Representing Laterals

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1.0 Introduction

The principal concern of this paper is determining the phonological make-up of laterals. Phonological, acoustic, and articulatory data will be examined in order to demonstrate that laterals are not simple coronal segments. Instead, we will see that a representation of laterals must include both a coronal and a dorsal component.

Laterals are always lingual segments, restricted to articulation by the tongue tip, blade, and body. There are five places of articulation at which laterals are produced: dental, alveolar, retroflex, palatal, and velar.

	Dental	Alveolar	Retroflex	Palatal	Velar
Approximants	l̪	l	ɭ	ʎ	ʟ
Flap/Tap		ɺ	ɻ̆		
Fricatives		ɬ ɮ			
Affricates		t͡ɬ d͡ɮ			

Table 1. Overview of lateral types

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By far the most common manner of articulation of laterals is approximant, a term coined by Ladefoged (Ladefoged 1964). An approximant is a "consonantal sound articulated in a manner involving an opening of the oral tract not radical enough to produce audible friction." (Pullum & Ladusaw 1986 p. 233) Lateral approximants are the only laterals which can be found at all five places of lateral articulation. Approximants are all sonorant consonants.

The only other sonorant lateral is the extremely rare lateral flap or tap. The lateral flap is always either alveolar or retroflex and is always voiced.[1]

There are four types of obstruent laterals, all at the alveolar or dental places of articulation. There is a pair of voiceless and voiced fricatives (ɬ ɮ) and a corresponding pair of voiceless and voiced affricates (t͡ɬ d͡ɮ).

The evidence presented in this paper will lead to two conclusions: (1) that all types of laterals behave like single segments composed of multiple articulatory features; and (2) that those articulatory features are both coronal and dorsal. Laterals are corono-dorsal complex segments. Section 2 lays out the evidence for the dorsality of laterals, first phonologically, then phonetically. Section 3 illustrates how laterals behave phonologically like segments with complex articulation. In Section 4, I explore how laterals can be represented as Corono-Dorsal complex segments within Feature Geometry.

2.0 The dorsality of laterals

2.1 Dorsality in the phonology of laterals

That laterals are coronal has been taken as a given throughout most of the phonological literature. Indeed it is the overwhelming coronality of laterals that has led to much influential work in Feature Geometry regarding lateral structure. Given the desire to formally express the restriction of laterals to coronal segments, Steriade (1986), Blevins (1988 and to appear), McCarthy (1988, following Blevins 1988), and Pulleyblank (1988) place the [lateral] feature as a dependent of the Coronal node. See the cited literature for the evidence of the coronality of laterals; I will not review it here.

Some researchers have noted that laterals do not always behave like simple coronal segments (v. Blevins, to appear; McDonough 1994). In this section, I will present evidence that laterals are unlike most coronal segments precisely because they also have a phonological dorsal component. If laterals are dorsal, in addition to being coronal, there should be phonological behavior to point to this fact. The hypothesis that laterals are all coronal and dorsal claims that all laterals--coronal and velar, plain and velarized--will behave like dorsal segments. We should find evidence of laterals and velars forming a natural class. Such evidence would fall into one of the following scenarios:

(1) (a) Laterals should form a class with velars to affect phonological change.
(b) Laterals should synchronically alternate with velars.
(c) Laterals should cause other segments to become dorsal.
(d) Laterals should be subject to co-occurrence restriction with velars.
(e) Laterals should be diachronically related to velars.
(f) Laterals should interact with other segments which have dorsal features.

Let us now take a look at evidence bearing on the question of dorsality and laterals. In all of the cases examined in this section, there is evidence of dorsality in laterals.

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[1]This sound is known to occur in the phoneme inventories of Zande, Kewa, Papago, Luvale, Logbara, Guajiro, Moro, Southern Namiquara, and Paez.

We begin with a case where the dorsal features of a lateral have spread to another consonant. In Jamaican English[2] (Cassidy & LePage 1980), we find that coronal stop + lateral clusters have historically become velar+lateral clusters (tl and dl > kl and gl).

(2)

Standard English	Jamaican English
little	[lɪkl]
handle	[hæŋgl]
turtle	[torkl]
black wattle (a tree)	[blak wakl]

The facts in Jamaican English follow neatly from an assumption that laterals have dorsal features which can spread to an adjacent consonant. Assuming a Feature Geometric view of place (Clements 1985, Sagey 1986, McCarthy 1988), this process would be characterized informally as in Figure 1, below.

