in Odden 1978, spirantizes noncoronal stops between vowels, and this formulation employs the feature [consonantal]. However, inclusion of [consonantal] is entirely redundant: since all stops in the language (indeed in all languages) are consonantal, mentioning [consonantal] does not productively restrict the rule.

(18) $\begin{bmatrix}+\text{cons}\\-\text{cont}\\+\text{grave}\end{bmatrix} \rightarrow \begin{bmatrix}+\text{voice}\\+\text{cont}\end{bmatrix} \; / \; \begin{bmatrix}+\text{syl}\\-\text{nas}\end{bmatrix} \_\_ \; [+\text{syl}] \quad (\text{p,k} \rightarrow \beta, \gamma \; / \; \text{V} \_\_ \text{V})$

A similar non-crucial use of [consonantal] can be found in Hayes 1986, which presents the Lithuanian vowel backing rule in (19). The intent of the rule is to back /e/ before [-consonantal] *u* and *w*, but not before velar consonants. We would maintain that the correct account depends on the distinction between C-place and Vocalic feature specifications (see e.g. Clements 1990a, Clements and Hume 1994); *u* and *w* are characterized with Vocalic Dorsal, a specification which velar consonants do not have.

(19) $\begin{bmatrix}-\text{cons}\\-\text{high}\end{bmatrix} \rightarrow [-\text{back}] \; / \_\_ \; \begin{bmatrix}-\text{cons}\\+\text{back}\\+\text{high}\end{bmatrix} \quad (\text{eu, ew} \rightarrow \text{ou, ow})$

It is important to note that this independently needed distinction between C-place and Vocalic specifications of place articulators does not serve as a replacement for the feature [consonantal]. First, laryngeals have neither C-place nor Vocalic specifications and thus would not function as part of a natural class defined by either property, whereas the feature [consonantal] places laryngeals in the same class as vowels and glides. Second, having a Vocalic specification would not reconstruct [-consonantal] in the case of a consonant with a secondary Vocalic articulation such as rounding or palatalization. Finally, the distinction between C-place and Vocalic specification of articulators will be invoked only for place-related phenomena such as assimilation or dissimilation of Dorsal; it will never be called on, for example, to restrict the class of targets or triggers in assimilation of voicing or other processes which operate independent of place.

A further case is presented in Feinstein 1979 where it is claimed that an allomorphy rule in Sinhalese replaces the plural suffix *wu* with *oo* after [-consonantal] segments, as shown in (20).

(20) [-cons] + /wu/ X] $_{noun}$
1 2 3 4 →
1 2 /oo/ 4

(21) illustrates the rule with relevant examples, abstracting away from the effects of later processes.

(21)

STEM	PLURAL		
/balw-/	balw-oo	'dogs'	[ballo]
/put-/	put-wu	'sons'	[puttu]
/li-/	li-oo	'women'	[liyoo]

The inclusion of [-consonantal] in (20) is intended to provide a means of grouping vowels and glides together. Since laryngeals do not occur in the relevant position in Sinhalese, one could reformulate the rule to apply after a segment characterized with a Vocalic specification, assuming that the place features of glides in Sinhalese are dominated by Vocalic. However, it is not obvious how place of articulation is relevant to this process, and we believe that a better solution derives from noticing certain less-than-desirable consequences that arise by selecting one allomorph versus the other, as illustrated in (22).

(22)

balw-wu	→	*balw].wu	balw-oo	→	bal.w]oo
put-wu	→	put].wu	*put-oo	→	pu.t]oo
li-we	→	*li].wu	li-oo	→	li].oo

In the case of a glide-final stem such as *balw-*, the selection of allomorph *wu* would give rise to a consonant+glide sequence in the preceding coda, resulting in an eminently unsyllabifiable form. Conversely, the correct form, with the allomorph *oo*, is easily syllabifiable. For a consonant final stem such as *put-*, both suffixes result in syllabifiable forms. Yet, the correct form with the suffix *wu* has an additional advantage, namely that the right edge of the stem corresponds to the right edge of a syllable, and as recent work in Optimality Theory has discovered (see e.g. Prince and Smolensky 1993, McCarthy and Prince 1993), there is a significant tendency for stem edges and syllable edges to coincide. Finally, we maintain that the choice of *oo* after a vocalic stem, such as *li-*, reflects the elsewhere case in this allomorphy; that is, there is a constraint against using the suffix *wu*, which forces selection of *oo* when no other constraints are relevant.

