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Consonant-Vowel Place Feature Interactions

Jaye Padgett

1. Introduction

Both consonants and vowels are formed with constrictions in the oral cavity, made by the lips, the tongue blade, the tongue body, and/or the tongue root. Since they make demands on the same organs, it should not be surprising that the place features of consonants can influence those of vowels or vice versa. Indeed such interactions are common: consonants and vowels frequently assimilate in place to one another, or dissimilate. But the empirical territory is not simple, and attempts to understand consonant-vowel place interactions (henceforth "C-V interactions") have led to much unresolved debate in phonological theory.

The questions most debated have had to do with the nature of the phonological features we assume, with questions of feature structure, and with claims about the locality of phonological processes. However, as the field of phonology gravitated toward questions of constraint interaction under the influence of Optimality Theory (Prince & Smolensky 1993 [2004]), attention toward these representational questions faded, without having been resolved. Whatever the theoretical framework, though, the empirical puzzles underlying the debate about C-V interactions remain, and remain interesting.

The discussion in this chapter will necessarily reflect the open-endedness of the historical discussion, as well as the framework in which that discussion was held – autosegmental phonology and feature geometry. Section 2 begins by presenting a typology of C-V interactions. Section 3 presents an influential model of feature geometry as a point of departure and discusses the challenges raised for that model by C-V interactions. Section 4 discusses a prominent approach to these challenges, a "unified feature" approach to consonants and vowels advocated by Clements (1991), Herzallah (1990), Hume (1994, 1996), Clements and Hume (1995), and others. In section 5 we pause to discuss issues of locality and transparency in C-V interactions. Section 6 discusses an alternative to the unified feature approach, due to Ní Chiosáin and Padgett (1993) and Flemming (1995 [2002]; 2003), called the "inherent vowel place" approach here. Section 6 concludes.

2. A Typology of C-V Interactions

The typology given here is not meant as an exhaustive survey of the kinds of C-V interaction known. Instead the goal is to classify processes according to the challenges they have presented for phonological theory. In particular, a key distinction will be made between "within-category" C-V interactions and "cross-category" C-V interactions.[1] Also, for space reasons the main focus will be on assimilations, with only occasional reference made to dissimilatory cases.

[1] These terms are borrowed from Clements (1991). Compare the "Type I" vs. "Type II" distinction of Ní Chiosáin and Padgett (1993).

2.1. Within-Category Interactions

It may seem incoherent to posit “within-category” interactions between the distinct categories of consonant and vowel. However, it is well known that consonants can have secondary articulations that are essentially vocalic in nature: vowel- or glide-like gestures, produced along with a consonant’s primary place of articulation. Some representative examples are illustrated in (1).[2]

(1) (Semi-)vocalic secondary articulations

labialization	palatalization	velarization	pharyngealization
tʷ	tʲ	tˠ	tˤ

Indeed, glides themselves are consonants with vocalic properties. “Within-category” interactions are those between a vowel and another (semi)-vocalic element, whether the latter is a secondary articulation or a primary one (a glide).

Let us begin with interactions between vowels and glides. The examples in (2) are from Kabardian (Colarusso 1992:32-3). Kabardian has a ‘vertical’ vowel system arguably consisting of only the two phonemes /ə,a/. These vowels assimilate in backness and roundness to a following coda glide. According to Colarusso, the triggering glide is elided in all but careful speech, with some compensatory lengthening (not shown). Effects like this of glides on vowels, affecting either vowel *color* (backness and/or roundness) or height, seem common in languages.

(2)	/q’əw/	[q’uw]	‘swan’	/bəj/	[bij]	‘enemy’
	/psaw/	[psow]	‘alive’	/t͡saj/	[t͡sej]	‘one of wool (kind of coat)’

Turning to vocalic secondary articulations, non-low short vowels in Irish are front before palatalized consonants and back before non-palatalized consonants; the latter are velarized. The symbols “I/E” denote underlying high and mid vowels (resp.) of indeterminate backness.

(3)	/mˠIdʲ/	[mˠɪdʲ]	‘we/us’	/pˠIntˠ/	[pˠʊntˠ]	‘pound’
	/sʲIvʲ/	[ʃɪvʲ]	‘you (pl.)’	/skʲIbˠ/	[skʲʊbˠ]	‘snatch’
	/tˠEtʲ/	[tˠɛtʲ]	‘smoke’	/bˠEsˠ/	[bˠʌsˠ]	‘palm (of hand)’
	/tʲEpʲ/	[tʲɛpʲ]	‘fail’	/lʲEmˠ/	[lʲʌmˠ]	‘with me’

Similarly, labialized consonants can cause a neighboring vowel to be round, as in Kabardian /dəʁʷ/ → [doʁʷ] ‘thief’ (Colarusso 1992:30). In a case involving pharyngealization (or

[2] This presentation simplifies reality in some ways. For example, sounds transcribed Cʷ or Cˠ might be labio-velarized and not just labialized or velarized. In addition, “pharyngealized” sounds are more accurately described as “uvularized” in at least some cases (McCarthy 1994).

uvularization, see note 2), emphatic consonants in Palestinian Arabic cause /a/ to ablaut to [u] instead of [i] in first measure imperfect verbs (Herzallah 1990): the imperfect form of [naðˤam] 'compose' is [ji-nðˤum] rather than expected *[ji-nðˤim] (cf. [katab], [ji-ktib] 'write'). Herzallah argues that secondary pharyngealization involves a component of backness that spreads to the vowel in these cases. In a more typical case of emphasis spread, vowels in Ayt Seghrouchen Tamazight Berber are backed and lowered next to emphatic consonants (Rose 1996), as shown in (4). Rose argues that emphasis spread is the spreading of the feature [RTR] ([Retracted Tongue Root]).

(4)	a.	[izi]	'fly'	b.	/izˤi/	[ezˤe]	'bladder'
		[llef]	'to divorce'		/tˤtˤef/	[tˤtˤɛf]	'to hold'
		[nðu]	'to be shaken'		/nðˤu/	[nðˤo]	'to cross'

Consonants commonly acquire vocalic secondary articulations by assimilating to adjacent vowels. For example, Russian consonants are palatalized before certain suffixes beginning in [i] or [e] (Padgett to appear):

(5)	Nom.sg.	Dim.nom.sg.	Loc.sg.	
	stol	stolʲik	stolʲe	'table'
	dom	domʲik	domʲe	'house'
	ʂar	ʂarʲik	ʂarʲe	'ball'
	zont	zontʲik	zontʲe	'umbrella'

A similar palatalization occurs in Nupe (Hyman 1970). Also in Nupe, consonants are rounded (or labiovelarized) before rounded vowels, e.g., [egʷũ] and [egʷo] for /egũ/ 'mud' and /ego/ 'grass' (respectively, tones not shown).

It is worth noting that the examples of within-category assimilation presented above never involve a vowel changing the features of a glide or of a consonant's secondary articulation. Such cases seem at best rare, but it is not clear why that should be.

