Variability in feature affiliations through violable constraints: The case of [lateral]

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In rule-based theories, segmental representations were stated in a universal feature geometry which expressed the relationships between features (Sagey 1986, Clements and Hume 1995, and many others). Features that were dominated by the same node in the feature tree could spread together or delink together. Nodes could act as targets for the spreading of their subordinate features. In OT, if universal feature geometry is to be incorporated into the theory it either (i) restricts the output of GEN or (ii) results from universally undominated constraints that effectively filter out all candidates with defective feature-geometric content. This is the approach taken by Uffmann (this volume). However, neither of these options is fully within the spirit of OT, committed as it is to an unfettered GEN, and free constraint ranking.

OT, however, opens up another possibility. Suppose the constraints that define feature relationships are not universally undominated, but rankable. In that case we would get 'variable feature geometry effects' in which features would sometimes group together, but other times not. Interestingly, such cases exist, and were a known problem for claims that feature geometry was universally invariant. The best known case is [lateral], which behaves as a dependent of the Coronal node in many cases (Blevins 1994), but as a dependent of a node responsible for voicing in sonorants - Sonorant Voicing or SV (Rice and Avery 1991, Piggott 1994) - in other cases.

This paper will argue that the variable behaviour of [lateral], while a problem for universally fixed geometries, is not a problem within OT. It results from rankable constraints on feature co-occurrence that prefer certain combinations such as [Coronal, lateral] or [+ sonorant, lateral] to others such as [Dorsal, lateral] or [-sonorant, lateral]. Once this move is made, the rationale for feature geometry largely disappears, as argued on different grounds by Padgett (1995, 2000). The paper is organized as follows. Section one sets out the range of lateral sounds found in languages and the evidence for the feature [lateral], followed by previous geometrical approaches, and the contradictory nature of the evidence. Section two proposes an account using feature co-occurrence constraints, and two fixed rankings *LatDors >> *LatCor, and *LatObs >> *LatSon derived from the phonetics. This is followed by a summary of the typological predictions of such an approach. Section three tests the theory on a range of cases that seem to require different feature geometries under earlier proposals.

1.Background:

1.1 The different types of laterals:

A suitable theory must account for the full range of lateral sounds, which I therefore survey in this section, based mainly on Ladefoged and Maddieson 1996. Most laterals are coronal, and they may have any of eight coronal places of articulation: dental, alveolar, post-alveolar and palatal, each either apical or laminal. There are no known labial laterals, not even linguo-labial ones, even though this occurs in child language, and in adult language for stops, so it is articulatorily possible. Phonetically velar laterals are found, and their articulation is clearly velar, not coronal. In Zulu, nasals before the velar lateral ejective affricate are [ŋ], not [n]. The examples below come from the Papua New Guinea language Mid-Waghi, which contrasts two coronals - dental [l̪] and alveolar [l] - with the velar [ʟ]:

(1) aḻa aḻa ‘again and again’ alala ‘speak incorrectly’ aʟaʟe ‘dizzy’

Most laterals are voiced approximants, but some laterals are voiced fricatives [ɮ], and some languages such as Zulu contrast the two. Not all laterals are voiced: there are truly voiceless lateral approximants such as Toda [l̥], and many voiceless lateral fricatives like the Welsh and Zulu [ɬ].

(2) Zulu: lálà ‘lie down’ ɮálà ‘play’ ɬàɬá ‘cut off’
Toda: kal ‘bead’ kal̥ ‘study’
Welsh: lo:n ‘road’ ɬond ‘full’.

Lateral affricates [tɬ] and [dɮ] are quite common, as are clicks with a lateral release, shown by ||:

(3) Tlingit: ɬaa ‘melt’ tɬaa ‘be big’ dɮaa ‘settle (of sediment)’
Zulu: k||ók||a ‘narrate’ g||álà ‘stride’

In sum, the following possibilities must be accounted for, with sample languages included:

(4)

	Approx	*Fric*	*Affricate*	*Click*
voiced	Zulu	Zulu	Tlingit	Zulu
voiceless	Toda	Zulu	Tlingit	Zulu

I shall assume that the approximants are sonorants (even if voiceless), and all the others are obstruents. The affricates and clicks I take to be lateral stops (as does Lin, this volume), and I shall not have room to discuss how they are distinguished from each other featurally.

1.2 Evidence for a feature lateral:
The focus of this paper is on the behaviour of the feature [lateral], so it is important to discuss the evidence for the existence of the feature in the first place. If a language has [l] but no [r], one might define [l] by the features [+cons, +son, -nas], and [lateral] would be redundant. However, if [l] contrasts with [r] as it does in many languages this will not suffice. Positive evidence for the feature [lateral] comes from its active role in the phonology of many languages. In Eastern Catalan (and Sanskrit), for example, [lateral] spreads onto nasals to create a lateral nasal: /nl/ → [n̺l] in /son les tres/ → [son̺les tres] (Mascaró 1976). Furthermore, there are phonological processes that involve only [l] and [r], and in which they either dissimilate, as in Latin, where the suffix /-alis/ surfaces as [-aris] after a lateral root: *nav-alis* vs. *sol-aris* (Steriade 1987), or assimilate, as in Sundanese, where the infix /-ar-/ surfaces as [-al] after a preceding /l/: *k-ar-usut* vs. *l-al-əga* (see Cohn 1992 for details). I conclude that the feature [lateral] cannot be dispensed with (but see Spencer 1984, Brown 1995 Walsh 1997 for a dissenting view). [1] I should note that for the purposes of this paper I shall treat it as a privative feature, but the results would not be materially affected if it were to turn out to be binary, as Steriade argues.

[1] The alternative would be suppose that the two liquids [l, r] differ in continuancy, but in that case dissimilations and assimilations of [l] and [r] should involve other coronal continuants as well. See Hegarty (1989) for a discussion of the continuant properties of [l].

