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1. Introduction

The goal of this paper is to present an accurate geometry of the place features of coronal articulations. I will demonstrate that using the traditional [anterior] feature leads to false predictions with respect to natural classes and natural phonological rules. I present a new geometry which does away with [anterior] and explains the various ways in which coronal consonants interact with vowels. I will be looking at the following types of segments, where 1a) to d) are the four types of consonantal coronal places, and 1e) is a (high) front vocoid.

1a) Laminal Dental, e.g. t̪
b) Apical Alveolar,[1] e.g. **t**
c) Laminal postalveolar (alveolo-palatal, palato-alveolar, or palatal),[2] e.g. t͡ʃ, **c**
d) Apical domals (retroflexes), e.g. **ʈ**
e) Front vocoid, e.g. **i**, **y**

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[1] In some languages, the alveolar is laminal and the dental is apical (e.g. Temne (Chomsky & Halle 1968)). In the languages of this study, however, the situation is as in 1a) and b) above. The laminal dentals will thus be called simply "dentals", and the apical alveolars "alveolars". Remarks about dentals in this paper would apply to alveolars in Temne, and *vice versa*.

[2] See Kingston (1993) for a discussion of the various types of laminal postalveolars as sharing one place of articulation. For convenience, I will refer to this class of segments as "palatal".

In the case of the coronal consonants 1a) through 1d), I take as a point of departure the standard feature geometric view which uses the feature [anterior] to divide coronals into two natural classes, dentals and alveolars being [+anterior], and palatals and retroflexes being [-anterior]. [anterior], along with [distributed], is considered dependent on the Coronal node (Steriade 1986, Sagey 1986, McCarthy 1988). This is shown in (2).

(2)

The geometry in (2) is used to make a four-way place contrast among coronal consonants, dentals being [+anterior], [+distributed], alveolars being [+anterior], [-distributed], palatals being [-anterior], [+distributed], and retroflexes [-anterior], [-distributed].

While this four-way contrast of [anterior] and [distributed] appears to neatly capture the distinctions between the four types of coronal consonants, I claim that the feature [anterior] has no phonological reality. In this paper I will test the predictions made by [anterior] against data from Australian and Dravidian languages which have three- or four-way coronal contrasts. After confirming the validity of [distributed] (or the equivalent monovalent Apical and Laminal) in Section 2, I will show in Section 3 that [anterior] does not define natural classes as predicted by the geometry in (2). In Section 4 I will argue that retroflexes are Apical coronals with a secondary Dorsal node, and in Section 5 I present a structure in which palatal consonants and (high) front vowels are both simple laminals.

2. Apicals, laminals, and the [distributed] feature

I turn back at this point to the coronal consonants of (1a) through (d), that is the dental, alveolar, palatal and retroflex consonants. The standard [anterior]-[distributed] model uses [distributed] to draw a distinction between coronals with an apical (tongue tip) articulation, and those with a laminal (tongue blade) articulation. In Gnanadesikan (1993) I showed that [distributed] makes a valid phonological distinction, as apicals and laminals belong to different natural subclasses of the larger coronal class. I will give here one example which shows the different phonological behavior of apicals and laminals. For more examples, see Gnanadesikan (1993) and Hamilton (1993).

In both the Australian and the Dravidian languages of my survey, apical coronals are frequently ruled out in word-initial position.[3] Laminal coronals and noncoronals are permitted. These languages can be said to follow constraint (3).

(3) * # Apical

A sample of languages obeying this constraint is shown in the following

[3] The rhotics are sometimes exceptions to this rule, being apical yet allowed in initial position. It may be that rhotics are underspecified for apical at the relevant point in the phonology, as they do not contrast with laminal rhotics.

table, where each language is identified by its language family and the number of distinct apical places it has.

(4) Language	Family	Number of Apicals	Reference
Tamil	Dravidian	2[4]	Christdas, 1988
Proto-Dravidian	Dravidian	2	Zvelebil, 1970
Ngiyambaa	Australian	1	Donaldson, 1980
Thargari	Australian	2	Dixon, 1980
Andiljaugwa	Australian	2	Dixon, 1970
Ngarluma	Australian	2	K. Hale, p.c.