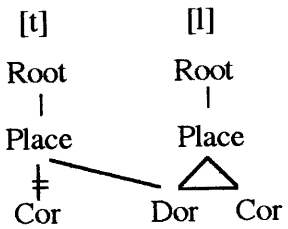

Figure 1. Spreading of Dorsal from Lateral in Jamaican English

An alternative solution is to analyze this phenomenon as a matter of a co-occurrence restriction on two adjacent Coronal nodes. Under this analysis, the first coronal in a cluster would dissimilate to a velar. However, this analysis will not work because there are numerous examples of coronal clusters which never dissimilate:

(3)

(a) [tranga] "stronger"
(b) [ti:sta] "canopy over a bed"
(c) [di:stant] "decent"
(d) [interval] "access road through cane-field or similar cultivation"
(e) [indian] "Indian"

We can see from the examples in (3) that there is no general prohibition on coronal clusters in Jamaican English.[3] I propose that Jamaican English shows laterals spreading dorsal features onto an adjacent consonant, causing coronal stops to become velar stops.

In Pennsylvania German (Reed 1947), velar consonants and lateral consonants act as a class to affect phonological change. Specifically, the low, central vowel is backed before all and only velars and laterals. The lateral in this language is described as a dental sonorant consonant, weakly palatalized in all positions.

(4)

(a) /fɛle/ → [fɒle] "to fall"
(b) /ɛld/ → [ɒld] "old"
(c) /bɛge/ → [bɒge] "cheek"
(d) /lɛŋ/ → [lɒŋ] "long"
(e) /ɛxd/ → [ɒxd] "heed"

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[2]Thanks to Thomas Klein for bringing these facts to my attention.

[3]Neither is [cont] a factor in coronal clusters; we see both clusters that agree and those that disagree in continuancy.

The process in this language can be informally stated as in (5):

(5) /ɐ/ → [ɒ] / velars and laterals

Now, compare the forms in (4) to the forms in (6); no consonant type, other than laterals and velars, causes low central vowels to back.

(6)
(a) [wɐser] "water"
(b) [ʃɐfd] "works"
(c) [pɐre] "pastor"

The class of velars and laterals is unexpected under the view that laterals are plain coronals. The vowel change in Pennsylvania German is completely natural, however, if laterals are coronal and dorsal segments. This phonological change is simply conditioned by segments with dorsal features. I suggest that this process involves spreading the Dorsal node of the consonant onto the central vowel, causing it to become a back vowel.

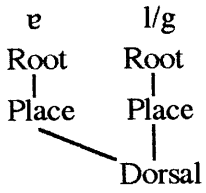

Figure 2. Dorsal spreading in PA German to back a central vowel

This same vowel shift before velars and laterals occurs in some dialects of southwestern Germany, such as central Baden, northeastern Baden, northern Württemberg, and Lorraine (Reed 1947).

Alternations between laterals and velar stops are also evidence of the dorsality of laterals. In Śħeri, a southern Arabian Semitic language (Johnstone 1975), we find that the voiced velar stop [g] is an alternate of the voiced lateral fricative [ɮ].[4] The lateral is the underlying form which is reduced to [g][5] in coda position:

(7)
(a) [ɣɛiɡ] (sing.) "man"
(b) [ɣoɮi] (dual)
(c) [ɣa:g] (pl.)

The reduction of laterals in coda position is not unusual, as we will see in the third section of this paper. It is interesting that we have evidence that the lateral fricative is also characterized by a dorsal component; dorsality of laterals is not only found in lateral approximants. If the lateral fricative were not underlyingly both coronal and dorsal, the alternation seen in Śħeri would be extremely difficult to account for. As it is, we can analyze this simplification as the loss of the lateral's Coronal node when in coda position. The Dorsal node is retained.

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[4]There are also underlying, phonemic voiced velar stops.

[5]It is not clear why this fricative lateral becomes a [g] and not a [ɣ] when it loses its Coronal node. There are velar fricatives in this language. The lateral and the velar fricative are both [+cont], while the [g] is [-cont]. Other languages, such as Korean, avoid fricatives in coda position. The case of Śħeri could also be viewed as avoidance of coda fricatives (*[+cont]]$_\sigma$).

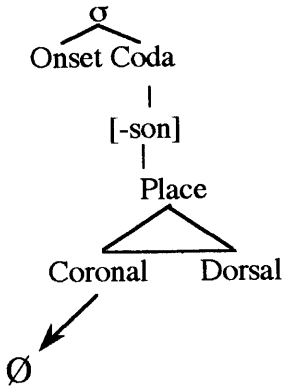

Figure 5. Coda simplification in Śħeri

In the Pittsburgh dialect of American English[6], we also find evidence of laterals forming a natural class with velars. In this dialect, a following [l] or [g] causes non-low vowels to lax.