Again, what all within-category interactions have in common is interaction among overtly (semi-)vocalic elements. Glides are [-consonantal] in the feature theory of the Sound Pattern of English (SPE, Chomsky & Halle 1968). Vocalic secondary articulations are likewise basically vocalic in constriction degree, even if they accompany primary constrictions that are [+consonantal]. For reasons that will become clear below, C-V interactions of this sort have created little controversy in phonological theory. This is in contrast to C-V interactions in which the *primary* articulation of a [+consonantal] segment appears to interact with a vowel's place, cases called "cross-category" here.

2.2. Cross-Category Interactions

Numerous cases are known in which plain (not rounded) labial consonants cause vowels to be round. This happens, for example, in a dialect of Mapila Malayalam described by Bright

(1972).[3] In this dialect, a vowel is inserted for apparently phonotactic reasons. The vowel is generally something like [ɨ] (not a phoneme of the language), as shown in (6)a; but it surfaces as [u] after [o] or [u] ((6)b) or after a labial consonant ((6)c). The rule is productive, applying even in borrowings like [trippu].

(6)	a.	paːlɨ	'milk'	b.	onnu	'one'	c.	caːvu	'death'
		pandɨ	'shake'		nuːru	'hundred'		jappu	'pound'
		kurvaːnɨ	'Koran'		unnu	'dine!'		islaːmu	'Islam'
		dressɨ	'dress'		oːɖu	'run!'		trippu	'trip'

Another well known case occurs in Turkish (Lees 1961; Lightner 1972). Within historically native Turkish roots, a high vowel following [a] and any intervening consonants is normally [ɨ] (sometimes transcribed [ɯ]). But it is [u] when a labial consonant intervenes, e.g., *yavru* 'cub, chick', *armud* 'pear'. Cross-category dissimilations also occur. For example, in Cantonese a syllable rhyme cannot have both a rounded vowel and a labial coda, e.g., *[up] (Cheng 1991). Other languages showing C-V interactions involving vowel rounding and plain labial consonants are discussed by Hyman (1973), Campbell (1974), Sagey (1986), Clements (1991), Selkirk (1993), Flemming (1995 [2002]), and Anttila (2002).

There seems to be a similar connection between coronal place of articulation and front vowels. A frequently cited example comes from Maltese Arabic (Brame 1972; Hume 1994; 1996). In imperfective Measure I verbs, the prefix vowel is normally identical to the vowel of the stem, as shown in (7)a. However, when the stem begins with a coronal obstruent, the prefix vowel is [i], (7)b. Note that some of the verbs in (7)b undergo an independently existing ablaut by which the imperfective stem vowel becomes [o]; this occurs in verbs without initial coronal obstruents too, e.g. [barad] vs. [jo-brod] 'to file'. In these verbs the prefix vowel is normally [o].

(7)		Perfective	Imperfective		
	a.	kotor	jo-ktor	'to increase'	
		ʔasam	ja-ʔsam	'to break'	
		ħeles	je-ħles	'to set free'	
		nizel	ji-nzel	'to descend'	UR = /nizil/

[3] Bright relies on Upadhyaya (1968) for data. The Mapila Malayalam (MM) data resemble the more often-cited Tulu facts also discussed by Bright; in fact, Bright suggests that the MM facts are due to contact with Tulu.

b.	daħal	ji-dħol	'to enter'
	talab	ji-tlob	'to pray'
	seħet	ji-sħet	'to curse'
	d͡ʒabar	ji-d͡ʒbor	'to collect'

Hume (1994, 1996) treats the general vowel copy as a case of feature stability: when the first vowel of the imperfective stem is deleted (by a normal syncope rule), its vowel place features surface on the underlyingly featureless prefix vowel. In (7)b, however, a rule applies by which the prefix vowel acquires its frontness from a coronal obstruent; this rule takes precedence over the feature stability rule.

In another widely cited case, non-low vowels in Cantonese must be front when between coronal consonants (Cheng 1991); next to [tit] 'iron' and [tøn] 'a shield' there are no forms like *[tut] or *[ton]. Similarly in Kabardian the vowels /a/ and /ə/ are allophonically fronted before coronal consonants, e.g., /ʃəd/ 'donkey' and /zaz/ 'bile' become [ʃɛd] and [zæz] respectively (Colarusso 1992:30). Discussion of other cases can be found in Clements (1976; 1991), Hume (1994) and Flemming (1995 [2002]; 2003).

Dorsal consonants can trigger backing of vowels. This is clearly true when the consonants in question are uvular, analyzed by many as having a [pharyngeal] (Herzallah 1990; McCarthy 1994) or [RTR] (Rose 1996) component to their place of articulation, as well as a [dorsal] one. In fact, uvulars, which are [+back, -high] in the SPE framework, can trigger backing and/or lowering. The data in (8) from Greenlandic Eskimo are taken from Buckley (2000), who cites Schultz-Lorentzen (1945) and Fortesciu (1984). The high vowels seen in (8)b are lowered to mid before either of the language's uvular segments [q] or [ʀ], (8)a. This is an allophonic change, since the vowel phonemes of Greenlandic Eskimo are /i,u,a/. According to Rischel (1974), this rule involves retraction as well as (or even more than) lowering, though this is not obvious from the transcriptions. As Elorrieta (1992) notes, this is consistent with the notion that uvulars are pharyngealized dorsal consonants.

(8)	a.	seʀmɛ-q	'glacier'	b.	seʀmi-t	'glaciers'
		ikɛ-ʀput	'our wound'		iki-t	'your wound'
		uvdlɔ-q	'day'		uvdlu-t	'days'

In Kabardian the phonemes /ə,a/ are backed before uvulars, e.g., /baq/ → [bɑq^{h}] 'cow shed' (Colarusso 1992:30).[4]

Velar consonants, which are also [dorsal], can also cause backing, and/or raising. One example is from Maxakalí (Gudschinsky et al. 1970; Clements 1991). Tautosyllabic VC sequences tend to display an excrescent vowel which either replaces the consonant or forms a transition from vowel to consonant, depending on aspects of the environment. The place of this excrescent vowel depends on the place of the consonant. As shown in (9)a, that

[4] Colarusso states that backing affects /ə/ also, and his rule predicts [ɤ], but he transcribes [ə].

vowel is /ə/ before alveolars.[5] But it is a high back vowel before velars, (9)b. (The vowel is also [i] before “alveo-palatals” and something like [ʌ] before labials.)

(9)	a.	/mit/	[mbijə̲tˀ]	‘sound of a jaguar’s footsteps’
		/kot nak/	[kowə̲ daɯ̆x]	‘dry manioc’
	b.	/noʔok/	[ndoʔoɯ̲̆x]	‘to wave (something)’
		/kɯcakkɯk/	[kɯʃaɯ̲kɯx]	‘capybara (species of rodent)’

If Clements (1991) is right that [ə] represents the basic quality of the excrescent vowel, then [k] (and also [ŋ]) seem to cause it to raise and back. Similarly, in Yoruba, certain *i*-initial nouns show the /i/ backing to [u] when a velar precedes. This occurs in a reduplicative context, e.g., /ki + isɔ/ → [isɔku̲sɔ] ‘saying; foolish/loose talk’ (Pulleyblank 1988:245-6, tones omitted). Other cross-category cases involving velars are discussed in Ní Chiosáin and Padgett (1993), Clements and Hume (1995), and references therein.[6]

Finally, pharyngeal consonants often cause vowels to lower and back, particularly to [a]. In fact, this can be a property of all “guttural” consonants – uvulars, pharyngeals, and (for some languages) laryngeals – which can all be analyzed as having a [pharyngeal] component to their place of articulation (McCarthy 1994). The examples in (10), taken from Rose (1996), who cites Cowell (1964), are from Syrian Arabic. The feminine suffix /-e/, seen in (10)a, is realized as [a] after gutturals, (10)b.