There is thus no question that the [distributed] feature captures a true phonological distinction. What may still be asked is whether the distinction should be made by one bivalent feature or by two monovalent features. In other words, is bivalent [distributed] sufficient, or do we need to replace it with Apical and Laminal? In many respects, the alternatives are very similar. If Apical and Laminal can be shown to have different dependent nodes, however, then [distributed] loses. That is, if Laminal can have a dependent feature that Apical can not have, then this situation can not be captured by bivalent [distributed], which should have a constant set of dependents. In Sections 4 and 5 I will develop a model (following, in part, Hamilton 1993) in which the dependents of Apical and Laminal are not the same. Assuming monovalent features for the moment, the picture of coronal places developed so far is that in (5).

(5) Coronal = t, ṭ — Apical; Coronal = c — Laminal

3. The nonexistence of [anterior]

Using the geometry in (5) we can divide coronals into two subclasses: the alveolars and retroflexes being apical and the dentals and palatals being laminal. What separates the retroflexes from the alveolars and the palatals from the dentals? In the standard view this is accomplished by [anterior]. Alveolars and dentals are [+anterior] and retroflexes and palatals are [-anterior]. This grouping predicts that we should find alveolars and dentals patterning together as opposed to retroflexes and palatals. We would expect to find at least some of the following phonological processes:

- Phonotactic constraints by which dentals and alveolars are ruled out but retroflexes and palatals are OK and/or *vice versa*.
- Assimilation of dental to palatal and alveolar to retroflex in the same environment.
- Assimilation of palatal to dental and retroflex to alveolar in the same environment.

None of these occur. Retroflexes and palatals do not pattern together as against

[4] This Tamil data is true of the Kanniyakumari dialect of Christdas (1988). Certain other dialects of Tamil distinguish only one type of apical stop.

alveolars and dentals. Consider first the realm of phonotactic constraints, taking Lardil as an example (Dixon 1970, Hale 1973). Lardil has a full complement of four coronal series. According to the standard model, we should have a natural class of two [+anterior] coronals and one of two [-anterior] coronals. In word initial position, the apical contrast in Lardil is neutralized in favor of the retroflex. In traditional terms, the [+anterior] apical is ruled out word initially. The same is not true for laminals. Both types of laminals may begin a word in Lardil. The two [+anterior] subplaces do not pattern together.

Phonotactic constraints provide us only with negative evidence in the case against [anterior]. For positive evidence we must turn to assimilations and allophony. In Australian languages with only one underlying laminal there is often allophony between the palatals and dentals. In some languages, such as Pintupi (Hansen & Hansen 1969), the two series are in free variation, with the palatals occurring far more frequently than the dentals. In other languages the palatals occur before /i/ (and /e/ if the language contains this vowel), while the dental occurs elsewhere, as in Gugada[5] (Platt 1972), Madimadi ("except in the second, accented syllable of words of more than two syllables," Dixon 1970), and Tiwi (Osborne 1974). Osborne gives examples of this alternation for Tiwi, as shown below, in which a dental appears before a back vowel, and a palatal appears before a front vowel.[6]

(6)	t̪aɲkənaɲki	'white breasted sea eagle'
	ciriɲini	'red backed sea eagle'
	n̪atiɲa	'one'
	ɲiɲani	'spirit'

In the words of the standard model, the [-anterior] laminals occur preceding a front vowel. Does the same environment condition a change to [–anterior] (i.e. retroflexion) in apicals? It does not. Instead, retroflexion is conditioned by *back* vowels.

Walmatjari (Hudson & Richards 1969) is an example of a language with apical alternations. In medial positions, alveolars and retroflexes contrast phonemically. Initially, however, they do not contrast, but rather alternate in a rather complex way. Utterance-initially or after a word or morpheme boundary, Walmatjari apicals have free variation between alveolar and retroflexes,except after /u/, /a/, and other retroflex consonants, where they are solely retroflex.[7] Examples are given in (7).

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[5] Before /a(:)/ and word-finally, the laminal nasal shows some free variation between the dental and palatal articulations.

[6] Osborne adds that there is some free variation in both environments, but that the situation shown in (6) is the most common.

[7] "Free variation" is my interpretation of Hudson & Richards' statement that the alveolar/retroflex contrast is "neutralized", and their transcription of the sounds as $^{t}_{l}$, etc. An alternative reading is that the articulation is midway between an alveolar and a retroflex. The analysis does not hinge on which interpretation is correct. Hudson & Richards do not give an example in which the preceding segment is a retroflex.