(8)

(a)	[tɫ]	"teal"	[fətɪg]	"fatigue"
	[stɫəɹz]	"Steelers")	[lɪg]	"league"
	[mɫ]	"meal"	[bɪgəl]	"beagle"
	[fɫajn]	"feline"	[ɫɪgəl]	"illegal"
	[rɫij]	"really"	[ɹɪgəl]	"regal"
	[dɫɪŋ]	"dealing"	[ʃɪŋkʌtɪg]	"Chincoteague"
(b)	[ɛl]	"ale"	[hɛg]	"Hague"
	[pʰɛl]	"pale"	[owmɛgʌ]	"omega"
	[mɛl]	"mail"	[sɛgʌ]	"Sega"
(c)	[pʰɷl]	"pool"	[frɷgəl]	"frugal"
	[tʰɷl]	"tool"	[lɷgij]	"loogie"
(d)	[tʰɷl]	"toll"	[ɹɷg]	"rogue"
	[ɹɷl]	"role"	[vɷg]	"vogue"

Tense vowels are not affected when the following consonant is anything but a lateral or a voiced velar stop.

(9)

(a)	[fijt]	"feet"	(b)	[ejk]	"ache"	(c)	[suwt]	"suit"	(d)	[mowp]	"mope"
	[kʰijp]	"keep"		[tʰejp]	"tape"		[kʰuwp]	"coop"		[əlowp]	"elope"
	[blijd]	"bleed"		[bejb]	"babe"		[uwz]	"ooze"		[howz]	"hose"
	[flijz]	"fleas"		[flejk]	"flake"		[fluwk]	"fluke"		[owk]	"oak"
	[sijn]	"scene"		[ejs]	"ace"		[guws]	"goose"		[blowt]	"bloat"
	[wijk][7]	"week"		[lejt]	"late"		[tʰuwb]	"tube"		[vowt]	"vote"

Vowels also remain tense word-finally:

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[6]The data on Pittsburgh English are from my own field notes. I would like to thank Susan Leeds for assistance with data collection as well as Rob Mason and Melissa Hickey, who served as the principal informants.

[7]There is one word in which i --> ɪ / __ k. That is the word "creek" [kɹ ɪk]. Although this looks like an exception to the pattern, the pronunciation of creek as [kɹɪk] is not particular to Pittsburgh English, but is a feature of most north midland dialects. No other north midland dialects have i --> ɪ / __ l, g. The word *creek*, then, is idiosyncratic to this whole region and is not a product of a regular phonological process.

(10)

(a)	[sij]	"see"	(b)	[sej]	"say"	(c)	[suw]	"sue"	(d)	[sow]	"sew"
	[fij]	"fee"		[mej]	"may"		[duw]	"do"		[t^how]	"toe"
	[dɒŋkij]	"donkey"		[lej]	"lay"		[ʃuw]	"shoe"		[low]	"low"

This lax vowel quality is widely recognized among native speakers of this dialect. One of the largest supermarket chains in Pittsburgh is called "the Giant Eagle". In the early 1990s, the store started marketing itself as the "Iggle". Informally, this vowel shift can be stated as in (11), below:

(11)

/i/ → [ɪ] /__ l, g
/e/ → [ɛ] / __l, g
/u/ → [ʊ] / __ l, g
/o/ → [ʊ] / __ l, g

Only adjacency of the vowel and the consonant is required for this vowel shift to take place. Syllable structure and morphological structure are irrelevant. The only boundary which affects this process is a word boundary. The vowel remains tense if there is a word boundary between the vowel and the [l] or [g]. This is true even for fast speech:

(12)

(a)	[sij # lɛgz]	*[sɪ # lɛgz]	"sea legs"
(b)	[sɯl # ɛgz]	*[sijl # ɛgz]	"seal eggs"

In general, vowels tend to tense and lengthen before voiced consonants; the environment before /l/ and /g/ is not a typical laxing context. This brings up the question of why voicing of the velar stop should matter; why is the class {l, g}, not {l, g, k}? It is well-known that voicing in dorsal stops is more difficult to maintain than in coronals and labials. One way to overcome this problem is to widen the pharynx (the other is to lower the larynx). This would indicate that [g] is produced with a wide pharynx. There is evidence presented by Ladefoged & Maddieson (in press) that laterals also have a markedly wide pharynx. It is possible that the widening of the pharynx, in addition to dorsality, defines the phonological class [l] and [g].