1.3 The problem with a fixed feature geometry: conflicting evidence:
In the late 1980's and early 1990's it was argued that feature geometry was universally invariant (Sagey 1986, Clements and Hume 1995, and many others), but certain features were rarely discussed because they posed a problem for this view. Among them were [lateral] and [strident]. The two main contenders for the placement of lateral are shown below, where SV stands for Sonorant Voicing, and is responsible for voicing in sonorants but not (most) obstruents.[2]

(5)

a. Under Coronal (Blevins 1994)		b. SV model (Rice and Avery 1991)
Place	OR	Sonorant Voicing
/ | \		/ \
Lab Cor Dors		[nasal] [lateral]
|		
[lateral]		

The predictions were clear: [lateral] required the presence of its superordinate node, and anything which affected that node (such as spreading it, delinking it, deleting it) would also affect [lateral]. Sister features should spread togther with [lateral]. The trouble was, the evidence was contradictory, as the following table shows:

[2] An obvious problem is that the class of voiced consonants (including obstruents and sonorants) cannot be expressed in this theory. Languages like Min, in which [l] behaves like the voiced counterpart of [t], are thus problematic. The solution, as a reviewer reminds me, is to suppose that in such languages the voiced stops are in fact really sonorant obstruents (as Tuttle (this volume) argues for Galice), and thus the class of voiced segments is the class with an SV node. However, this will not work for languages like Polish, in which lexical voicing assimilation involves only obstruents, *including* voiced and voiceless stops, but post-lexical voicing assimilation groups voiced obstruents and sonorants together. See §3.1.4 for details.

Table I: (Shaded cells are cases where no language with supporting data has yet been found.)

	Under Coronal?		Under [Sonorant Voicing]?	
	FOR	**AGAINST**	**FOR**	**AGAINST**
1	Laterals are usually Coronal: *many languages*	Placeless laterals: *Javanese* Velar laterals: *Yagaria*	Laterals are usually voiced sonorants: *many languages*	Voiceless laterals: *Tahltan* Obstruent laterals: *Min, Bantu* Affricate laterals *Tahltan, Zulu*
2	Place spreading spreads [lat] from trigger: *Selayarese*	Place spreading doesn't spread [lat]: *Chukchi*	Voice/nasal spreading spreads [lat] from trigger: *Sanskrit*	Voice spreading doesn't spread [lat]: *Polish*
3	Coronal node as target of [lateral] spreading: *Teralfene Flemish, Yanggu Chinese*	Laterals skipped by harmony that targets Coronals: *Tahltan*	[SonVoice] node as target of [lateral] spreading: *Toba Batak*	Laterals skipped by harmony that targets sonorants: ?
4	Place spreading removes [lat] from target: ?	Place spreading doesn't remove [lat]: *English, Basque*	Voice spreading removes [lat] from target: *?*	Voice spreading doesn't remove [lat]: ?
5	Place loss removes [lat]: ?	Place loss doesn't remove [lat]: *Caribbean Spanish*	Devoicing removes [lat]: *Yagaria*	Devoicing doesn't remove [lat]: *English*
6		In affricates, [lateral] is clearly a release feature, i.e. manner: *Tahltan*		Need to state natural class of voiced obs. and voiced son.: *Polish, Min*

2. The proposal

The perplexing behaviour of laterals, while a problem for a fixed feature geometry, can be handled quite simply within OT by means of rankable feature co-occurrence constraints (Padgett 1995, 2000, Pater 1999, Pulleyblank 1997). The preference for a coronal place of articulation means that *LATERALCORONAL is low-ranked in most languages, while the preference for lateral approximants means that *LATERALSONORANT is low-ranked in most languages. Conversely, the absence in a

language of velar laterals and lateral affricates or clicks means that *LATERALDORSAL and *LATERALOBSTRUENT are high-ranked and thus surface-true. However, languages may vary as to how they rank these constraints. For example, if *LATERALDORSAL is low-ranked velar laterals may be found. This thus avoids one of the immediate problems with a fixed feature geometry: its excessive rigidity.

As in other aspects of phonology where the constraints are grounded in the articulatory phonetics, there are limits on the ranking permutations for the constraint families that derive from these physiological imperatives. Just as sonority-based constraints are usually agreed to have a fixed ranking with respect to each other, so too do the constraints relating to laterality. I shall posit the following fixed rankings, into which other constraints may intervene:

(6) *LATERALOBSTRUENT >> *LATERALSONORANT
*LATERALLABIAL >> *LATERALDORSAL >> *LATERALCORONAL

These rankings, in conjunction with faithfulness constraints and other familiar parts of the OT grammar, have the following effects:

a. restrict the types of lateral inventories
b. explain the targets of spreading
c. explain the outcomes of processes
d. give the effects of dependency, without feature geometric representations

In so far as this account denies the need to place [lateral] under any particular node, it is line with the claims of Hegarty (1989), Bao (1992), who argue that it is simply a dependent of the Root node. I would go further, and agree with Padgett (1995, 2000) that features can be treated as an unstructured set of which [lateral] is a member, and that feature geometry as such is redundant. The next section expands on this proposal.

2. 1. Lateral inventories:

2.1.1 Preference for Sonorants:

The following typology arises from placing the faithfulness constraints at different points in the fixed ranking of *LATOBS >> *LATSON:

(7)	*LAT OBS >> *LATSON >> FAITH	Languages with no laterals (18.6%, Maddieson 1984)
	*LATOBS >> FAITH >> *LATSON	Common language type, with sonorant laterals
	FAITH >> *LATOBS >>*LATSON	Languages with both obstruent and sonorant laterals

Examples of obstruent laterals include not only the obvious affricates and clicks, but also languages in which [l] patterns as a voiced obstruent, such as Min, which has [l] instead of [d]. For example, /p,t,k/ voice to [b,l,g] foot-internally (Hsu 1996) and /b,l,g/ nasalize to [m,n,ŋ] before nasal vowels. In some Bantu languages, like Ikalanga, historical *d has become /l/, but under velarization /l/ becomes the stop [gw], suggesting that it may still be an obstruent.