(7a) utterance-initially:
luwaɳi ~ **ɭ**uwaɳi 'speared'
nuŋu ~ **ɳ**uŋu 'blood'
taɲji ~ **ʈ**aɲji 'hard'

b) across boundary:
maɳin **t**ilijaʈi ~ maɳin **ʈ**ilijaʈi 'woman with a light'
iiŋki + **l**anta ~ iiŋki + **ɭ**anta 'poke!'
yaɽu + **ɭ**anta (*lanta) 'wound it!'
wi**l**ka **ɭ**anta (*lanta) 'spear the lizard!'

Walmatjari is by no means unique in displaying an affinity between back vowels and retroflexes. In the morphophonemics of Yankunytjatjara (Goddard 1983), verbs of the "1-Class" form their present in -ɲi or -ni and their past perfective in -ɳu or -nu. Stems ending in /i/ take the alveolar-initial allomorphs, while stems ending in /a/ take the retroflexed forms.[8] /u/-final stems do not occur.

In Pitjantjatjara (K. Hale, p.c.), alveolars and retroflexes exhibit the same morphophonemic alternation as in Yankunytjatjara, giving us the forms in (8).

(8) watj**a** + **ɲ**i 'to say'
tjiki + **n**i 'to drink'

The environment of retroflexion in these three languages is in each case after a back vowel. In each case palatalization is not caused in the same environment. The standard view maintains that retroflexion and palatalization are both caused by a change from [+anterior] to [-anterior]. This change would be caused by assimilation processes in both palatalization and retroflexion. We are thus led to the conclusion that both front vowels and back vowels can cause assimilation to [-anterior]. This implies that both front vowels and back vowels possess the feature [-anterior]. The presence of [anterior] in turn implies a Coronal node. This is clearly an undesirable result, as coronal consonants are defined as those in which the *front* part (traditionally the tip and/or blade, but also including the front part of the body so as to include front vowels—see Hume 1992) of the tongue is raised. This definition in no way includes back vowels.

This section has shown multiple instances where [anterior] fails to pick out natural classes for the phonology to target. Not only are palatalization and retroflexion not triggered in the same environment, but they are triggered by *opposite* kinds of vowels.[9] The obvious conclusion is that [anterior] is a spurious feature and must be evicted from the geometry. Section 4 explores how to replace [anterior] in the case of apicals, and Section 5 does the same for laminals.

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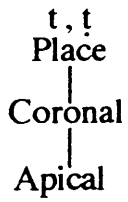
[8] Goddard does not provide examples of the alternation.

[9] There is one case I know of in which retroflexion is triggered by front vowels. This is the *ruki*-rule of Sanskrit, in which /s/ is retroflexed following r, u, k, or i (Allen 1951). This is problematic for a theory endorsing [anterior] as well as the one I present below. There is also a language, Papago, in which both front and back high vowels condition palatalization. If these cases are analyzed as pure assimilations, we are led back to the paradox discussed above, where front *and* back vowels condition changes to [–anterior]. Further work is needed to understand these cases.

4. Retroflexion as dorsalization

In Section 2 I showed that apicals form a distinct subclass within the coronal consonants and thus share the place features in (9).

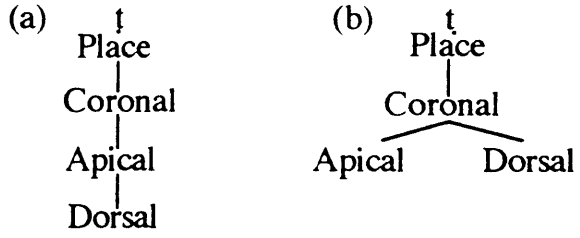
(9)



Clearly, an additional feature is required to distinguish between them. If one of the apicals is unmarked with respect to the other, its geometry can remain as in (9), while the other takes the added feature. According to Hamilton (1993), the alveolar is the unmarked apical. This view gains strong support from Dixon's (1970) and Busby's (1980) observation that no Australian language lacks an alveolar, although retroflexes are frequently missing from the inventory (40% of the 134 languages in Busby's sample lack a retroflex series).[10] The structure in (9) may thus be regarded as that of the alveolar.