What we see in Pittsburgh English is more accurately described as a co-occurrence restriction than a "process". There are no morphological conditions which would allow us to see an alternation between i~ɪ, for example. Pittsburgh English simply has an inviolable surface constraint. This constraint disallows adjacency of tense vowels (which have a wide pharynx or ATR) and dorsal consonants with a wide pharynx (ATR). This co-occurrence restriction applies to lateral as well as velars. I suggest that what we see in Pittsburgh English is the OCP at work militating against sequences of dorsal segments with a wide pharynx. I further claim that laterals, vowels, and voiced velar stops are precisely the segments which are dorsal and have a wide pharynx. The surface constraint is *[dor/ATR] [dor/ATR]. In Pittsburgh English, this constraint is satisfied by making the adjacent vowels [RTR].[8]

Both historically and synchronically, it is quite common to find laterals becoming back vowels and [w], both dorsal sonorant segments. This alternation is known to occur with both velarized and plain laterals. In Polish (Carlton 1991), for example, [l] > [w] in all positions. We can view this historical process as the loss of the Coronal node of the lateral. If laterals

[8]It is possible that the low vowels do not participate in this laxing because of structure preservation; Pittsburgh English does not have low, lax vowels underlyingly. All of the lax vowels we see before [l] and [g] are also found underlyingly. This might also explain why we get a neutralization with /u/ and /o/ both going to [ʊ]; /o/ cannot become [ɔ] because it is not a vowel native to this dialect.

were plain coronals, there would be no explanation for the change of the lateral into a dorsal segment.[9]

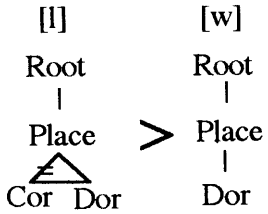

Figure 4. Loss of Coronal in Polish Laterals

In Catalan (Alcover & Moll 1968), there has been a change from coda [l] in Standard Catalan to coda [u] in the Belear dialect.

(13)

Standard Catalan		Belear Catalan
[alba] "sunrise"	→	[auba]

This can also be viewed as the diachronic loss of the lateral's Coronal node, just as in Polish.

Synchronically, we can see the [l] ~ [w] alternation in Mehri (southern Arabian Semitic). An underlying [l] in the root will surface as [w] when it is in coda position (Johnstone 1975).

(14)

/ɬ 1 θ/	"third"
[ɬ o: 1 ə θ]	"third (masc.)"
[ɬ ə w θ e: t]	"third (fem.)"

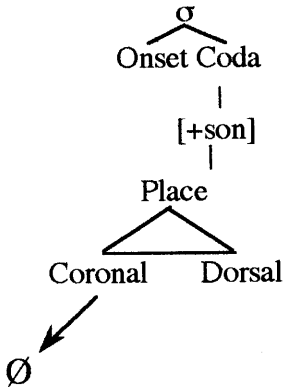

Figure 5. [l] → [w] in Mehri

Both Belear Catalan and Mehri exhibit coda simplification similar to the facts of Śheri discussed above. In Catalan, the process in an historical one. The Coronal node of all laterals has been lost in coda position. We do not see evidence of synchronic alternations between [l] and [w] in Catalan. However, in Mehri, there is clear evidence of a synchronic coda simplification. The Coronal node of the lateral is lost in coda position, leaving only the Dorsal node. This sonorant dorsal segment then surfaces as a [w].

If laterals are dorsal, we should find cases where this dorsality interacts with the dorsality of other segments. Retroflex consonants have been argued to have dorsal features in addition to coronal features (Gnanadesikan 1993; Dixon 1980; Hale 1973; Stevens, Keyser & Kawasaki 1986; and Hale, Farmer, Nash & Simpson 1981 among others). If this is true, we

[9]With the loss of the Coronal node, a sonorant dorsal segment is left. Labiality is added to remain within the Polish phoneme inventory.

expect to find evidence of the interaction between the dorsality of the retroflex and the dorsality of the lateral. In particular, we might expect to find co-occurrence restrictions or dissimilations (OCP effects) on retroflexes and laterals. Many Australian languages exhibit OCP effects for retroflexes and laterals. In languages such as Alyawarra, Djinang, and Maung, laterals at all places of articulation are prohibited in clusters with retroflex consonants.

First, let us turn to the arguments that retroflex consonants have a dorsal component. In has been noted that retroflex consonants are associated with [+back] vowels across languages, both historically and synchronically. Retroflex consonants have been created solely in environments where there is a [+back] vowel. Dixon (1980) reconstructs an alveolar consonant phoneme for proto-Australian which had a retroflex allophone after /u/. This allophonic alternation was then phonemicized, so that we find phonemic alveolars and retroflexes in most Australian languages today. Similar arguments have been made for the generation of retroflex consonants in Dravidian languages (Gnanadesikan 1993). Synchronically, there is evidence that retroflex allophones arise in environments with back vowels. In Walmatjari (Gnanadesikan 1993), an apical consonant becomes a retroflex after /a/ and /u/.