These observations are captured by means of the constraints in (23), which govern the selection of the two available plural suffixes *oo* and *wu*: (a) prohibits a consonant+glide sequence in the coda (this constraint is a specific instance of a more general crosslinguistic constraint against rising sonority in the syllable coda — see the discussion of sonority and impedance below); (b) requires that the right edge of a stem be aligned with the right edge of a syllable; and (c) rules against the use of the allomorph *wu*.

(23) a. *CG]$_{\sigma}$
b. Align (Stem, R; Syllable, R)
c. *wu

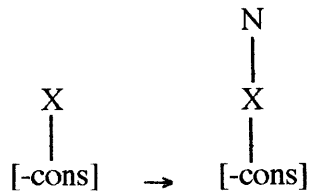
Following work in Optimality Theory, we assume that constraints are violable and may be ranked with respect to one another. As the following tableaux illustrate, the selection of the correct allomorph in each case is achieved in Sinhalese with no reference to the feature [consonantal].

(24)

		*CG	Align	*wu
	balw].wu	*!		*
☞	bal.w]oo		*	
☞	put].wu			*
	pu.t]oo		*!	
	li].wu			*!
☞	li].oo			

Our survey of the phonological literature reveals that most uses of [consonantal] are unwarranted, as in the cases which we have just presented, or are technically incorrect. To cite just one example of the latter, the syllable structure algorithm presented for German (Rubach 1990) in (25) indicates that all [-consonantal] segments are realized as syllable nuclei. However, without further qualifications, this incorrectly predicts that not only vowels, but also glides and the laryngeal fricative /h/ are syllable peaks.

(25)



There are two legitimate phenomena which at first glance seem to motivate reference to [consonantal]. The first involves nasalization phenomena and the second, the calculation of sonority. We argue that these cases are in fact related.

Consider nasalization first. A common process of nasalization, shown in (26), is documented in Arabela and Warao where nasality spreads rightward to vowels, glides and laryngeals; and in Capanahua, nasality spreads leftwards to these same segments. This seems to provide the best evidence for [consonantal] since nasal spread in these languages groups together all of the putatively [-consonantal] segments. We know of no other cases where vowels, glides and laryngeals function as a natural class.

(26) Arabela (Rich 1963)

/maanu/	[mããnũʔ]	'woodpecker'
/nuwa/	[nũw̃ãʔ]	'partridge'
/nyaari/	[nỹæ̃æ̃riʔ]	'he laid it down'
/tinyakari/	[tinỹãkariʔ]	'afternoon'

Warao (Osborn 1966)

/inawaha/	[inãw̃ãh̃ã]	'summer'
/moaupu/	[mõãũpu]	'give them to him!'
/mehokohi/	[mẽh̃õkohi]	'shadow'

(26) Capanahua (Loos 1969)

/boon/	[bõõ]	'hair'
/bawin/	[bãw̃ĩ]	'catfish'
/ciʔin/	[cĩʔ̃ĩ]	'by fire'
/ciponki/	[cipõŋki]	'downriver'
/waran/	[warã]	'squash'

A survey of nasalization processes outlined in (27) reveals a hierarchy of nasalizable segments.

(27)

LANGUAGES	TARGETS OF NASAL SPREADING
Arabela, Warao, Capanahua	Vowels/Glides
Urhobo	Vowels/Glides, Liquids
Terena	Vowels/Glides, Liquids, Nasals
Applecross Gaelic	Vowels/Glides, Liquids, Nasals, Fricatives

In Arabela, Warao and Capanahua, as we have seen, vowels and glides nasalize. In Urhobo (Kelley 1969 and p.c), as illustrated in (28), nasality spreads to all approximants, that is vowels, glides (including the labial approximant β)[7] and liquids, excluding voiceless [r̥].