What, then, do we add to (9) to derive retroflexion? I believe that the cases of Walmatjari, Yankunytjatjara and Pitjantjatjara (see (7) and (8) above) give us a clue. In each case the retroflexes are associated with back vowels. Assuming a major place model of vowel features (such as Clements 1991), back vowels are characterized by Dorsal. This is the obvious candidate for the assimilatory feature in the retroflexion cases presented earlier.[11] The place features of retroflexes would thus be as in (10a) or b).

(10)



(b) has the advantage of not making a major place node dependent on a subplace node as (a) does. (a), on the other hand, explains simply why back vowels cause assimilation in apicals but not in laminals: Dorsal only goes under Apical, not

[10] In the Indo-Aryan languages of India the situation appears reversed, with retroflexes but not alveolars in the inventory. Cross-linguistically, however, the alveolar appears to be less marked. The issue of markedness is not crucial here, though. If retroflexes pattern with back vowels, alveolars can be seen as patterning with front vowels. Either we assign both series secondary features, or we choose one as unmarked and assign secondary features to the other. Here, and in the discussion of laminals below, I have pursued the latter option.

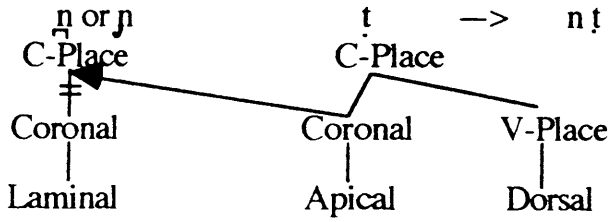
[11] Labial is obviously not at work here, since retroflexes are not rounded and both *a* and *u* trigger retroflexion. In Polish, however, when retroflexes are palatalized (thus destroying the retroflex articulation), rounding is added to preserve the distinction between the retroflexed and normal palatals (Hume 1992). The rounding would serve to give the acoustic impression of dorsalization.

Laminal. I will not attempt to choose between (13a) and b), but turn instead to justify the placement of Dorsal as a dependent (directly or indirectly) of Coronal.

In placing Dorsal somewhere under Coronal in (10), I am in part following Selkirk (1991, 1993), who makes major articulator nodes dependent on each other so as to represent various modifications of a primary articulation. The argument here comes from dependency effects (as in Mester 1986). Coronal assimilations result in total homorganicity, demonstrating that all place features relevant to coronal subplaces are dependent on the Coronal node. An example comes from Iwaidja nasal-stop clusters.

In Iwaidja (Pym 1979), nasal-stop clusters of coronals must be totally homorganic, although coronal-noncoronal clusters are permitted. Thus *nb, ng, ɲb, ɲg, ɳb* and *ɳg* are all permitted heterorganic clusters, but **nj, *ɳj *nḍ, *ɳd*. The only permitted coronal-coronal clusters are the homorganic *nd, nʸdʸ*, and *ɳḍ*.[12] Thus coronal clusters share not only their specification of major place, but also the values of all features distinguishing the coronal subplaces. If Dorsal were not dependent on Coronal, but located elsewhere such as under a V-Place node (as in Clements, 1991), sharing a Coronal node would not imply sharing retroflexion. This is shown in (11).

(11)



Such assimilations do not occur. Instead, coronal assimilations in Iwaidja and elsewhere result in total homorganicity.

The homorganicity requirement is evidently a result of the OCP, which prohibits adjacent instances of Coronal. Adjacent coronals must therefore share their Coronal nodes. In doing so they also share all their other place features. We can conclude, then, that the features responsible for the coronal subplaces—including Dorsal—are directly or indirectly dependent on the Coronal node.

I turn next to further evidence for the Dorsal (or [+back]) specification of retroflexes. In the Australian languages we have already seen instances of back vowels triggering retroflexion. In some Dravidian languages, the opposite process has taken place, that is, retroflexes have triggered backing in vowels.