The association of retroflex consonants and back vowels has led many to suggest that retroflex consonants are characterized by a [+back] feature. Most representations of [+back] in Feature Geometry place it as a dependent of the Dorsal node. If retroflex consonants and lateral consonants both have a dorsal component, then we would expect to find co-occurrence restrictions on laterals and retroflexes referring to the dorsality in each. This is exactly what we do find. In the Arandic language Alyawarra (Yallop 1977), for example, there are laterals at all four places of coronal articulation (dental, alveolar, retroflex, and palatal).

Bilabial	Dental	Alveolar	Retroflex	Palatal	Velar
p	t̪	t	ʈ	tʲ	k
pᵐ	t̪ⁿ	tⁿ	ʈᶯ	tʲⁿ	kᵑ
m	n̪	n	ɳ	nʲ	ŋ
	l̪	l	ɭ	ʎ	
		r	ɻ		
w				y	ɣ

Table 2. Alyawarra Phonemes

Laterals can occur in clusters with consonants at all places of articulation except retroflex.

(15)
(a) [a**lp**ima] "go away"
(b) [wu l̪ t̪ ima] "press against, step on"
(c) [kum**pa**l**t**a] "scraper"
(d) *[ɭ ʈ]
(d) [iʎtʲarima] "wave"
(e) [aghi**lk**a][10] "dawn, early sun"

In Alyawarra, we see that there are co-occurrence restrictions on laterals and other segments with dorsal features. In this case, laterals are prohibited in clusters with retroflex consonants. This is not a prohibition on clusters of retroflexes; the clusters [ɳ ʈ] and [ʈⁿ ʈ] are

[10]The proposals which claim that retroflexes have a Dorsal node usually represent the Dorsal node as a secondary feature. The fact that laterals can occur with primary Dorsal nodes (as in this example with a velar stop and a lateral) leads to the conclusion that the Dorsal node in laterals is indeed secondary. This topic will be taken up fully in section 4.

in fact quite common. This prohibition only refers to laterals and retroflexes. This fact would be quite puzzling if laterals did not have a dorsal feature. This co-occurrence restriction is a Place-based phenomenon. What prompts the restriction is not "laterality" per se, but something that retroflexes and laterals share. It is not manner that they share, clearly. I would argue that it is Place.

To summarize, I have shown evidence of laterals and dorsals patterning together. We have seen laterals and velars acting as a natural class. This natural classhood has been expressed in many forms: laterals and velars conditioning vowel quality change (Pennsylvania German and Pittsburgh English); alternations between laterals and dorsal segments, some dependent on syllable position (Śheri, Polish, Belear Catalan, and Mehri); the spreading of a Dorsal node from a lateral to an adjacent segment (Jamaican English); and co-occurrence restrictions on laterals and segments with a dorsal feature in a cluster (Alyawarra, Maung, Djinang). This behavior is exactly what we expect if lateral segments have a Dorsal node.

2.2 Articulation of laterals

The phonological behavior of speech sounds can be related to their articulation. In this section, we will see how the various types of laterals are articulated. In turn, I will consider how the articulation of laterals is reflected in the acoustics. In both the articulatory and the acoustic studies, we will observe that laterals involve **both** the tongue tip/blade and the tongue dorsum. Laterals are complete lingual segments.

The flow of air has been the focal point of traditional definitions of a lateral articulation. Chomsky & Halle (1968): "Lateral sounds are produced by lowering the mid section of the tongue at both sides or at only one side, thereby allowing the air to flow out of the mouth in the vicinity of the molar teeth." (p. 317) Pullum & Ladusaw (1986): Laterals are "...[a]rticulated in a manner that involves oral airflow predominantly around the central obstruction across the sides of the tongue rather than down the center line of the oral cavity." (p.237) Catford (1988): Laterals are sounds "...in which the mouth-passage is blocked in the centre so that air flows out only along the side(s) of the tongue..." (p. 75)

More recent work has defined laterals by the articulatory gestures involved. According to articulatory studies dating from the late 1970s through the present, all lateral segments involve two distinct gestures. One gesture is apical, made with the tongue tip or blade. But laterals also involve a dorsal gesture in addition to the apical gesture. Sproat & Fujimura (1993) demonstrated, with x-ray microbeam data, that in English all types of laterals have both of these gestures. The apical gesture is a movement of the tongue blade to the alveolar ridge. The dorsal gesture is a retraction of the tongue body away from the palate. In a "light" or plain [l], the tongue tip extremum occurs before tongue body lowering. In a "dark" or velarized [l], the tongue body lowering extremum occurs before tongue tip extremum. Giles & Moll (1975) found that with dark l in English, apical contact is not even achieved for all speakers. In addition to the work just cited, research by Fujimura, Miller, & Escolar (1977), Fujimura & Lovins (1978), and Browman & Goldstein (1989) all report experimental evidence of both tongue blade and tongue dorsum gestures in laterals.