The prediction of the fixed ranking given here is that no language can have *only* obstruent

laterals and no sonorant laterals. While this is certainly the usual case, there are some possible counter-examples, including Min if its [l] is an obstruent. However, Min has no other oral sonorant consonants - no /r/ - so high ranked SON=NAS could be invoked. An alternative might be to say that this [l] is not phonologically [lateral] at all, but is just an oral stop. Another possible counter-example is Tlingit, which has fricative and affricate laterals, but no voiced approximant. This needs further investigation. Finally, the existence of voiceless lateral sonorants as in Tahltan [ɬ] (Shaw 1991) simply implies that SON=VOICE can be low-ranked.

2.1.2 Preference for Coronals:

I now turn to the preference for Coronal place. The typology is given below:

(8)	*LATLAB >> *LATDORS>>*LATCOR>> FAITH	Either no laterals, or placeless ones.
	*LATLAB >> *LATDORS>> FAITH >> *LATCOR	Common type, with Coronal laterals[3]
	*LATLAB >> FAITH >> *LATDORS >>*LATCOR	New Guinea type, with velar and coronal laterals
	FAITH >> *LATLAB >> *LATDORS >>*LATCOR	Unattested

An example of placeless laterals comes from Cambodian: (Nacaskul 1978). The co-occurrence restrictions on identical Place features do not treat /l,r/ as Coronal, even though Place restrictions cross-cut obstruents and sonorants, stops and fricatives, nasals and glides, as the following table shows. Instead, they behave like [h ʔ] in co-occurring freely with all other sounds.

(9)	C1\C2	b p m w	t d n r l	c s ñ y	k ŋ h ʔ
	p	* * * *			
	t		* * *	* * * ?	
	c		* ? ?	* * * *	
	k				*

Languages with Dorsal laterals will include those like Mid-Waghi (see (1) in §1.1), and also perhaps languages with palatal laterals, which have been argued to be both Coronal and Dorsal by Sagey 1986 and others. The last grammar in (8), which predicts the existence of the unattested labial laterals, is an unexplained gap. One possibility is that the perceptual effects of lateral release in labials would be too subtle to make such a contrast functionally effective. I shall have nothing further to say about labial laterals.

The main prediction of this typology is that no language should have only Dorsal laterals.

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[3] Walsh (1997) argues that all laterals have both Coronal and Dorsal Place. This is certainly true phonetically in some languages, and perhaps phonologically too (in English, for example, /l/ vocalizes to the Dorsal [u] in many dialects, and children often turn coronals into velars before [l]), but in other languages there is no evidence of a phonologically active Dorsal component. Palatal laterals may also be Coronal and Dorsal, and contrast with plain Coronal laterals. This analysis of palatals is problematic for the view taken here, as a reviewer points out, since it seems to require a positive constraint LAT=COR, but I have no room to explore this further here.

Either it must have complex corono-dorsal laterals, or Dorsal and Coronal ones in contrast. Blevins argues that many of the cases of apparent velar laterals, such as Yagaria and Kunite, are in fact phonologically complex, being both Coronal and Dorsal. The fact that they have /ʟ/ but no /l/ is then not a problem. However, Mid-Wahgi has a Dorsal /ʟ/ that (contra Blevins) does not seem to be in any way Coronal [4], but the language also has contrasting /l̪/ and /l/. For Blevins, committed to [lateral] under the Coronal node, this is a problem, since all laterals must be Coronal, but for the approach outlined here plain Dorsal laterals are fine, so long as they contrast with plain Coronal ones.

Putting together the results of this section, a language with only coronal sonorant laterals will have the grammar in (10).any of the languages discussed in this paper are of this type.

(10) *LatObs, *LatDors >> Ident-lat >> *LatSon, *LatCor

The relevant faithfulness constraint here is IdentLat, which requires that segments that are lateral in the input must be lateral in the output.[5] The Richness of the Base hypothesis means that inputs such as /ʟ/ will inevitably arise, but they cannot survive under this grammar. Ident-Lat says nothing about the creation of new laterals, but these will violate two of the markedness constraints in the above grammar, so that a new instance of /l/ will violate *LatSon and *LatCor. As a result, if a constraint such as Share-F that could create new laterals is ranked below the grammar in (10), no new laterals can be created, although underlying /l/ can survive. In the next section we look more closely at assimilation.

2. 2 Targets of spreading:

Let us assume that assimilation involves a violation of the Ident family of faithfulness constraints, such as Ident-Place, and Ident-Son, under pressure from higher ranked constraints such as Share-F (or Agree) and Syllable Contact. Any assimilation process that creates the ordinary sonorant Coronal lateral [l] from an underlying non-coronal or non-sonorant will thus violate at least one of Ident-Place and Ident-Son (and of course also Ident-Lat). The ranking of these constraints with respect to the constraints causing assimilation, here abbreviated as Assim , will determine which segments may undergo the process. If IdentSon >> Assim, targets must be sonorant. If IdentPlace >> Assim, targets must be Coronal. If the output is always Coronal and sonorant, *LatObs and *LatDors are always high ranked, and *Lat Cor and *LatSon are always low-ranked. The following typology results:

(11) a. Target must be sonorant:
*LatObs, **Ident-Son >> Assim** >>*LatSon
a'. Target need not be sonorant, but output will be:
*LatObs >> **Assim >> Ident-Son**, *LatSon

[4] The fact that /ʟ/ assimilates to a following coronal as in /aʟ-to/ > [alto] 'eastwards' does not demonstrate that it has an underlying Coronal node of its own.