(28)

/iwewuyẽ/	[ĩw̃ẽw̃ũỹẽ]	'grated material'
/eroβõ/	[ẽr̃õβ̃õ]	'brass'
/ozũ/	[ozũ]	'palm-wine'
/evun/	[evũ]	'belly'
/ɛr̥ɛrẽ/	[ɛr̥ɛ̃r̃ẽ]	'anthill'
/ɔmarẽ/	[ɔmãr̃ẽ]	'old man'

In Terena (Bendor-Samuel 1960), shown in (29), nasalization proceeds through all segments except obstruents.

(29)

emoʔu	'his word'	ẽmõʔũ	'my word'
ayo	'his brother'	ãỹõ	'my brother'
owoku	'his house'	õw̃õŋgu	'my house'

In Applecross Gaelic (van der Hulst and Smith 1992), shown in (30), all segments except obstruent stops can nasalize.

(30)

/šɛ̃nɛ.var/	[šɛ̃̃nɛ̃̃.ṽãr̃]
/tʰr̃iišar/	[tʰr̃̃iišãr̃]
/sNãnʸdʸan/	[šNãnʸdʸan]
/kʰ̃ɔispaxk/	[kʰ̃ɔ̃išpaxk]

In other words, there is a scale of susceptibility to nasalization that is reminiscent of the sonority scale: vowel/glide, laryngeal > liquid > sonorant stop > fricative. However, when viewed in terms of sonority, a problem arises when we consider the role of laryngeals.

[7] We assume that the contrast between *w* and the bilabial approximant that Kelly 1969 describes as β, which we treat as both [+sonorant] owing to their nasalizability, is that Labial in *w* is dominated by Vocalic, whereas in β it is dominated by C-place: see Clements and Hume 1994 for discussion of that contrast; see also Herman 1994 for discussion of a similar structure in Karuk where, however, the two segments are phonetically identical.

While they pattern with vowels and glides in being maximally susceptible to nasalization, they are not themselves high sonority segments.

Though sonority calculations have not always included [consonantal] — see Steriade 1982 — certain works such as Levin 1985, Clements 1990b and Zec 1988 invoke [consonantal] (or its converse [vocoid]) in calculating sonority. This can be seen in (31) where [-consonantal] makes vowels/glides more sonorous than liquids, nasals and obstruents.

(31)

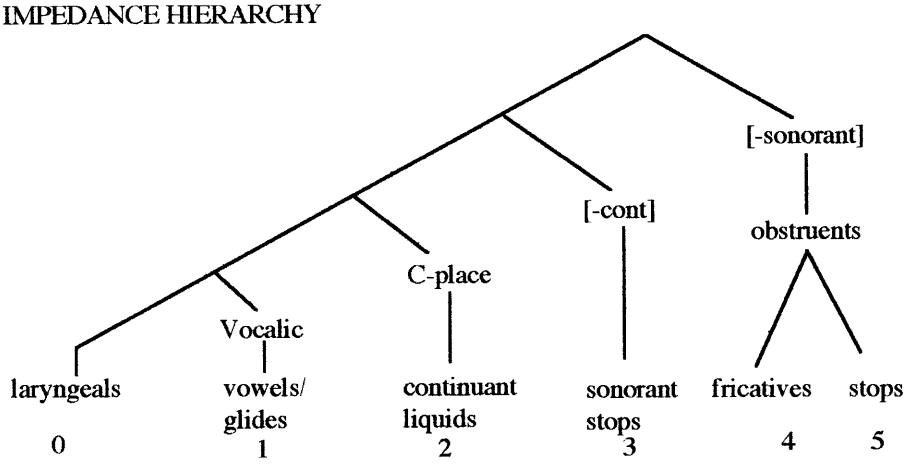
O	<	N	<	L	<	V	
						-	consonantal
				+		+	approximant
		+		+		+	sonorant

Yet, constructing the hierarchy in terms of [consonantal] implies that the laryngeals /h/ and /ʔ/ would be high-sonority items. The literature on sonority is conspicuously quiet on where laryngeals should fit. One empirical test for sonority is fitness-for-peakhood: more sonorous segments are most likely to be syllable peaks and less sonorous segments are least likely to be peaks. However, we know of no case where laryngeals are peaks.