Ladefoged & Maddieson (in press) define laterals as sounds in which "the tongue is contracted in such a way as to narrow its profile" (Ch. 6 p. 1). This definition is based on cine x-rays and palatograms from a variety of language families. One of the reasons that Ladefoged & Maddieson have abandoned the airflow definition of laterals is articulatory evidence that airflow is not always completely blocked down the midline of the mouth during lateral production. They found that the airflow patterns were in fact quite variable from language to language and speaker to speaker. The narrowing gesture of the tongue was what they found to be a constant in lateral articulation. This characterization implies that both the tongue body and the tongue blade are involved in the articulation of laterals. The tongue blade cannot be narrowed with out the tongue body also being narrowed, and *vice versa.*

When laterals, cross-linguistically, are defined gesturally, we see that they are more complex than an airflow definition would lead us to believe. The evidence shows that laterals are characterized by two gestures, one of the tongue tip/blade and one of the tongue body.[11]

2.3 Acoustic properties of laterals

We will see in this section that, cross-linguistically, laterals do not resemble other coronal segments. The second formant in laterals is quite a bit lower than for plain coronals, suggesting the presence of a dorsal gesture.

Sonorant laterals are the most common laterals cross-linguistically. It should be no surprise, then, that they are also the best studied laterals phonetically. Let us first look at the description of alveolar laterals. Ladefoged, Cochran, & Disner (1979) note that the spectrograms for dental and alveolar laterals look similar in a variety of language families. In spectrograms, formant loci are determined by place of articulation. Non-lateral alveolar consonants have a low F1 locus and an F2 locus around 1650 Hz (Olive, Greenwood, & Coleman 1993).[12] But alveolar laterals do not look like other alveolars in this respect. Both F1 and F2 values are markedly lower in laterals. In fact, the first three formants of an alveolar lateral have values extremely similar to the glide [w]. The only consistent difference between [l] and [w] is that the energy around F3 is higher for [l] than for [w]. This higher energy is indicative of the greater constriction of the lateral.

It is interesting that even so-called "light l"s resemble the dorsal [w] in a spectrogram. Other than high energy around F3, there are two properties that distinguish [l] and [w] acoustically. The first is that there is a steady state of the formant structure in [l] but not in [w]. The other is that we see a slight discontinuity in the transition form the previous vowel to the lateral and from the lateral to the following vowel. This discontinuity is not found in [w] and is weak to non-existent in the more velarized [ɬ] found in coda position in English. This discontinuity from vowel to alveolar lateral does not resemble the transition of other alveolar consonants according to Olive, *et al* (1993).

Also unlike other coronal consonants, vowels have very little influence on the formants of laterals. This is indicative of a lack of co-articulation between vowels and laterals. Since laterals involve both a tongue tip or blade and a tongue body gesture, it is possible that co-articulation of vowels and laterals is impossible because both lingual articulators are already employed for lateral production.

A lower F2 is indicative of a dorsal tongue gesture. Velarized laterals have lower F2 values than plain, apical laterals. All laterals have a lower F2 than other coronals. The fact that F2 is lower in laterals than in other coronal consonants is strong evidence that laterals also contain a dorsal gesture.

The allophonic variation between plain and velarized [l] in English is well known. The lateral is plain in the onset and velarized in the coda. However, there is a case where both versions emerge in one segment. This occurs when there is ambisyllabicity. When a lateral occurs post-tonically (as in the word "feeling"), the lateral starts out as a velarized [l] and ends up as a plain [l] acoustically. It is not the case that two lateral segments are present. Olive, *et al* (1993) compare forms such as "feeling" with those like "feel lucky". In the latter case, there is clear evidence of two separate segments, even in fast speech. In "feeling", there is one lateral with two phases.

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[11] It should be noted that a dorsal node can be instantiated by a raising or lowering of the dorsum, just as a labial node can be instantiated by lip rounding or spreading. The gesture of the articulator is language and manner feature specific. But different gestures with one anatomical articulator can be phonologically equivalent. See Selkirk (1993) for arguments along this line.

[12] In languages with laminal (dental and palatal) laterals, the laminality of the segment is indicated by higher frequency of F2 and the slower rate of formant transition to and from the lateral.

One of the peculiarities of the production of laterals is the formation of side chambers in the mouth when the tongue is narrowed so that it no longer makes contact with the soft palate. This gesture results in the characteristic lessening of the intensity of the second formant. This feature is found in both coronal and velar laterals (Ladefoged, Cochran, & Disner 1979).

We have seen that the acoustic data on laterals support the definition of laterals as both coronal (tongue tip or blade) and dorsal (the tongue body). The formant structure of laterals is very similar to that of [w], also a dorsal segment. The loci of the formants diverges from other coronals in just the direction we expect from a dorsal articulation (a lower F2).