(10)	a.	daraʒ-e	‘step’	b.	waːʒh-a	‘display’
		ʃerk-e	‘society’		mniːħ-a	‘good’
		madras-e	‘school’		daggaːʀ-a	‘tanning’

The examples of cross-category assimilation discussed so far involve consonants affecting vowels. A striking fact is that consonant-to-vowel cross-category assimilations are notably missing (Ní Chiosáin and Padgett 1993). The one clear exception to this claim is the case of palatalizing mutations. As many have noted (e.g., Clements 1976; Mester & Itô 1989), front vowels, especially higher ones, often trigger mutations of velars or dentals/alveolars to palato-alveolar (or a similar) place of articulation. Hume (1996) cites a case of velar mutation in Slovak (Rubach 1993) by which /k,g,x,ɣ/ become [t͡ʃ,d͡ʒ,ʃ,ʒ] respectively before any of [j,i,e,æ]:

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[5] The relevant excrescent vowel is underlined. Along with the excrescent vowel a preceding glide can appear. A breve indicates the vowel is non-syllabic. Gudschinsky et al. actually indicate a good deal of variation in these excrescent vowel qualities.

[6] Some researchers have suggested that cross-category assimilations of vowels to velars like these are unexpectedly rare compared to cases involving labial or coronal consonants (Ihiunu & Kenstowicz 1994; Flemming 1995 [2002]). This seems possible, but no comprehensive comparative survey has been done. Flemming’s claim that they do not exist at all seems too strong.

(11)	a.	vnuk	‘grandson’	c.	t͡sveng	‘sound’
		vnut͡ʃik	(dim.)		t͡svend͡ʒatʲ	‘to sound’[7]
	c.	strax	‘fright’	d.	boɣ	‘god’
		straʃitʲ	‘frighten’		boʒe	(voc.)

Such cases are common, and they clearly involve assimilation of a velar consonant to a front vowel. The existence of these cases might lead us to expect equally frequent assimilations to round vowels such as /ku/ → [pu], or assimilations to [a] such as /fa/ → [ħa]. But assimilations like these, or the many others that can be imagined if vowels can cause place assimilation of a consonant, are glaringly absent.[8]

Apart from this asymmetry, another interesting fact about cross-category assimilations should be noted. Compared to within-category assimilations, they seem “weak”, in several respects. First, they appear to be much less frequent. This seems especially clear if we compare within-category effects in which a consonant’s secondary articulation affects a vowel to cross-category effects in which a consonant’s *primary* articulation affects a vowel, e.g., /kʷɨ/ → [kʷu] vs. /pɨ/ → [pu]. If we keep in mind that consonants with secondary articulations occur in a minority of languages while *all* languages have plain consonants (see, e.g., Maddieson 1984), the difference is very striking. The seeming exception to this generalization involves gutturals, which when present in a language, seem likely to trigger assimilation of a vowel (McCarthy 1994; Rose 1996).

Second, cases in which a consonant’s primary place takes precedence over its secondary place in determining a vowel’s place features, e.g., /pʲɨ/ → [pʲu], seem nonexistent (Ní Chiosáin & Padgett 1993; Flemming 1995 [2002]; 2003).

Third, cross-category effects often seem to involve vowels that are “underspecified” in the sense of being either epenthetic, reduplicative, or central. The case of Mapila Malayalam is typical: the vowel [ɨ] is not one of the language’s phonemes /i,e,a,o,u/, it is predictably inserted, and it is central. Central vowels (whether predictable or not) are often hypothesized to lack specification to some degree, whether phonetically (Browman & Goldstein 1992) or phonologically (Kaye et al. 1985; Clements 1991; Lombardi 2003). That cross-category effects often seem linked to central and epenthetic vowels suggests that they often can be feature-filling, but not feature changing.

Fourth, cross-category effects generally seem to be highly local: the consonant and vowel must be immediately adjacent or nearly so. Though some within-category effects seem to have this property too (e.g., rounding or palatalization of consonants by vowels), some clearly do not. For example, consonants can dissimilate across vowels, and yet cross-category dissimilations are local.

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[7] The triggering vowel is assumed to be/æ/ which backs later in the derivation.

[8] Some apparent counterexamples are discussed below and in Ní Chiosáin and Padgett (1993).

Finally, some cross-category effects seem to need "ganging up" in order to obtain. In the case of Cantonese vowel fronting mentioned above, the vowel must be *surrounded* by coronals in order to undergo the rule. In Feʔ-feʔ-Bamileke, a labial consonant causes an adjacent reduplicating vowel to be round, but only when a round vowel is also present; likewise, a coronal consonant causes it to be front only when a front vowel is also present (Hyman 1972).[9]

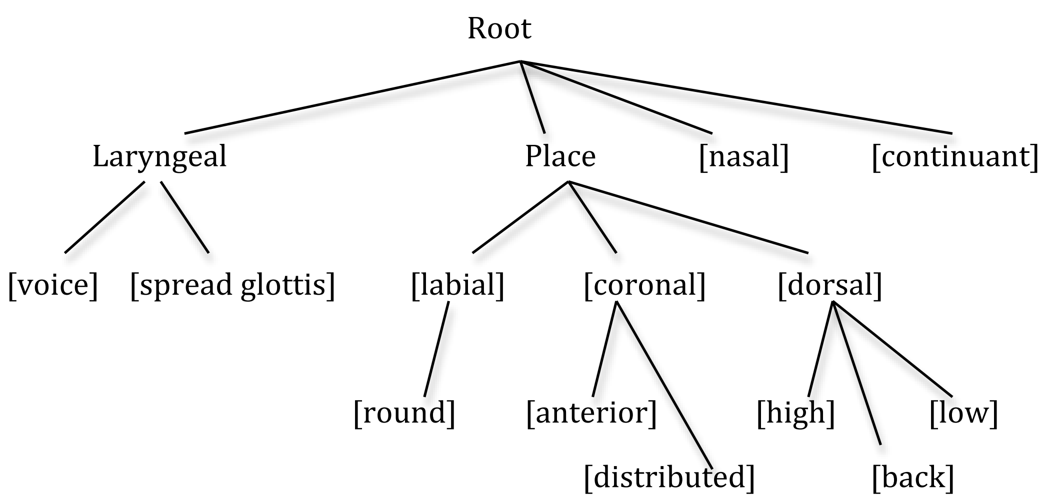
These facts about cross-category effects, suggesting that they are in some sense "weak", should arguably follow from any account of them.

3. C-V Interactions and Feature Theory

Research on C-V interactions became particularly active within the context of the development of feature geometry theory. This article assumes a basic familiarity with the workings of autosegmental phonology and feature geometry. (See chapter 130.)