[5] Here I assume that non-laterals, with the possible exception of /r/, are unspecified for laterality underlyingly.

b. Target must be Coronal:
*LATDORS, **IDENT-PLACE >> ASSIM** >> *LATCOR
b'. Target need not be Coronal, but output will be:
*LATDORS >> **ASSIM >> IDENT-PLACE**, *LATCOR

By combining one of the sonorancy rankings with one of the Place rankings, we get the following mini-grammars (with low-ranked *LATCOR and *LATSON omitted for space reasons).

(12) a & b.: Target must be sonorant and Coronal: Flemish, Toba Batak
*LATOBS, *LATDORS, **IDENT-PLACE, IDENT-SON >> ASSIM**
a & b': Target must be sonorant, but need not be Coronal: Selayarese
*LATOBS, *LATDORS, **IDENT-SON >>ASSIM >> IDENT-PLACE**
a' & b: Target must be Coronal, but need not be sonorant: Sanskrit, Yanggu
*LATOBS, *LATDORS, **IDENT-PLACE >> ASSIM >> IDENT-SON**
a' & b': Target need not be Coronal or sonorant, but output will be both: ?
*LATOBS, *LATDORS, **ASSIM >> IDENT-SON**, IDENT-PLACE

Finally, rankings with *LATSON, *LATCOR ranked above ASSIM, (and thus *LATOBS, *LATDORS even higher) would not allow laterality to surface at all on the target, so we would observe either failure of assimilation before laterals (Javanese), or possibly assimilation of other lateral properties, such as voicing (Polish), or coronality (Chukchi), but not laterality.

2.3 Possible outputs of assimilation:
What about the possible outcomes? If *LATDORS, *LATOBS >> ASSIM, the outputs must be coronal sonorants, and this is the most common case. If ASSIM>> *LATDORS, assimilation could create velar laterals. Rather surprisingly, this seems to be unknown, but palatal laterals, which may be thought of as both Coronal and Dorsal, can certainly be created, as in English *welch* [ʎʧ]. Lastly, if ASSIM >> *LATSON, assimilation could create lateral obstruents. I am not aware of such cases, but some reports of failure of assimilation in /t-l/ inputs could perhaps actually be reinterpreted as [t͡l l] outputs, which would be hard to distinguish from simple [tl] clusters. McCarthy (2002) argues that markedness must distinguish between underlying marked segments ('old' markedness) and derived marked segments ('new' markedness). He calls preservation of underlyingly marked segments coupled with failure to tolerate creation of new marked ones the 'grandfather' effect. When a segment is highly marked, like [t͡l], any grammar that creates new instances of this must have 'new' markedness for *LATSON ranked very low. If the language also has no underlying /t͡l /, the grammar has *OLD t͡l >> IDENT, ASSIM >> *NEW t͡l . I will not explore this further here, but see Yip (in press) for more details.

In the rest of this paper I show how this approach deals with a representative subset of the processes in Table I.

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3. How this account deals with a sample of the languages in Table I:
3.1 Does lateral spread : the second row of Table I
3.1.1 Selayarese: When Coronal spreads in Place assimilation, so does [lateral]:
Selayarese has a rule of nasal Place assimilation pictured below. If the trigger is [lateral], the velar nasal becomes not just Coronal but also lateral (Mithun and Basri 1985):

(13) /annaŋ/ *'six'*

anna**[mp]**oke	*'six spears'*
anna**[ñj]**arang	*'six horses'*
anna**[nt]**au	*'six persons'*
anna**[nr]**upa	*'six kinds'*
anna**[l l]**oka	*'six bananas'*

In a feature-geometric analysis, Place spreading spreads all the lower nodes, including Coronal and this drags its subsidiary [ant, distr, lateral] as well. In the approach outlined here, it is an instance of a language where the target must be sonorant, but need not be Coronal, as in (11 a&b'):

(14) *LatObs, ****LatDors, Ident-Son >> Share-F >> Ident-Place , *LatSon**, *LatCor

In order to locate each language within the language typology outlined in §2, here and in the rest of the paper I give a full ranking as in (14), but in the tableaux I show only the most relevant constraints. Not every ranking is motivated by a full tableau, for reasons of space. For example, the high ranking of *LatDors here is motivated by the complete lack of [ʟ] in the inventory of Selayarese, and the high ranking of Ident-Son by the fact that only sonorants can be targets. Lastly, some rankings are posited as universally fixed, such as *LatDors >> *LatCor.

The tableau therefore shows only the crucial constraints: Share-F is violated once for each unshared lateral or Place feature, along the lines of the gradient use of Spread-F in Padgett (2000).

(15)

input: /ŋl/	*LatDors	Share-F	Ident-Place	*LatSon
☞ a. ll			*	**
b. ŋl		**!		*
c. nl		*!	*	*
d. ʟl	*!	*		**

In candidate (d), an illicit Dorsal lateral has been created. In (c) the feature [lateral] is not shared, and in (b) neither Coronal nor [lateral] is shared. In (a) both are shared, so although this violates Ident-Place it is the optimal candidate. Note that for a /tl/ input, Ident-Son >> Share-F will block lateralization.

3.1.2 Chuckhi: Place spreads, but laterals spread only their coronality.

We now turn to a case where Place assimilation does *not* create laterals. The data here come from Chukchi (Clements & Hume 1995:270). Similar facts hold in English intrusive stop formation, and also in Catalan and Yoruba.

(16)

təŋ-əɬʔ-ən	'good' (/tEŋ-/)	ten-leut	'good head'
tam-pera-k	'to look good'	tan-ran	'good house'
tam-vairgin	'good being'	ten-yəɬqət-ək	'to sleep well'
tam-waɣərɣ-ən	'good life'		
tan-tsai	'good tea'		

As in Selayarese, the target is a sonorant. The failure to spread lateral is clearly not due to high-ranked IDENT-PLACE since the input velar nasal *does* become a Coronal nasal. Instead, it seems that new laterals cannot be created by assimilation because of high-ranked *LATSON (or perhaps *LATCOR).