Traditional definitions of laterals involve the description of airflow out of the mouth. More recent work characterizes laterals as having both tongue tip/blade (coronal) and tongue body (dorsal) gestures. This gestural observation is only relevant to the phonology if there is independent evidence that these two articulations influence the phonological behavior of laterals. We have seen in the previous section that there is ample evidence to support the hypothesis that laterals have both coronal and dorsal features. Based on both phonological and phonetic data, I assert that all laterals are Corono-Dorsal complex segments. In the next section, I will demonstrate that laterals indeed behave as complex segments.

3.0 Laterals as complex segments

A complex segment is defined as one segmental unit with multiple articulators (Sagey 1988). The classic cases of complex segments are doubly articulated stops such as [k͡p], a labio-dorsal stop, and [p͡t], a labio-coronal stop. These types of phonemes are quite widespread in the languages of West Africa. What characterizes a complex segment is that there are two active articulators, but the segment is treated as one unit with respect to syllable structure. The claim is that there is only one root node, but it dominates two place nodes. In Sagey's (1986) terms: "...complex segments are like contour segments (and unlike consonant clusters) in that they must be represented on a single x-slot." (p. 69)

Laterals have always been taken to be a single segment. Languages which have no consonant clusters can have a lateral (Hawaiian, Nakanai). If the Coronal Place and the Dorsal Place of the lateral were treated as two separate segments, the phonotactics of such language would look odd indeed.

One of the indications of a complex segment is its tendency to simplify in codas. In most languages, the segments which can occur in coda position are more restricted than the segments which can occur in onset position. In many languages, only one articulator is licensed in the coda. Languages handle this situation either with place simplification, or deletion, which is the ultimate simplification of a segment.

The processes in (16), below, are cases of marked segment types, including complex segments, simplifying in the syllable coda.

(16)

(a)	Latin:	$k^w \rightarrow k / \_]_\sigma$
(b)	Korean:	$t^h \rightarrow t / \_]_\sigma$
(c)	Nahuatl:	$t\underline{l} > t / \_]_\sigma$
(d)	Sanskrit:	$d^h \rightarrow t / \_]_\sigma$

It is clear that laterals are often licensed in coda position (as in English, Arabic, Dyirbal, Latin). However, we do find a number of languages which do not allow laterals except in the onset of a syllable.

Śheri	[ɮ] → [g] / _]σ
English (some British dialects)	[l] → [ɣ] / _]σ
Belear Catalan	[l] → [u] / _]σ
Serbo-Croatian	[l] → [o] / _]σ
Mehri, Brazilian Portuguese, American English (N. Midlands)	[l] → [w] / _]σ
Florentine Italian, Modern Greek Andalusian Spanish	[l]→ [ɾ] / __]σ

Table 3. Coda simplification of laterals

Parallel to coda simplification in other complex segments, laterals show a tendency to simplify in coda position. In this simplification, it is usually the Dorsal node of the lateral which is retained (as we saw in Figure 3). The preference for retention of the Dorsal node can be accounted for by the cross-linguistic preference for dorsals over other segments in codas. According to Trigo (1988), "...languages..favor velar consonants over labial and coronal consonants in coda position."

Let us now look more carefully at the data of laterals simplifying to alveolar flaps. The first case is Florentine Italian.[13]

(17)		Standard Italian	Florentine Italian	English
	(a)	[dol t͡ʃ e]	[dor t͡ʃ e]	"sweet, dessert"
	(b)	[sɔldi]	[sɔr di]	"money"
	(c)	[palkoʃɛniko]	[parkoʃɛniho]	"stage"

In Florentine Italian, the Dorsal node of laterals is lost in coda position, resulting in a non-lateral flap. It is not clear, however, if Florentine Italian has a synchronic or diachronic loss of the coda Dorsal node in laterals. With a few exceptions, all words end in open syllables. This makes alternations between /l/ and /r/ very hard to detect. One place we might expect to see an alternation is with the definite article /il/. When the definite article occurs before a consonant-initial word, however, the lateral is lost all together. What we find instead is compensatory lengthening of the stem's onset.

(18) /il + dor t͡ʃ e/ → [iddor t͡ʃ e]

This loss of the lateral in coda position here is really a severe form of simplification. Although in non-alternating cases, we find the lateral reducing to the coronal flap, in the alternating case of the definite article, the lateral is reduced to zero. Only the mora is retained in the compensatory lengthening of the stem onset.

In Andalusian Spanish, laterals also reduce to alveolar flaps. In this language, however, we see evidence of this reduction in alternations.