A good starting point for our discussion is a feature geometry representation based on the influential work of Sagey (1986) with some modifications suggested by McCarthy (1988), shown in (12) (some details omitted).

(12) Feature Geometry



Focusing on the place of articulation features, one notable property of Sagey's model is its basis in active articulators of the vocal tract: [labial], involving the lips, [coronal], involving the tongue tip and/or blade, and [dorsal], involving the tongue body. In its grounding in articulation the model is in the tradition of SPE. However, Sagey's model departs from SPE in various respects, including in holding that the articulator nodes [labial], [coronal], and

9 If the neighboring vowel is high, it is sufficient to cause the change. Otherwise the vowel and consonant together cause it.

[dorsal] are privative, and that they are organizational nodes in feature geometry, as shown in (12).[10]

As Sagey argues, an advantage of an articulator-based model like this is that it easily represents complex segments – segments that have more than one place of articulation, such as [g͡b]. In SPE, by comparison, velars are [-anterior, -coronal] and labials are [+anterior, -coronal]. In such a system it is unclear how to specify a segment that is both labial and velar. This point is relevant to us, since consonants bearing vocalic secondary articulations are complex segments. For example, in Sagey's terms the segments [t^w] and [t^j] are represented as in (13)a-b, focusing only on place features.[11] Vowels are specified in terms of the features in (12) also and are often complex segments themselves. The vowels [u] and [i] for instance, are specified as in (13)c-d. The representation in (13)d assumes that [i] has an active lip spreading gesture, which requires involvement of the lips. Since all vowels are specified for tongue body features, all vowels have a [dorsal] specification.

(13)
a. [t^w]
Place
/ \
[labial] [coronal]
| |
[+rnd] [+ant]

b. [t^j]
Place
/ \
[coronal] [dorsal]
| |
[+ant] [-back]

c. [u]
Place
/ \
[labial] [dorsal]
| |
[+rnd] [+back]

d. [i]
Place
/ \
[labial] [dorsal]
| |
[-rnd] [-back]

To give a more complete understanding of this feature system, the table in (14) shows place specifications for plain, palatalized, and rounded consonants of all three major places of articulation and for five representative vowels. The symbol '✓' indicates specification of a privative (major) place feature. In this theory, specification of a feature such as [round] or [back] is possible only if the relevant major place – here, [labial] or [dorsal] respectively – is specified. Otherwise full feature specification is assumed for the sake of discussion. For our purposes what is particularly worth noticing is the disjointedness of the consonantal vs. vocalic place specifications. Unless they are labialized or palatalized, coronal consonants have nothing in common with vowels. Plain labials are like rounded vowels in having a [labial] specification – but not in being rounded. The exception to this disjointedness is with [dorsal] consonants, which following SPE are specified for vocalic tongue body

[10] For Sagey they are privative because they are *class nodes* rather than features. Like Clements (1991) and others, I understand them as features and assume features can be dependent on other features.

[11] Some features are omitted for simplicity, including [distributed], [high], and [low]. [t^w] is understood as labialized, not labiovelarized.

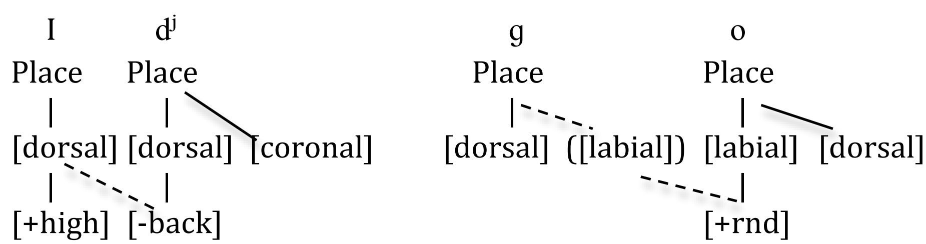
features. This is in fact how velars are distinguished from uvulars ([-high, -low]) and pharyngeals ([-high, +low]).

(14) Feature specifications (Sagey 1986)

		p	pʲ	pʷ	t̪	t̪ʲ	t̪ʷ	k	kʲ	kʷ	i	y	a	o	u
[labial]		✓	✓	✓			✓			✓	✓	✓		✓	✓
	[round]	-	-	+			+			+	-	+		+	+
[coronal]					✓	✓	✓								
	[anterior]				+	+	+								
	[distributed]				+	+	+								
[dorsal]			✓			✓		✓	✓	✓	✓	✓	✓	✓	✓
	[high]		+			+		+	+	+	+	+	-	-	+
	[low]		-			-		-	-	-	-	-	+	-	-
	[back]		-			-		+	-	+	-	-	+	+	+

Within such a model, many within-tier interactions are straightforward to represent. For example, the dependence in Irish of a short vowel's backness on the following consonant (see (3)) is an assimilation as shown in (15)a.[12] The assimilation of a plain consonant to a round vowel, as in Nupe [egʷo] 'grass', is as in (15)b. (The rule spreads [+round], and [labial] is inserted on the consonant by Node Interpolation (Sagey 1986). Alternatively, [labial] spreads to the consonant.) Apart from the advantages of an articulator-based representation, it is not the particular geometry assumed here that makes within-category effects easy to represent. The point is that vowels, glides, and (semi-)vocalic secondary articulations on consonants are assumed to employ the very same set of place features. If that is true, then whatever the geometry, there is no (at least general) difficulty in representing within-category processes.

(15) a. /mˠIdʲ/ → [mˠɪdʲ]   b. /ego/ → [egʷo]



Compare the situation with cross-category assimilations. Recall that in Mapila Malayalam the vowel /ɨ/ is rounded after a plain labial consonant (see (6)). Since it is a plain (not labialized) labial consonant in question, it cannot be specified [+round]. Whether the consonant is specified [-round] or unspecified for [round], spreading [labial] as in (16)a will not cause the vowel to round. In the case of Maltese Arabic (see (7)), the problem seems even worse. The feature [-back] needed to achieve [i] is no part of the representation

[12] Irrelevant detail will often be omitted in representations shown.

of a coronal consonant.[13] Spreading [coronal], the only seeming option, is of no help. The issue once again is not about the feature geometry pursued. The problem is that the place features that are assumed to define consonantal place are largely disjoint from those assumed to define vocalic place. There is therefore no straightforward way to explain why plain consonants can affect vowels in this way.

(16) a. /jappɨ/ → [jappu] ??

p ɨ
Place Place
| - - - - - - |
[labial] [dorsal]
|
([-rnd])

b. /jV-tlob/ → [ji-tlob] ??

V t
Place Place
| - - - - - - |
[dorsal] [coronal]

This problem of disjoint place features for consonants and vowels had been noted for some time. For example, before the advent of autosegmental phonology or feature geometry, Campbell (1974) and Clements (1976) had pointed out the problem for the SPE feature theory of processes like those of Mapila Malayalam and Maltese respectively. Campbell noted the lack of connection between the features [labial] and [round], and Clements did the same for [coronal] and [back]. By comparison, cross-category effects involving [dorsal] consonants make sense in the feature theory of SPE/Sagey (1986), because such consonants are specified for [high], [low], and [back]. For example, the vowel lowering of Greenlandic Eskimo (see (8)) can be represented as in (17). The point holds equally if Greenlandic is better understood as [RTR] spread from a consonant. To put it differently, according to this theory assimilations by vowels to [dorsal] consonants are, in a sense, within-category effects: the influence of [dorsal] consonants is accomplished through vowel place features.