(17) *LATOBS, ***LATDORS >> *LATSON , (***LATCOR **) >> SHARE-F >>IDENT-PLACE**

input: /ŋ-l/	*LATDORS	*LATSON	SHARE-F	IDENT-PLACE
☞ a. nl		*	*	*
b. ŋl		*	**!	
c. ll		**!		*
d. ɭl	*!	**	*	

As before, candidate (d) creates an illicit Dorsal lateral. Now, however, the Coronal [l] in candidate (c) is ruled out by *LATSON. (a) wins out over (b) because it at least shares Place features. One point of clarification might be useful. A reviewer suggests that *LATSON could be replaced by IDENT-LAT here, and in many other cases in this paper. This is not in fact true, for reasons explained at the end of section 2.1.1. IDENT-LAT looks only at underlying instances of [lateral], whereas the *LAT constraint family looks at both old and new cases. To block lateralization of non-laterals, *LAT constraints are essential.

3.1.3 Sanskrit: Sonorant voicing spreads, taking [lateral] with it:
The third case is again one that creates new laterals, like Selayarese, but this time as part of a process that spreads voicing, nasality, and laterality, creating new sonorants. In Sanskrit (Whitney 1889) stops optionally assimilate in nasality to the following segment, (18a), [Whitney: 161], and coronals lateralize, (18b). If the target was a nasal /n/, as in (18c), it lateralizes but stays nasal [Whitney: 65]. Before other voiced segments, as in (18d), obstruents voice.

(18) a. tat namas → tan namas / tad namas
vak me → vaŋ me / vag me
triʂ̪up nunam → triʂ̪um nunam / triʂ̪ub nunam
b. tat labhate → tal labhate
c. trin lokan → triɭ lokan
d. /..k l.../ → [...g l...] No examples, but Whitney:54 is explicit on this point

In a feature-geometric analysis, this process has been analyzed as spreading sonorant voicing, dragging nasality and laterality with it. [6] Empirically, this is problematic, for two reasons: (i) /nl/

[6] Korean has usually been cited as the classic case of this type, but Kang (2002) shows that contra most reports obstruents do NOT usually lateralize, so that han+patʰ+lo > hanpanno 'Hanpat Street', *[hanpallo].

should become *[ll], with no nasalization left on the target (ii) the spreading of obstruent voicing must be separately handled.

Let us assume that this process is triggered by the Syllable Contact Law, as argued by Davis and Shin 1996 for Korean. The unacceptable sequences are those with a rising sonority incline across the syllable boundary: nl, dl, dn, tl, tn, td. These are adjusted to create the best possible syllable contact, but using the available features only: neither nasality nor laterality can be inserted, although they can be spread. There is no need to see the spreading as taking a bundle of features, just whatever is needed to improve syllable contact (cf Padgett 1995). Since the target of lateralization is Coronal but not necessarily sonorant, we have the following grammar, an instance of (11 a' & b). The grammar we need is this: *LATOBS, *LATDORS, IDENT-PLACE, DEPF >> **SYLLCONTACT >>IDENT-SON, *LATSON,** *LATCOR. SYLLCONTACT violations are counted by the number of steps up on the sonority scale between C1 and C2, where the scale is t < d < n < l. The first tableau shows an input with a coronal stop.

(19) Lateralization of coronals

input: /tl/	*LATDORS	DEP-F	SYLLCONTACT	*LATSON
☞ a. ll				**
b. nl		*!	*	*
c. dl			**!	*
d. tl			***!	*

Although not shown in the above tableau, the winner also violates IDENT-SON and *LATCOR (twice), so these must be low-ranked. The language has no lateral obstruents, so *LATOBS must be undominated. The next tableau shows an input with a non-coronal.

(20) Voicing of non-coronals:

input: /kl/	*LATDORS	IDENT-PLACE	DEP-F	SYLLCONTACT	*LATSON
☞ a. gl				**	*
b. kl				***!	*
c. ŋl			*!	*	*
d. ll		*!			**
e. ʟl	*!				**

Not that candidate (a) above does not violate DEP-F, since the underlying [voice] feature of /l/ has simply spread left onto the velar. In the next tableau, I show what happens to an /nl/ input, in which the nasal lateralizes, but remains nasal:

(21) Preservation of nasality is a MAX-F effect:

input: /nl/	MAX-F	DEP-F	SYLLCONTACT	*LATSON
☞ a. l̪l				**
b. ll	*!			**
c. nl			*!	*

Lastly, for a /tn/ input [nn] will win out over [tn] or [dn] by virtue of better satisfying SYLLCONTACT.

3.1.4 Polish: Laterals cause voicing assimilation but not lateralization.

The fourth case, like the second, involves a failure to create new laterals, but this time when voicing spreads from a sonorant to a preceding consonant. The following data show a post-lexical process in Krakow and Posnan Polish (Glowacka, p.c., Madelska et al 1998):

(22) šybax → šyba[ɤ] leśńičufki
trop → tro[b] lisa
brat → bra[d] Doroty / Natalji / Iwony / Luizy 'brother of X'
syn → sy[n] Luizy 'son of Luiza'

Similar facts hold in all dialects between verbal prefixes and roots:

(23) s-kɔnʧɨʨ 'to end' z-biʨ 'to break' z-liʧɨʨ 'to count'

The first thing these facts demonstrate is that voicing in obstruents and sonorants must be handled by the same feature, as discussed in footnote 2. The second thing they show is that if voicing assimilation caused by sonorants involves spreading the SV node, we cannot explain why nasality and laterality do *not* spread.

I assume that voicing assimilation results if IDENT-PLACE >> SHARE-F >> IDENT-VOICE. IDENT-PLACE here can either be construed as a reference to a feature class, following Padgett 2000, or as a shorthand for IDENT-LAB, IDENT-COR, IDENT-DORS etc. See § 4 for more discussion. Here I consider only coronal inputs, starting with /tl/. Candidate (b) in (24) creates an illicit lateral obstruent. Candidate (c) violates IDENT-SON. Candidate (a) with voicing assimilation does better than (d) on SHARE-F.