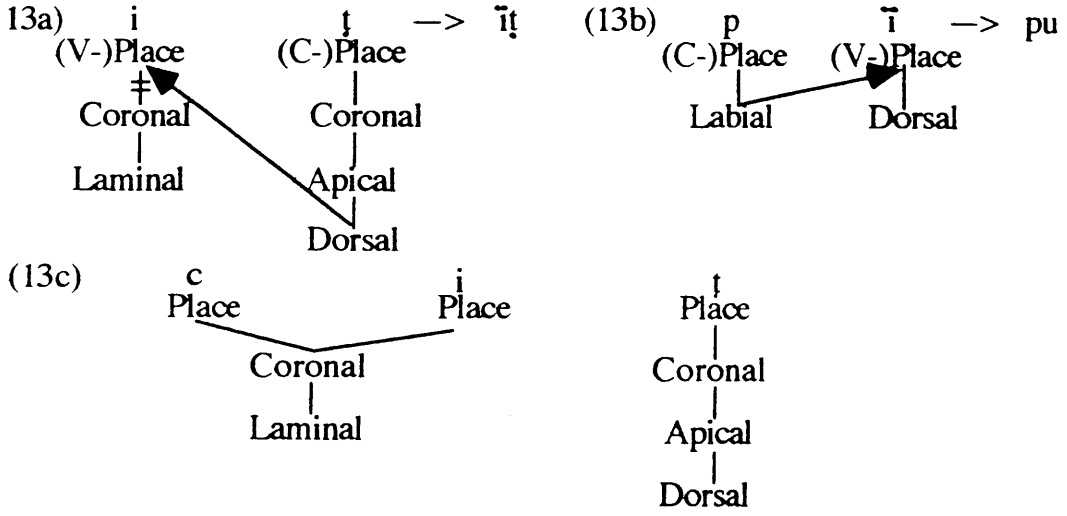
Koḍagu (Zvelebil 1970) is a case in point. This language added high and mid back unrounded vowels (*ï* and *ë*) to the general Dravidian five-vowel system

[12] Heterorganic clusters ending in apicals are independently ruled out in Iwaidja. However, if we assume that segments can share their Coronal node without sharing the specification for retroflexion (as in the hypothetical (11)), then nḍ and ɳd clusters can be linked and would not violate Iwaidja's constraint against apicals in C_2 position. The constraint is thus irrelevant here.

of *i*, *e*, *a*, *o*, *u*. These vowels are now phonemic, but they were originally derived from the front vowels in the following way. Front vowels were backed before retroflex consonants. If the preceding consonant was labial, the resulting back vowel would be rounded; otherwise, it would be unrounded. Examples of this, comparing Koḍagu words to cognates in other Dravidian languages, are shown below, where (12a) shows backing in the absence of a labial, and (12b) shows backing and rounding in the presence of a preceding labial (data from Zvelebil).

(12)	Koḍagu		Other Dravidian
(a)	ïḷi		iḷi (Tamil, Malayalam, Kannada) "to descend"
	ëṇṇ–	"to say, tell"	eṇṇu (Tamil) "to think, count"
	kë:l	"to hear, ask" ke:l	(Tamil) "to hear"
(b)	puḍi–		piṭi (Tamil & Malayalam) "to catch hold"
	poṇṇï		peṇ (Ta, Ma, Ka) "wife, female"

The relevant structures are shown in ((13a) and (13b) below. If the preceding consonant was a palatal, the change did not take place at all. (13c) shows the blocking effect of the palatal. The palatal is assumed to be linked to the front vowel, blocking delinking of Coronal (see Section 5 for a discussion of the features of front vowels).



In the modern language, loss of some retroflexes has obscured the earlier operation of the process in (13a). It is still the case, however, that only back rounded vowels (and /a/) can occur between labials and retroflexes, and that back unrounded vowels can not occur after palatals (as in (13c)).

The evidence from Koḍagu strengthens the claim that retroflexes possess the feature Dorsal, since at one time the assimilation process of (13a) operated productively. These facts also support the affinity, noted in Section 3, of palatals and front vowels, since the environment of the palatal blocked the backing of these vowels.

The Micronesian language Ponapean (Rehg 1973) provides additional

support for the claim that retroflexes are dorsalized coronals. Ponapean has a consonantal inventory of labials (p, m), labio-velarized labials (p^w, m^w), apical-dentals (t, s, n, l), an apico-alveolar (r), a retroflex affricate (ʈʂ, which patterns as a stop), and velars (k, ŋ). The *r* is presumably phonologically retroflex (as in other languages such as Sanskrit) since it patterns with the retroflex affricate, as shown below. The consonants pattern in two groups, as in the following chart.