(17) /seʀmi-q/ → [seʀmɛ-q]

i q
Place Place
| |
[dorsal] [dorsal]
- - - - - - |
[-high]

4. Unified Feature Theory

The idea that consonants and vowels should be specified by the same set of place features has been motivated by researchers in diverse frameworks, including Schane (1984; 1987), Kaye et al. (1985), Anderson and Ewen (1987), Hulst (1989), Selkirk (1988; 1993), and Clements (1991). The latter two researchers cast the idea roughly in terms of the features of Sagey (1986), as shown in (18).[14] Following McCarthy (1994) a feature [pharyngeal] is

[13] Hume (1994) argues that the vowel's height is a default value and so doesn't need to be spread.

now included. McCarthy argues that uvular, pharyngeal, and for at least some languages, laryngeal consonants have in common a [pharyngeal] specification.

The unified feature approach capitalizes on the apparent articulatory parallelism between consonants and vowels: both labial consonants and round vowels involve a constriction at the lips; both coronal consonants and front vowels involve a constriction at the tip/blade/front of the tongue; both dorsal consonants and back vowels involve a constriction at the tongue dorsum; and both pharyngeal consonants and low vowels involve a constriction between the tongue root and the pharynx wall. (The parallelism in the case of [coronal] is the most questionable, as we will see later.) For Clements (1991) and others working within this framework (including Herzallah 1990; Hume 1990; 1994) the consonant-vowel parallelism does not extend to vowel height (or stricture features in consonants). Distinct features are still needed for these properties of segments. This means that the unified feature approach obviates the vowel color features [back] and [round], but not [high] and [low].

(18) Unified place features for consonants and vowels (Clements 1991)

		p	p^j	p^w	t̪	t̪^{j}	t̪^{w}	k	k^j	k^w	ħ	i	y	a	o	u
CPlace	[labial]	✓	✓	✓												
	[coronal]				✓	✓	✓									
	[dorsal]							✓	✓	✓						
	[pharyngeal]										✓					
VPlace	[labial]			✓			✓			✓			✓		✓	✓
	[coronal]		✓			✓			✓			✓	✓			
	[dorsal]													✓	✓	✓
	[pharyngeal]													✓		

Of course, vocalic rounding is not articulatorily identical to the labial constriction of a consonant; likewise for the other parallel features. For these unified features to be phonetically interpreted we require reference to a segment's manner features. For example, if a sound is specified [-consonantal] then [labial] is interpreted as lip rounding. Alternatively, the relevant information is read off of feature-geometric structure. Thus Herzallah (1990), Clements (1991), Hume (1994, 1996), and Clements and Hume (1995) locate [labial], [coronal], [dorsal], and [pharyngeal] under separate CPlace and VPlace nodes, depending on whether a consonantal or vocalic constriction is intended. In these terms, the segments seen above in (13) are now rendered as in (19). Segment (19)a is interpreted as [t^w] because [labial] is a VPlace feature while [coronal] is a CPlace feature; and so on for the other representations.[15]

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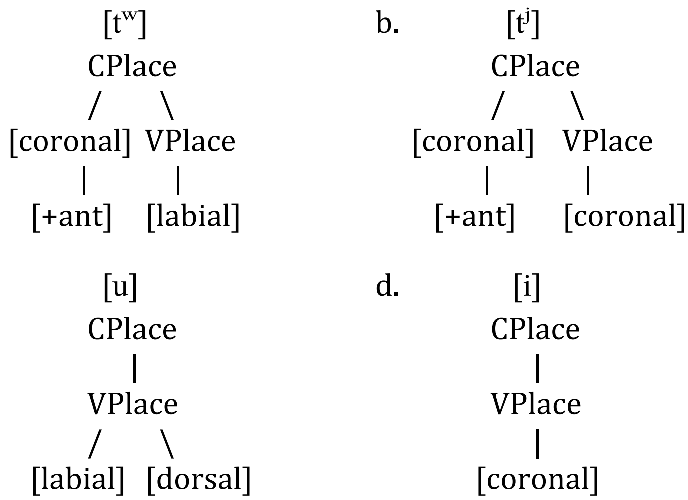
[14] However, Clements treats these features as binary valued. The features [anterior] and [distributed] are not shown here.

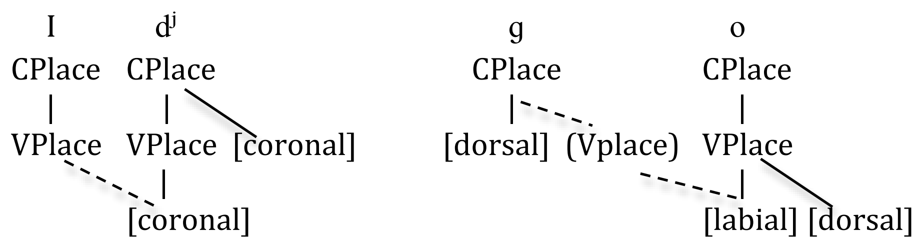
[15] These representations simplify the full geometry assumed by the references cited, to focus on what is crucial here. There are reasons for assuming VPlace is a dependent of CPlace (or "Place" according to some),

(19) a. [tʷ] b. [tʲ] c. [u] d. [i]



Naturally it remains true in this theory that vowel place features and secondary vocalic articulation features on consonants are the same. Therefore it remains straightforward to characterize within-category assimilations as seen in (15) above, now understood as in (20). Cases such as Greenlandic Eskimo (see (8)) are also arguably within-category, as noted above.

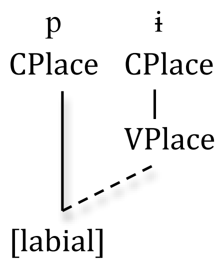
(20) a. /mˠId^j/ → [mˠɪd^j] b. /ego/ → [egʷo]

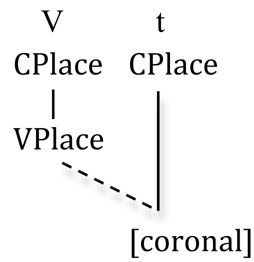


What is new with unified features is the possibility of directly capturing cross-category assimilations too. Compare the representations in (21) to the problematic (16) above. In (21)a (Mapila Malayalam), [labial] spreads from a consonant to a vowel. Notice that [labial] is linked to CPlace for the consonant and to VPlace for the vowel. It is therefore interpreted as consonantal lip constriction for the consonant and as rounding for the vowel. Similar reasoning holds for (21)b (Maltese, see Hume 1994; 1996). Cases of backing around dorsal consonants, as in Maxakalí (see (9)), similarly involve the spreading of [dorsal] from consonant to vowel.

instead of e.g., a sister to it, but they would take us too far afield. See Clements (1991), Odden (1991), and Ní Chiosáin (1994) for discussion of this issue and for motivation of VPlace as a feature-geometric constituent.