(24) *LATOBS, **IDENT-SON, *LATSON**, IDENT-PLACE **>> SHARE-F >> IDENT-VOICE**

input: /tl/	*LATOBS	IDENTSON	*LAT-SON	SHARE-F	IDENT-VOICE
☞ a. dl			*	** [lat,son]	*
b. d͡l̪-l	*!		*	* [son]	
c. ll		*!	**		*
d. tl			*	***! [lat, son, voice]	

In the account proposed here, we can again attribute the failure of lateral spread to high-ranked *LATSON. It is the /nl/ inputs below that demonstrate the need for this constraint.

(25)

input: /nl/	*LATOBS	IDENTSON	*LAT-SON	SHARE-F	IDENT-VOICE
☞ a. nl			*	** [lat, nas]	
b. ll			**!		

3.2 Three superficially different targets of spreading:
I now turn to how the proposal handles different targets of spreading. The examples are from the third row of Table I:

3.2.1 Flemish: **Coronal sonorants as target of [lateral] spreading**:
In Teralfene Flemish (Blevins 1994) [lateral] spreads rightwards to Coronal sonorants. Other Coronals appear to be transparent, as in (a), but non-coronals are said to block and not undergo the process, as in (b).

(26)	a. smelt-**n**	smelt**l**	*'to melt'*
	vals-**n**	vals**l**	*'filings'*
	b. elp-n	elpen	*'to help'*
	zwolme	zwoleme	*?*

Blevins' feature geometric analysis says that [lateral] can only spread to adjacent Coronal nodes. Any non-coronal interrupts the adjacency. [-son] segments also accept [lateral], and it is either subsequently delinked, or possibly stays and is present phonetically but not perceived.

I begin with a re-interpretation of the facts. Suppose that the assimilation, like most consonantal assimilations, is a fact about clusters only. Then notice that the examples in (b) that purport to show blocking by non-coronals all surface with a vowel between the lateral and the nasal target, so that they are no longer in a cluster together. I therefore suppose that only vowels block the process.[7].

Given this preamble, the targets of assimilation must be both sonorant and Coronal, so the basic grammar is as follows (an instance of (11 a&b):

(27) *LATOBS, *LATLAB, IDENT-PLACE, IDENT-SON >> SHARE-F >> NOGAP, *LATSON, *LATCOR

Showing only the crucial constraints, the following tableaux demonstrate the rankings. l͡m stands

[7] Lastly, many dialects of this area have a small excrescent or epenthetic vowel between a lateral and a following non-coronal, so that [elpen] is likely to be more like [eləpen] (John Harris, p.c.). In that case laterals are never in a cluster with anything except a following coronal. However, it could be argued that this vowel is only a phonetic side-effect of release, so in what follows I will assume it is absent. Note that these excrescent vowels differ from the [e] in the second syllable of [elpen], which is obligatory, and must be phonologically present

for a labial lateral, a non-existent sound for which there is no IPA symbol! SHARE-F violations are calculated pairwise. For e xample, in [lpl], [l] and [p] differ by two features (Place and lateral), as do [p] and [l], and [l] and [l] do not differ at all, so we assign four stars to [lpl]. The first tableau shows the failure of non-coronals to assimilate.

(28)

input: /lm/	*LATLAB	IDENT-PLACE	SHARE-F
a. l͡lm	*!		*
b. ll		*!	
☞ c. lm			**

Since obstruents are transparent, it appears that targets must also be sonorant, and that gapping is allowed:

(29)

input: /ltn/	*LATOBS	IDENT-SON	SHARE-F	NOGAP
a. l͡tl	*!			
b. lll		*!		
c. ltn			***!	
☞ d. ltl			**	*

In the case of non-coronals sandwiched between two coronals, obligatory epenthesis takes place *after* the non-coronal. My data is insufficient to be sure what causes the epenthesis. Perhaps Place reversals in clusters from Coronal to Labial and back to Coronal are banned, triggering epenthesis, an idea formalized here as *CORLABCOR. In any case, what is crucial in the tableau below is that SHARE-F applies to the [lp] clusters only, so there is no motivation for creating a new lateral from the now solitary [n].

(30)

input: /lpn/	*CORLABCOR	DEP	SHARE-F	*LATSON
a. lpl	*!		****	**
b. lpel		*	**	**!
☞ c. lpen		*	**	*

The final grammar is shown below:

(31) *LATOBS, *LATLAB, IDENT-PLACE, IDENT-SON , *CORLABCOR>> DEP >> SHARE-F >> NOGAP, *LATSON, *LATCOR

3.2.2 Yanggu Chinese: All Coronals as targets of [lateral] association

The data discussed in this section add an extra complication, in that the [lateral] feature is floating, and must acquire its Place from another segment in order to surface. Even so, it can be handled with the tools developed here, with high-ranked *LAT LAB, *LATDORS again being crucial. Yanggu Chinese has a very unusual affix (Yip 1992). It may be rhotic or lateral, or both, surfacing variously as [r, l, R, and l̥], where the last two are retroflexed. All that concerns us here is that the lateral variants only surface in words with surface coronals, and they are attracted to the rightmost coronal. This mobility suggests that [lateral] is a floating feature:

(32)	a. No Coronals:	xou	xour	'monkey'
		pɛ	pɛr	'card, board'
	b. Initial Coronal:	tu	tlur	'rabbit'
		na	nlar	'to press'
	c. Initial and final coronals:	tsʰuən	tsʰuəl̥	'village'