(14)

Front	Back
p	p^w
m	m^w
t	ʈʂ
l	r
n	ŋ
s	—
—	k

Consonants in the "front" column may not co-occur in the same morpheme with their counterparts in the "back" column.[13] Thus sequences such as pVp, m^wVm^w, or tVt are allowed, but *pVp^w, *tVʈʂ, etc. This is analyzed by Goodman (1991) as an OCP effect. Consonants sharing values of [sonorant], [continuant] and major places are required by the OCP to have linked Place nodes. Any features dependent on the Place nodes would then also be shared (see Mester 1986 for a discussion of dependency effects).[14]

The division of the consonants into two groups is thus justified, but the labels "front" and "back" have not been. First, it is reasonable to assume (with Goodman 1991) that the secondary articulation of the labio-velarized labials is represented by the features of back vowels, that is, Dorsal (or [+back]) and/or Labial. Further evidence for the labeling of the two columns, however, comes from the interactions between consonants and short vowels. Consonants in the "front" column have a centralizing effect on short *back* vowels. Consonants in the "back" column centralize short *front* vowels. This is shown in (15) (from Rehg).

(15)

Vowels	Front Consonants	Back Consonants
i	[pil] "also"	[rɨr] "secret"
e	[mɛm] "sweet"	[ʈʂəŋ] "tight"
a	[pa^p] "swim"	[kɑ^k] "can"
u	[lʉs] "jump"	[p^wuŋ] "correct"
o	[pøs] "explode"	[ʈʂop^w] "lush"
ɔ	[pəs] "hammer"	[rɔŋ] "burned"

When a vowel is flanked by consonants of both types, the quality of the vowel will glide from one to the other. The data cited above show that "back"

[13] There are five exceptions to this: one involving *l* and *r*, and four involving *ŋ* and *n*.

[14] Under this analysis the pairing of n and ŋ is mysterious, but note that this is the case with the most exceptions.

consonants are incompatible with front vowels, and that "front" consonants are incompatible with back vowels. This justifies the classification of Ponapean consonants into front and back groups. The back consonants have a primary or secondary Dorsal feature. The "front" consonants include all consonants that are neither velar nor secondarily dorsal, that is, they have no Dorsal node. The retroflex *ʈʂ* and *r* pattern as back as opposed to their front counterparts *t* and *l*. This implies that they are characterized by a Dorsal node, and supports the present claim that retroflexes are dorsalized coronals.

5. Place features of laminals and front vowels

The previous section presented an alternative to the [anterior] feature in the case of apicals. I turn now to the project of accurately characterizing laminals without using the traditional [anterior] feature. As with the apicals, I draw on the interactions of laminal consonants with vowels. The following type of consonant-vowel interaction is widely attested in the world's languages.

(16) t + i —> č i

Analysts of this process are led to a conclusion that can be stated as follows:

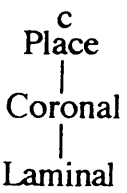
(17) / č/ is a coronal with some dependent, distinguishing feature [X]
/t/ becomes / č/ through assimilation with front vowels
∴ Front vowels possess some feature [X]

What is [X]? It is often identified in the literature as [–anterior] (see for example Schachter & Fromkin 1968, Mester & Itô 1989, Broselow & Niyondagara 1991, Clements 1991, Hume 1992), along the following lines:

(18) / č/'s distinguishing feature is [-anterior]
[anterior] is dependent on Coronal
∴ Front vowels are [-anterior] coronals

This reasoning is crucially dependent on the existence of [anterior], which was shown to be an invalid feature in Section 3. If we do not assume an [anterior] feature, then (18) does not follow. I suggest instead that [X] is simply Laminal (=[+distributed]). In other words, a palatal consonant is characterized by a Coronal node with a single Laminal dependent, as in (19).

(19)



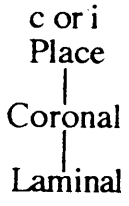
One line of evidence for the structure in (19) comes from the relative markedness of dentals and palatals. The less marked laminal should be given a simple laminal specification, as in (19), while the more marked laminal should have a more complex structure. In the Australian languages, the palatal can generally be recognized as the unmarked laminal (as argued by Hamilton 1993), suggesting that it has the simple structure in (19). In languages where there is only

one phonemic laminal, it is generally palatal. Allophonic variation may occur, though, with palatals before front vowels and dentals (or dentals and palatals in free variation) elsewhere, as described for Gugada, Madimadi and Tiwi in (6) above. In cases of free variation (generally before non-front vowels), the palatal is still the most frequent form, so that "the major allophone is normally lamino-palatal, although there may be a minor lamino-dental allophone (and in a few cases the major allophone is lamino-dental)" (Dixon 1970, p80). In fact, Busby's (1980) survey of Australian phonemic inventories fails to list a type of inventory which includes dentals and not palatals. This is because a single laminal dental does not occur without a palatal allophone. Single laminal languages are thus all classed together in Busby's survey.