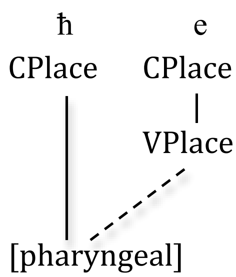
(21) a. /jappɨ/ → [jappu] b. /jV-tlob/ → [ji-tlob]





Finally, cases in which a vowel becomes [a] around a guttural consonant, as in Syrian Arabic (see (10)), are analyzed as the spreading of [pharyngeal] (Herzallah 1990; McCarthy 1994; Rose 1996), as shown below.

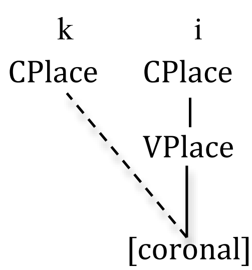
(22) /mniːħ-e/ → [mniːħ-a]



In short, unified feature theory solves the problem of cross-category interactions by eliminating the disjointedness of consonantal and vowel place features.

If features can spread from CPlace to VPlace as in (21) and (22), then we might expect that the reverse can happen. This is just what is proposed for palatalizing mutations of the sort seen in Slovak, where /k,g,x,ɣ/ become /t͡ʃ,d͡ʒ,ʃ,ʒ/ respectively before any of /j,i,e,æ/ (see (11)). Since front vowels are characterized as [coronal] instead of [-back] in this unified theory, this kind of mutation can be viewed as assimilation, specifically "coronalization" (Broselow & Niyondagara 1989; Mester & Itô 1989; Pulleyblank 1989; Lahiri & Evers 1991; Hume 1996):

(23) /vnuk/ → [vnut͡ʃik]



The outputs of the Slovak rule are not simply [coronal]; they are (af)fricated palato-alveolars. Hume (1994, 1996) reasonably assumes that front vowels are [-anterior] coronals. This entails that "coronalization" will output [-anterior] coronals too. The rest must follow from redundancy rules like [-anterior] → [+delayed release].

As noted above, this approach to unified features does not attempt to unify features for vowel height and consonantal stricture. This means that, when such features are affected by cross-category assimilation, it must be for independent reasons. For example, Hume (1994, 1996) argues that the front vowel derived in Maltese is [+high] [i] because this is the default height for vowels in the language.

On the other hand, since [+low] is not a likely default height in Arabic, Herzallah (1990:185) assumes that [pharyngeal] spreading as in (22) leads to a low vowel because of a redundancy rule [pharyngeal] → [+low].[16] Since gutturals seem to cause assimilation to [a] typically, this redundancy rule will be needed for other cases too. This might be seen to somewhat undermine the argument of unified feature theory. The point of unified features is to capture the assimilatory nature of cross-category effects. The lowering that occurs around gutturals seems just as assimilatory as the spreading of the pharyngeal constriction, so why treat it differently? The case of Maxakalí (see (9)) also supports the view that consonants can affect vowel height as well as vowel color. Recall that the inserted vowel in that language is [ə] before alveolars; Clements (1991) suggests that this is the default inserted vowel. But before velars the inserted vowel is both back and high, [ɯ]. A redundancy rule [dorsal] → [+high] might work, but, side-by-side with [pharyngeal] → [+low], it begs the question why we do not allow that consonants directly affect height as well as color.

This question aside, unified features have a clear appeal. They explain cross-category effects because they assume that coronal consonants and front vowels form a natural class, as do labial consonants and round vowels, etc. Apart from assimilations and dissimilations like those already seen, more evidence for such natural classes comes from instances of vowel strengthening or consonantal weakening. For example, when the vowel [i] or glide [j] are strengthened to consonants, they are strengthened to coronal consonants, or at least consonants with a coronal component – palatals or palato-alveolars. This occurs in Porteño Spanish when the (semi-)vowel is in onset position, as in /jelo/ (or /ielo/) → [ʒelo] 'ice' (see Harris & Kaisse 1999 and references therein). A relevant example of weakening comes from Irish lenition, whereby /b,m/ are reduced to [w] (see Ní Chiosáin 1991). If front vowels and palato-alveolars are both [coronal], and if labial consonants and [w] are both [labial], then these processes can be understood as the "promotion" or "demotion" of those features in the CPlace/VPlace representation. As with the assimilations, however, such accounts will often need the help of redundancy rules.

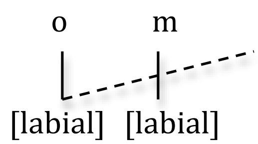
5. Non-interaction and Locality

Our discussion of C-V interactions has so far ignored an important issue. There are ways in which consonants and vowels apparently *fail* to interact, and our theory needs to explain

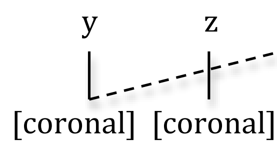
[16] Herzallah discusses Palestinian Arabic in this context. Also, she employs the vowel aperture features of Clements (1991) rather than [high] and [low].

these too. Perhaps the most basic question arises from the simple observation that consonants typically seem to be transparent to vowel harmonies and other kinds of vowel-to-vowel place assimilations. In Turkish, for example, vowels harmonize for roundness as well as backness (Lees 1961; Clements & Sezer 1982). Most consonants are transparent to the harmony.[17] Particularly relevant to the discussion here, labial consonants are transparent to round harmony, as in [somun] 'loaf', and coronal consonants are transparent to backness harmony, as in [økyz] 'ox'.[18] The issue raised by such cases is dramatized in (24).

(24) a.



b.



Unification of place features for consonants and vowels is motivated by the cross-category interactions we have seen so far. However, the ability to *block* spreading is also a kind of interaction (if a passive one), and the principles of autosegmental phonology imply that spreading as in (24)a-b *should* be blocked. A similar implication arises for vocalic [dorsal] spreading through dorsal consonants (not shown). These representations cross lines, a maneuver ruled out within autosegmental phonology for features on the same tier (see chapter 81).[19]

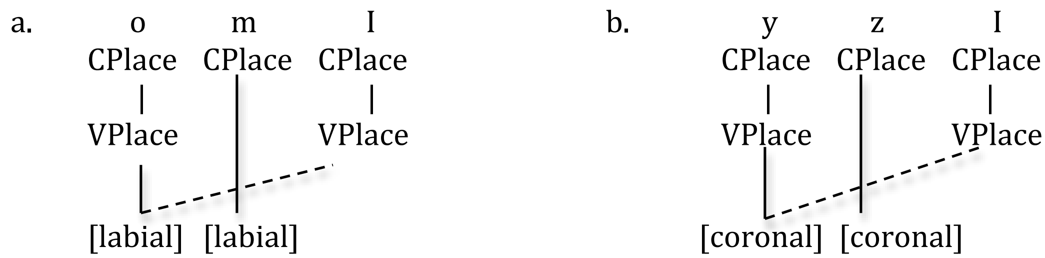
As we have seen, Clements (1991), Clements and Hume (1995), and others working within this unified features framework, locate vocalic and consonantal place features under distinct nodes in feature geometry, VPlace and CPlace respectively. The full representations for the scenarios in (24) (modulo some irrelevant simplifications) are shown in (25) below. In feature geometry, a *plane* on which association lines spread is defined by adjacent tiers. Therefore the plane defined by the [labial] tier and the CPlace tier in (25)a is different from that defined by the [labial] tier and the VPlace tier. Clements (1991) and Clements and Hume (1995) suggest that, even when the same feature such as [labial] is involved in the spreading, line crossing is prohibited only *within a plane*. Therefore spreading as in (25)a is allowed. (Put differently, apparent line crossing is only a problem when the crossed lines link to the same mother node in the geometry.)