The facts are quite complex: see Yip 1992 and Chen 1992 for full details. Here I stick to the core of the phenomenon. Since the laterals appear to form onset clusters, I start by assuming that clusters must be homorganic, or that SHARE-F holds in clusters. Coda clusters are disallowed by *COMPLEXCODA, and will not be considered here. I also assume that placeless consonants are not allowed, SPECIFYPLACE. Lastly, *LATLAB, *LATDORS are undominated, meaning that laterals must be Coronal. The combination of these means that the [lateral] feature must seek out a Coronal node, and if none is available, it cannot surface. Where there are two Coronal nodes, ALIGN-R selects the right-most. The 'Coronal target' effect is here achieved by *LATLAB, *LATDORS >> MAX-LAT, and is exactly parallel to cases like Flemish where spreading to Coronal targets is achieved by *LATLAB, *LATDORS >> SHARE-F.[8] The full grammar is SHARE-F, *LATLAB, *LATDORS, SPECIFYPLACE >> MAX-LATERAL>> *LATCOR., ALIGN-R. In the first two tableaux final [l] in the output candidates is a placeless lateral

The first tableau shows an input stem with no Coronal segments. SPECIFY-PLACE means that [lat] needs a Place node, and *LATDORS forces it to be Coronal. Candidate (b) below, in which [lat] has no Place node, is thus ruled out. I assume that high-ranked DEP-F (not shown) rules out insertion of new Coronal nodes. The affixal /r/, on the other hand, comes with its own Place features, so candidate (a) satisfies SPECIFY-PLACE.[9]

[8] An alternative to MAX-LAT would be MAX-AFFIX.

[9] There is one outstanding puzzle: why can't the Place node of /r/ host [lat], creating a retroflex lateral, since this is how [lat] surfaces on a stem-final Coronal, as in (36)? It is possible that /r/ is [-lat] underlyingly, but I leave this question for future research.

(33) Failure to surface in the absence of Coronals

input: /xou-r[lat]/	SHARE-F	*LATDORS	SPECIFY PLACE	MAX-LAT
☞ a. xour				*
b. xoul			*!	
c. xʟour		*!		
d. xlour	*!			

If the input has a coronal node, [lat] seeks it out to satisfy SPECIFYPLACE, as shown below.

(34) Attraction to Coronal nodes

input: /na-r[lat]/	SHARE-F	*LATDORS	SPECIFY PLACE	MAX-LAT	*LAT COR	ALIGN-R
☞ a. nlar					*	*
b. nar				*!		
c. nal			*!			

Where there are two Coronal nodes, the rightmost wins, and here the final [l] at last has a Place node of its own, and can surface at the right edge.

(35) Preference for right-most coronal

input: /tsʰuən -r[lat]/	SHARE-F	*LATDORS	SPECIFY PLACE	MAX-LAT	*LATCOR	ALIGN-R
☞ a. tsʰuəl̥					*	
b. tsʰluər					*	*!
c. tsʰuər				*!		

3.2.3 Tahltan: **Harmony that targets Coronals ignores [lateral] affricates** :
The next case is one where lateral segments fail to undergo a harmony that otherwise targets coronals. Tahltan (Shaw 1991) has five series of coronals, shown here by their voiced affricate members : d, dl, dð, dz, dʒ. At each place of articulation, there are voiced/voiceless and glottalized as in [dz, ts, ts']. At the last four places, there also voiced and voiceless fricatives, as in [z, s]. Within a word, the last three series harmonize with the rightmost participant. In the following data, the first-dual subject prefix /θi(d)/ stays [θ] before non-coronals or the /d/ and /θ/ series, but becomes [s] before the /dz/ series, and /ʃ/ before the /dʒ/ series:

(36) θi:tθædi 'we ate it'

ni-s̲i-t'a:ts 'we got up'
u-ʃidʒɛ 'we are called'

The lateral /dl/ series are not triggers or targets, and are transparent: naθ̲iba:tɬ 'we hung it'

My proposal here is extremely simple. The failure of the lateral series to participate in harmony results from high-ranked *LAT >> SHARE-F. Since all the other series are non-lateral, they are free to harmonize. *LAT here is shorthand for *LATOBS, *LATSON, *LATDORS and *LATCOR. Note that underlying laterals will still survive, if IDENT-LAT >> *LAT.

(37) Harmony with /s/

input: /θi-s/	*LAT	SHARE-F
a.θi-s		*!
☞ b. si-s		

(38) No harmony with /l/

input: /θi-l/	*LAT	SHARE-F
☞ a. θi-l		*
b. li-l	*!	

This suggestion has one drawback (Clements, p.c.). It predicts the possibility of a system in which one of the other features resists change as the result of high-ranked *ANTERIOR or *DISTRIBUTED. In the former case, [θ] and [s] could harmonize, since both are [anterior] and only the feature [distributed] would change, but [š] could not. In the latter case, [s] would be the one left out. I know of no cases that fit either description, although to make the point one needs a language with the three-way contrast between /θ, s, š/, and consonant harmony, a rare combination. See Gafos (1996) for a useful survey of coronal harmony systems, and a rather different view as to the spreading feature..

3.2.4 Toba Batak: [Sonorant Voice] as the target of lateral spreading:

One of the classic cases that has been used to argue the case for [lateral] being under an SV node is Toba Batak (Hayes 1986). Coronal sonorants assimilate to a following liquid:

(39)

Spreading	*No change*
nr → rr	ln, rn, lr
nl → ll	mr, ml, ŋl, ŋr
rl → ll	rr, ll, nn.

The target conditions are thus identical to the Teralfene Flemish case, and the same basic grammar (an instance of (11a&b)) suffices:[10]

[10] The assimilation here may be caused by the Syllable Contact Law, not SHARE-F, except for the fact that /lr/ is unchanged.

(40) *LatObs, ***LatDors, Ident-Place, Ident-Son >> Share-F,*** *LatSon, *LatCor

input: /nl	*LatDors	Ident-Place	Ident-son	Share-F
a. ll				
☞ b. nl				**!