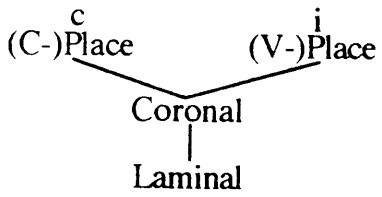
To summarize Busby 's and Dixon's findings, if an Australian language has only one underlying laminal, it will in most languages always or usually surface as palatal. If instead it is usually dental, it will still sometimes be palatal. This evidence suggests that for reasons of markedness the palatal laminal should not be derived from the dental by the addition of structure. Rather, the palatal has the simple structure of (19), and the dental possesses some extra structure.

A second point in favor of Laminal as the [X] feature is the place of articulation of high front vowels and glides. These high front vocoids have a palatal articulation, and are clearly laminal and not apical. They do not contrast with 'dental' vowels. Rather, there is only one place of articulation for front vocoids. It is reasonable then to consider that one place as the unmarked laminal place and not burden the front vowels with extra structure. I propose, then, that the place features of front vowels are identical to those of palatal consonants. This is shown in (21a). A či-type sequence is found in (21b).

(21) a

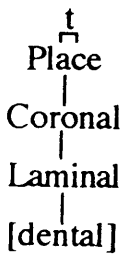


b)



It is the laminal dental, then, that has the extra structure, as shown in (22). I label the extra feature [dental], following Hamilton (1993).[15]

(22)



[15] In some languages of the Indian subcontinent, the dental can be shown to be an unspecified coronal. Such dentals will not have the underlying structure of (22). I discuss this further below.

As the feature [dental] is dependent on Laminal, it will not affect apicals. It thus does not duplicate the job of the discredited [anterior]. The dependence of [dental] on Laminal and not Apical is the reason for replacing [distributed] with monovalent Laminal and Apical. If we were to continue using [distributed], the presence of [dental] only with [+distributed] would receive no explanation. In the present model, the facts are captured by making [dental] a dependent of Laminal.

How does this theory explain palatalization processes, such as the alternation of t̪ and c that we have seen in Gugada, Madimadi and Tiwi (see (6) in Section 3 above)? How can a dental (with more structure) assimilate to a front vowel (with less structure)?

There are two answers to this, depending on the language. Consider first a language where there is only one underlying laminal series, and t̪ and c alternate allophonically. Recall that in such a language, e.g. Pintupi, and to a lesser extent, Tiwi and Gugada (as discussed in Section 3 above), there is often some free variation between palatal and dental articulations. I would suggest that in such cases the [dental] feature is not underlyingly specified. The articulation of the single laminal is allowed to wander somewhat, as long as it remains within the confines defined by Laminal. In the environment of a front vowel, a palatal is more likely to be heard. The [dental] feature will only be present underlyingly in languages where the two laminals contrast phonemically. The apparent assimilation of a dental to a palatal in the environment of a front vowel thus does not involve the loss of the [dental] feature, since this feature is left unspecified.

In a second type of language (found in the Dravidian and Indo-Aryan families, but not the Australian), the dental and palatal contrast phonemically, but the dental will assimilate to a following palatal (but not *vice versa*). This is true of Sanskrit external sandhi (Whitney 1889, Coulson 1976), as shown in (23) (examples are from Whitney, who does not supply glosses).