(19)		Andalusian Spanish	Standard Castillian Spanish	English
	(a)	[e.lo.so]	[e.lo.so]	"the bear"
	(b)	[er.θo]	[el.θo]	"the zoo"
	(c)	[ar.ba.ka]	[al.ba:.ka]	"basil"
	(d)	[pur.po]	[pul.po]	"octopus"

[13]Thanks to David Holton for bringing the Florentine Italian and the Andalusian Spanish facts to my attention. These data are from his field notes.

In comparing (19a) and (19b), we can see that the lateral of the definite article /el/ surfaces as a lateral before vowels and as a flap before consonants. This can be analyzed as the loss of the lateral's Dorsal node in coda position.

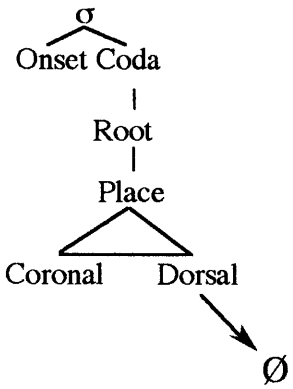

Figure 6. Lateral reduction in Andalusian Spanish

4.0 The representation of laterals

We have seen evidence that laterals are both coronal and dorsal. We now turn to the question of the relationship between the coronal and dorsal features of laterals. There are two types of evidence that we have seen which are relevant to this question: OCP effects and segment types resulting from the loss of one set of place features.

Laterals show OCP effects with segments which have secondary dorsal features (e.g. Alyawarra retroflexes). There is no evidence of OCP effects between laterals and primary dorsals. For example, in Alyawarra, laterals and velar stops may co-occur. In English laterals may occur in initial clusters with velars, but not coronals (√[kl], *[tl]). These co-occurrence restriction facts suggest that the dorsal features of laterals are secondary features.

The other type of evidence for the relationship between the articulatory features in laterals comes from the result of the loss of one articulator. When one articulator is lost, the result is a non-lateral segment. The class of segment that arises when a lateral loses one of its articulatory features is telling. When laterals lose coronal features, the resulting dorsal segment is almost always a vocoid (e.g. English, Belear Catalan, Serbo-Croatian, Mehri, Brazilian Portuguese). On the other hand, when a lateral loses its dorsal features, the resulting coronal is always a consonant (e.g. Florentine Italian, Modern Greek, Andalusian Spanish). This type of evidence suggests that the dorsal feature of laterals is a vowel feature, while the coronal feature is consonantal. This conclusion is also supported by the work we have seen which claims that retroflex consonants have secondary vocalic [back] feature. It is this secondary vowel feature in retroflexes that interacts with laterals. I submit that laterals are represented within Feature Geometry as in Figure 7, below, with a primary consonantal Coronal node and a secondary vocalic Dorsal node.

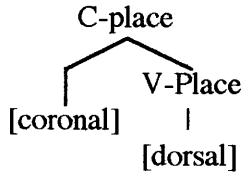

Figure 7. The representation of laterals

Distinctions among laterals can be acheived in a straight forward way. The Coronal node can support [+/- distributed] and [+/- anterior]. The dorsal node has a [+back] dependent in retroflex laterals.

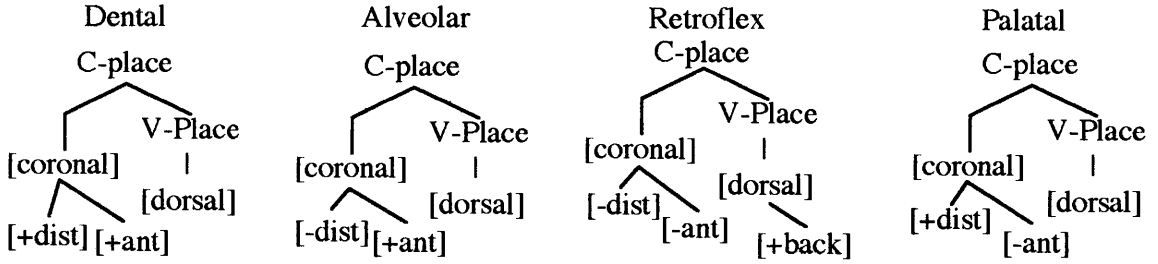

Figure 8. Distinctions among coronal laterals

5.0 Conclusion

Laterals often behave as coronal consonants. However, we have seen that the articulation of laterals includes both a coronal and a dorsal gesture. The acoustics of laterals also show us that laterals are not simple coronals. We have seen that laterals behave phonologically as segments with both coronal and dorsal features. From spreading to co-occurrence restrictions, the dorsality of laterals is active in the phonology for a variety of lateral consonants. No previous work has given us a representation of laterals that can account for lateral dorsality. In this paper, I propose that all laterals are Corono-Dorsal complex segments, allowing us to better understand the complicated phonological behavior of laterals.

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