(41) Only Coronals lateralize

input: /ŋl/	*LatDors	Ident-Place	Ident-son	Share-F
☞ a. ŋl				***
b. ll		*!		
c. ʟl	*!			*

(42) Only sonorants lateralize

input: /tl/	*LatObs	Ident-Place	Ident-son	Share-F
☞ a. tl				**
b. tl-l	*!			0
c. ll			*!	

3.3 Laterals as targets

The cases above have concerned the behaviour of lateral as the trigger of some process, but the complete picture requires us to understand their behaviour as targets, and in particular whether laterality survives or is lost. For reasons of space the full set of cases cannot be covered here, so I will just sketch the problem and proposal. In a fixed feature geometry, if a superordinate node is eliminated by spreading of a neighbouring node, [lateral] should be lost. So if [lateral] is under Coronal, it should be lost under Place assimilation. However, Row four of Table I shows cases where laterals as the target of rules that spread Place or voicing may or may not keep their laterality, as in English where /l/ assimilates to a following dental, but without ceasing to be lateral: we[l̪θ] *'wealth'* Similarly, if a superordinate node is lost by some process like debuccalization in coda position, [lateral] should be lost. However, Row five shows that when place or voicing contrasts are neutralized for such reasons, laterality may or may not survive. Caribbean Spanish allows only velars in coda position, so that /tren/ → treŋ 'train', but laterals survive: /tonel/ = [tonel] 'barrel'.

The core of an OT account is that if IdentLat is ranked above whatever causes neutralization, laterality will survive. In the case of spreading, we have Ident-Lat >> Share-F, and in the case of neutralization due to place markedness, we have Ident-Lat >> *Coronal. The full details are worked out in Yip (in prep.)

4. Conclusions

I have argued that traditional universal feature geometry is too rigid to handle variation like that seen with laterals. It is a desirable property of OT that it allows for cross-linguistic variation in affinities

between features, while also expressing universal preferences as fixed rankings of constraints governing feature-combinations. These fixed rankings are grounded in phonetic dictates. The preference for Coronal laterals is the phonologization of the articulatory fact that lateral release is most readily produced with the blade of the tongue not the dorsum or the lips. The preference for voiced sonorant laterals is the phonologization of the fact that in a laterally released sound the airflow is never obstructed enough to hinder spontaneous voicing.

The need for admitting this sort of variation makes any attempt to incorporate a fixed feature geometry into OT a retrograde step. It is also unnecessary: the advantages of feature geometrical theories can be achieved by constraints on feature co-occurrence, along the lines of Padgett (1995, 2000). The arguments for representational approaches to feature combinatorics are rendered moot.

The arguments here have been based entirely on the feature [lateral], but what of other features? Variable behaviour might be seen whenever the features are most readily produced on a certain type of segment, but can nonetheless be produced on other sounds too. For example, [strident] sounds, in which the turbulence produced at the point of constriction is sufficiently strong, and/or where the ensuing airstream then hits a sharp obstacle like the teeth, is easy to produce with the tip or blade of the tongue, but hard to produce elsewhere. We derive from this a constraint hierarchy *[Labial, strident] >> *[Coronal, strident]. Languages which contrast [f] and [ɸ], like Ewe, arguably violate the former as well as the latter. Turbulent airflow also requires a period of incomplete closure, or continuancy, so we also derive *[-cont, strident] >> *[+cont, strident]. Languages that violate the former have strident affricates, which have often been argued to be strident stops (see Lin, this volume, and references therein). In principle, then, the interactions of these constraints might also produce comparable variation to that we have seen with laterals.

For other features, no such variation is to be expected. [anterior] and [distributed] refine the type of contact the tip or blade of the tongue makes with the roof of the mouth. As such they can only be present in Coronals, and a sound that is [Dorsal, +ant] is phonetically uninterpretable.

The approach taken here is in many ways close to that of Padgett (2000), but there are two differences. First, Padgett uses feature classes, sets of features such as Place, which is defined as the union of the sets Pharyngeal and Oral, where Oral is in turn the union of Labial, Coronal, Dorsal, and V-Place, and V-Place in turn is the union of Height and Color. Lateral is not mentioned in Padgett's paper. I have tried to demonstrate here that even feature classes can be dispensed with. Second, Padgett says explicitly (2000: 99) that feature classes do not overlap, which in our context means that [lateral] cannot be a member both of Place and SV, contra Yip (1990). It is difficult to see how the variable behaviour of [lateral] can be captured if this latter stipulation is maintained, so it would probably be necessary in his approach to loosen the grammar such that the SINGLE MOTHER NODE CONDITION which bans feature class overlap is a violable constraint.

If one accepts the case made here against a fixed feature geometry, one might ask whether all representational restraints might be relaxed at the level of GEN, so that anything is a possible candidate. The answer is unclear. Consider the prosodic hierarchy. Although moras are usually grouped into syllables before joining any higher level constituent, there are cases where this has been argued not to be the case, such as Bella Coola (Bagemihl 1991). The constraint that forces moras to be parsed into syllables may thus be extremely low-ranked in this language, and should arguably not be part of GEN. On the other hand *reversals* of the hierarchy are presumably not found: it is hard to envisage a language in which syllables dominate feet, instead of vice-versa, suggesting that this may be located in GEN. I suspect, however, that this data gap is more apparent than real. The terms mora, syllable, and foot, are just labels for levels in the hierarchy, and could equally well be stated in numerical terms. So really all we are saying is that level n is normally directly parsed into level n+1, and that this constraint seems to be usually high-ranked, but by no means always surface true. It is

in fact frequently violated in languages which do not allow degenerate feet, for example, and where the stray syllables (level n) are then directly dominated by the prosodic word (level n+2). A more complex case is presented by languages in which moraic feet could potentially break up syllables, so that a bi-moraic foot would be composed of a monomoraic syllable, plus the first mora of a heavy syllable. The undesirability of this configuration has been dubbed Syllable Integrity, and if this is a universal, then it must somehow be incorporated into GEN. Resolution of these issues is beyond the scope of this paper.

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