(23) ut̪ carat̪i —> uccarat̪i
et̪at̪ **c**$^{\mathbf{h}}$at̪t̪ram —> et̪a**cc**$^{\mathbf{h}}$at̪t̪ram

Another case is that of fast speech sandhi in Telugu, shown in (24) (Bhaskararao 1982, cited and analyzed in Gilbert 1992).[16]

(24) ko:t̪i + **c**eppu —> ko:**cc**eppin̪di
"monkey" "tell" "A monkey told"
pa:t̪a + **j**abbu —> pa:**jj**abbu
"old" "disease" "old disease"
ad̪i + **c**a:lu —> a**cc**a:lu
"that" "enough" "That is enough"
ad̪i + **j**arug —> a**jj**arugin̪di
"that" "moved" "That moved"

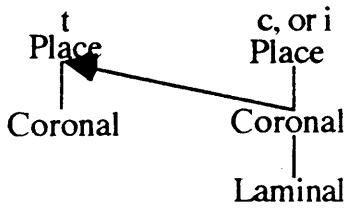
[16] The 'c' in the Telugu examples is a palatal affricate when followed by a front vowel, and an alveolar (laminal) affricate elsewhere. This appears to be an example of a single laminal varying in its articulation, as discussed above.

In cases such as these, the dental can be considered the unspecified coronal, having the place structure of (25) (as pointed out by Gnanadesikan (1993) for Sanskrit and Gilbert (1992) for Telugu).

(25)

These unspecified coronals will assimilate to other coronals. So t + c = cc, or t + i = ci, as in (26).

(26)



The analysis of these coronals as underspecified does not depend simply on their assimilation to palatals. These dentals also assimilate to retroflexes, as shown below. (27) gives Sanskrit examples, and (28) shows Telugu examples.

(27) t̪aṭ ʈi:ka: —> t̪aʈʈi:ka:
t̪aṭ ʈʰa:lini —> t̪aʈʈʰa:lini

(28) pa:t̪a + ʈe:bilu —> pa:ʈʈe:bilu
"old" "table" "old table"
aḍi + ɖabba: —> aɖɖabba
"that" "can" "That is a can"

As these examples show, the dentals in Sanskrit and Telugu assimilate to both apicals and laminals, implying that they are not specified as either apical or laminal themselves. In this case, then, the laminal palatal will have more Coronal dependents than the dental, and will be the source of assimilations for the unspecified dental.

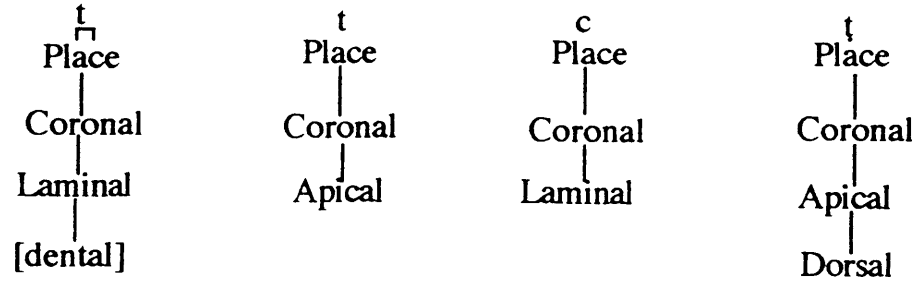
This section has realized the goal of replacing [anterior] by giving palatals a simple Laminal specification and giving dentals (when they are not unspecified coronals) an additional [dental] feature. The interaction of coronal consonants with front vowels has been explained by giving front vowels the same unmarked laminal specification as the palatal consonants.

6. Conclusions and speculations

This paper has sought to construct a unified theory of coronal features as they appear in consonants and vowels. This theory dispenses with the discredited [anterior], and takes into account the interactions of coronal consonants with both front and back vowels. The theory presented uses the nodes Apical and Laminal

to separate coronals into two natural classes. The apicals are subdivided into two classes by assigning to retroflexes a dependent Dorsal node. Front vowels and unmarked laminals share a simple Laminal specification. Contrasting dentals are added with the [dental] feature. These structures are shown in (29).

(29)



There is obviously more work to be done in this area. One interesting topic for further investigation is that [dental] and Dorsal might be the same feature (as in Wilkinson 1988). Drawing on acoustic data, Stevens, Keyser & Kawasaki (1986) assign dentals the feature [+back] as an "enhancement" feature. If a [+back], or Dorsal, articulation truly characterizes dentals, it could replace [dental]. The four coronal subplaces would then be neatly symmetric: the alveolars and palatals are simple coronals, with Apical and Laminal (or, in this case simply [distributed]) distinguishing them. Each type can be dorsalized, adding the retroflex and dental series. While this idea is appealing from a strictly theoretical view, more work would be needed to confirm it.

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