[17] The exceptions are palatalized consonants in certain limited circumstances. Since palatalization is a VPlace specification, this blocking is *within*-category. Blocking in such cases is the rule across languages, in contrast to the situation with plain consonants.

[18] These examples involve harmony in the root, but the observation about transparency holds equally for harmony between a stem and a suffix.

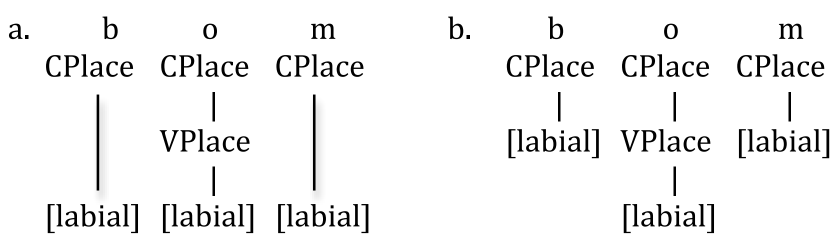
[19] See Sagey (1988), Hammond (1988), Bird and Klein (1990), Scobbie (1991), Coleman (1991), and Archangeli and Pulleyblank (1994) on deducing the ill-formedness of line crossing within the theory.

(25)



This suggestion raises questions about the formal understanding of tiers and planes that have not been fully explored. In any case, the worry about non-interaction of CPlace and VPlace features goes beyond this kind of spreading. For example, many languages place restrictions on homorganic consonants occurring within forms. In autosegmental phonology these have been explained by means of the Obligatory Contour Principle, which prohibits tier-adjacent identical feature specifications (see for example McCarthy 1986; Mester 1986; Yip 1989; Frisch et al. 2004 and references therein). Such restrictions can apply to consonants separated by vowels, and crucially, do not seem to be blocked even by vowels of the "same" place of articulation; that is, forms such as [bom] are as ill-formed as [bam].[20] But given unified features, the consonants' [labial] features in (26)a are not tier-adjacent, since the vowel's [labial] intervenes. Why should this form be dispreferred? (The answer is *not* because sequences such as [bo] or [om] themselves are ruled out; they are not in most languages having this kind of dissimilation.) Analogous issues arise with front vowels and coronal consonants, etc., and the same general issue arises in reverse when vowels dissimilate across all consonants, as in Ainu (Ito 1984).[21] To deal with this question, Clements (1991) suggests that instances of a feature are not on the same tier when they are dominated by different mother nodes, and in fact to highlight this point he draws representations as in (26)b.[22] Hume (1994, 1996) and Clements and Hume (1995) frame a similar idea differently: there is one [labial] tier, as in (26)a, but two instances of a feature can fail to interact when they are dominated by different mother nodes. Therefore the [labial] features dominated by CPlace may interact with each other and may each fail to interact with the intervening [labial].

(26)



[20] One exception is Akkadian (McCarthy 1979; Yip 1988; Hume 1994; Odden 1994). A prefix /m/ dissimilates to [n] given another labial consonant in the stem. The sounds [u,w] do not trigger dissimilation, but they *do* block it.

[21] There are other theoretical approaches to dissimilation that do not appeal to tier-adjacency, including the idea of local self-conjunction advocated by Ito and Mester (1996) and Alderete (1997). Such approaches might avoid the question raised by (26).

[22] This re-definition of the notion "tier" may render unnecessary the reference to planes in (25). If consonantal and vocalic [labial] are on different tiers, then there is by definition no line crossing (in the relevant sense) in such cases.

Obviously there should be concern at this point about losing the gains made with unified features. If CPlace and VPlace features are on different tiers, or if they can fail to interact because CPlace and VPlace are different mother nodes, then why do CPlace and VPlace features *ever* interact? Selkirk (1988; 1993) considers many of the same issues, and makes the important observation that cross-category dissimilations and cooccurrence restrictions seem to hold only under segmental adjacency.[23] Both Selkirk and Clements suggest that this observation be elevated to a principle. A similar, though more general, observation was made at the end of section 2 above: cross-category dissimilations *and* assimilations, unlike within-category cases, are always highly local.

To summarize: according to a unified features view of C-V interactions, consonant and vowel place features are unified, and so can interact. But cross-category interaction seems limited to (near-)segmental adjacency, and a unified feature theory must address this limitation by separate stipulation (e.g., interaction can happen across tiers/with different mother nodes only under (near-)segmental adjacency.) If the empirical observations here are on the right track, one might still raise questions about the account. In particular, the very motivation for unified features seems weakened by the need to stipulate *non-interaction* except under close adjacency. In addition, the latter stipulation does not follow from anything else in the theory; cross-category effects are limited in a way not really explained.

6. Inherent Vowel Place Specifications

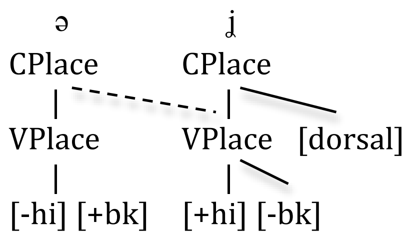
An alternative approach to cross-category C-V interactions, also couched within feature geometry theory, is proposed by Ní Chiosáin and Padgett (1993) and Flemming (1995 [2002]; 2003): perhaps "plain" consonants are not as plain as they are assumed to be.

To begin with, many consonants have been claimed to be complex segments, specified for both consonantal and vowel place features, even though they are "plain" in the sense of lacking secondary articulations that are transcribed. For example, there is a long-standing view that palatals, alveolo-palatals, and at least certain palato-alveolars are inherently specified for features indicating a high and front tongue body, and studies of their articulatory properties support this view (see Keating 1988; 1991; Keating & Lahiri 1993). This fact also explains why these segments are the most common outputs of palatalizing mutations of velars and coronals, assuming these mutations involve assimilation. Similarly, uvulars and pharyngeals may involve inherent specifications for vocalic tongue body and/or root position. In this view, they cause lowering or retraction of vowels because they are themselves specified for a feature like [-high] or [RTR] (see Chomsky & Halle 1968; and more recently Elorrieta 1992; Halle 1995; Rose 1996). If these consonants involve inherent vowel place specifications – in addition to independent consonantal specifications – then effects such as the lowering or retraction of vowels before uvulars in Greenlandic Eskimo, or the raising and fronting of vowels before palatals and palato-alveolars in Kabardian, e.g., /ʒəʝ/ → [ʒɪʝ] 'tree' and /ʒaʃ/ → [ʒɛʃ] '(to) be bored, tired' (Colarusso 1992:30), are not cross-category assimilations at all.

[23] Selkirk's notion of "cross-category" is actually more abstract than that employed here. Her notion makes some different empirical predictions.