We offer a reconstruction of sonority which, we show, correctly ranks sounds according to the observed hierarchy. Furthermore this is done with no reference to [consonantal]. Following Clements and Zec, we distinguish between the classes vowel/glide, liquid, nasal, and obstruent, with obstruents further divided into fricatives and stops. We include laryngeals as an additional class. As in these works, the presence of certain properties contributes to the sonority of segments.

Our reconstruction of the hierarchy reinterprets sonority in terms of the notion IMPEDANCE, which is the resistance offered by a sound to the flow of air through the vocal tract, defined to exclude the larynx. Impedance is roughly the converse of sonority. This change in terminology is paired with a change in conception, and it entails an empirical dividend. Our claim is that certain properties inherently increase the impedance of a sound, and that these properties are weighted. This is spelled out in (32) where right-branch elements have greater impedance than left-branch elements, and where impedance decreases as you move down the hierarchy. As can be seen, being an obstruent contributes significantly to impedance; being a non-continuant contributes, though less so; having a C-place articulation contributes a bit to impedance and having a Vocalic constriction contributes very little. As a result, laryngeals have no impedance.

(32) IMPEDANCE HIERARCHY



Linguistic generalizations stated in terms of high sonority are stated in terms of low impedance. Laryngeals have a special status since they have zero impedance, thus, thinking in terms of sonority, sonority is undefined for them. Our typology of syllable peaks is that they are required to have some impedance value, which must not exceed a certain language-specific maximum. Thus laryngeals cannot be syllable peaks. We claim that variation in nasal spreading is also stated in terms of impedance, such that the target of nasalization cannot have an impedance value greater than some language-specific maximum. Laryngeals and vocoids are thus most susceptible to nasalization,[8] since they will generally not exceed that value.

5. Possible segments

Up to this point we have shown that reference to the feature [consonantal] is unnecessary in describing changes that a sound or class of sounds undergoes, or in describing sounds as a natural class. The final class of evidence we examine concerns the question of whether [consonantal] is necessary for characterizing phonemic contrasts. Once again, our conclusion will be that it is not.

Since, as shown in (33), languages contrast oral and nasal vowels, or front round and unrounded vowels, or voiced and voiceless consonants, or homorganic fricatives and stops, distinctive feature theory must include features such as [nasal], [labial], [voice] and [continuant].

(33)						
	Nasalization (Yoruba)	k̃ɔ̃	'sour'		kɔ̰	'teach'
	Rounding (French)	vüü	'view'		vi̱	'life'
	Voicing (English)	b̲eat		p̲eat		
	Continuant (English)	th̲igh		t̲ie		

The same cannot be said about [consonantal]. In the realm of vowels, no language has [-consonantal] vowels contrasting with [+consonantal] vowels, and we have a hard time imagining what a [+consonantal] vowel would be. Furthermore, it is tautological that languages cannot exploit a consonantal contrast with laryngeals, since [+consonantal] segments require a particular degree of supraglottal constriction, and laryngeals necessarily have no supraglottal constriction. Thus, certain contrasts simply aren't attested, while those that seem to exist, can be handled by other features. That is, unlike [nasal] or [continuant], [consonantal] never functions as the sole feature responsible for distinguishing segments. For example, as (34) indicates, the contrast between the labial glide [w] and the bilabial fricative [β] can be expressed on the basis of the feature [sonorant].[9] Similarly, the palatal glide [y] and the lateral palatal approximant [ʎ] can be distinguished by the feature [lateral]. In short, [consonantal] is not critical to the representation of phonemic contrasts.

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[8] Cohn (1993) notes that nasal spread in Sundanese targets vowels and laryngeals, but not the glides *w* and *y*. She proposes that glides in Sundanese be specified as [+consonantal]: our account of this assigns the place features of glides in Sundanese to C-place, and thus glides have a higher impedance than laryngeals and vowels.

[9] Or, as indicated in note 7, the distinction may also be rendered in terms of C-place versus Vocalic features.

(34)

w	β
[+sonorant, LABIAL]	[-sonorant, LABIAL]
y	**ʎ**
[+sonorant, -lateral, CORONAL]	[+sonorant, +lateral, CORONAL]

As we have argued, in no case is reference to [consonantal] crucial. Based on these and other findings, we conclude that the feature [consonantal] is superfluous and therefore can be eliminated from feature theory.

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