For example, the raising and fronting seen in Kabardian might be understood as in (27). For the sake of discussion we revert to the familiar vowel place features of SPE, but following the literature on VPlace constituency (see note 15) continue to assume this aspect of the geometry. The palatal fricative [ʝ] is assumed to have (at least) a primary [dorsal] specification. The point is that what spreads in this case are features of tongue body height and frontness that are uncontroversially relevant to vowels; in effect, palatals (and palato-alveolars in Kabardian) are understood as inherently palatalized segments.

(27) /ʒəʝ/ → [ʒɪʝ]



The question raised by works such as Ní Chiosáin and Padgett (1993) and Flemming (1995 [2002]; 2003) is to what extent features relevant to vowel place might inhere within other "plain" consonants. If all cross-category C-V interactions were caused by such inherent features, then "cross-category", though a useful classificatory term, would lose any theoretical import: all C-V interactions would be within-category.

Ní Chiosáin and Padgett (1993) approach the phonetic claim from an articulatory point of view, following the general articulatory approach to features in the SPE tradition. They note that consonantal constrictions involve offsets and onsets, that is, movement from a previous position into the consonant, and movement from the consonant into a following position. The idea is diagrammed as in (28), for a labial consonant in an intervocalic context such as [ɨbɨ]. During the onset transition there is a short period of time when the constriction is not yet consonantal, and yet this vocalic period is shaped by the impending consonant. Likewise, early in the release the constriction becomes vocalic while still shaped by the preceding consonant. As the diagram implies, this must have effects on the quality of the vowel near the closure.

(28) Stages of consonant production

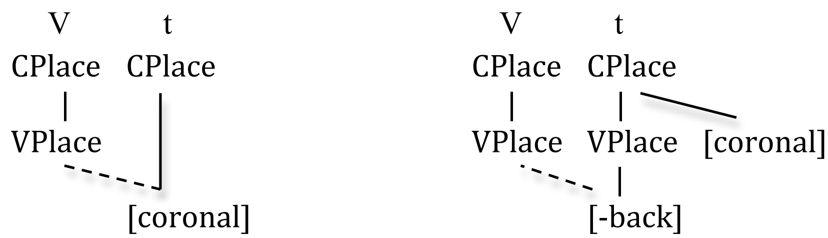
ɨ	ᵘ	b	ᵘ	ɨ
vowel	onset	closure	offset	vowel

-- > -- > -- > -- > -- > -- > -- > -- > -- > -- > -- > -- > -- >

Flemming (1994 [2002]) emphasizes these acoustic or auditory effects of the transitions into and out of consonants, and in fact argues for the incorporation of auditory-based features into phonological theory. It is well known that consonantal offsets and onsets influence vowel formants; in fact, the resulting dynamic formant transitions are an important cue to both vocalic and consonantal place. Flemming notes that labial consonants, for example, lower vocalic F2 (second formant) values, while dental and alveolar coronals raise F2.[24] Since vowel place (particularly vowel color) is cued by the location of F2, consonants therefore have the inherent ability to affect perception of vowel place.

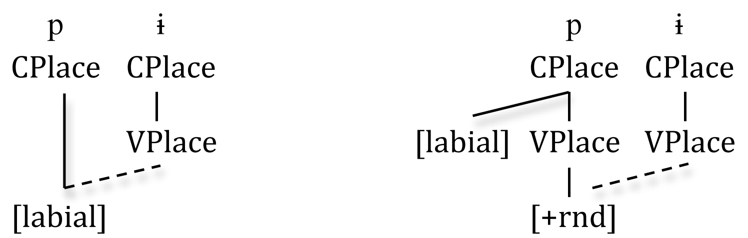
Flemming (2003) discusses the articulatory basis of the acoustic effects in more detail, focusing on coronal consonants. According to his survey of relevant studies, anterior coronals, and palato-alveolars, tend to cause tongue body fronting due to coupling between the tongue blade/tip and the tongue body, and this is the reason for the rise in F2 around such consonants. With this in mind consider once again the fronting of vowels by coronal consonants, as in Maltese Arabic (see (7)). The idea is that fronting happens not because the consonant spreads its primary [coronal] articulation as in (29)a, but because the consonant has some inherent tongue fronting, with a concommitant effect on F2, and this is what spreads to the vowel, (29)b. For the sake of discussion this is formalized in terms of the traditional feature [back].

(29) a. /jV-tlob/ → [ji-tlob] b. /jV-tlob/ → [ji-tlob]



Similarly Mapila Malayalam (see (6)) involves not spreading of primary [labial] as in (30)a but spreading of the inherent vocalic labial constriction, and lowering of F2, formalized here by means of [+round], (30)b.

(30) a. /jappɨ/ → [jappu] b. /jappɨ/ → [jappu]



In an analogous fashion velars can spread inherent [+back] and/or [+high] in cases like Maxakalí (see (9)), and gutturals can spread inherent [+low] in cases like Syrian Arabic (see (10)).

It is uncontroversial that consonants phonetically affect vowels both articulatorily and acoustically, as this approach to "cross-category" interactions assumes. However, incorporating these relatively small phonetic effects into phonology raises questions. One question is prompted by our use of the conventional vowel place features [back], [round],

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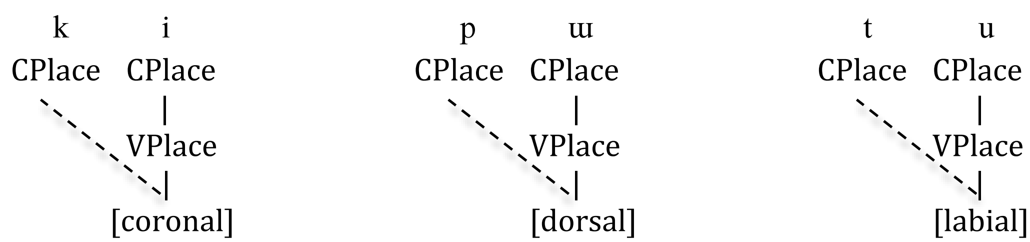
[24] Discussion of vowel formants and of formant transitions can be found in, e.g., Stevens (1998) and Johnson (2003). Another advocate of auditory features in phonology is Boersma, e.g., Boersma (1998).

etc., in the account above. How are we justified in specifying the Maltese [t] as [-back] if it isn't palatalized [t^{j}], or the Malayalam [p] as [+round] if it isn't rounded [p^{w}]? The answer suggested by Ní Chiosáin and Padgett (1993) is that such specifications are realized as bona fide secondary articulations when they are contrastive, but not when they are redundant. In a language such as Russian, where palatalized coronals contrast with non-palatalized ones, [-back] on [t] is realized as [t^{j}]; in a language without this contrast, redundant [-back] is realized as [t^{i}] (borrowing notation from Ní Chiosáin & Padgett 2001; Flemming 2003), a coronal with only the inherent tongue body fronting described above. This answer to the question predicts that non-palatalized coronals in Russian could not be [-back] even inherently, since this specification is reserved for palatalization. This prediction is correct; in fact, non-palatalized sounds in Russian are velarized, i.e. [t^{ɣ}].

The inherent vowel place approach to "cross-category" effects arguably has some advantages over the unified feature approach. First, it helps explain an asymmetry in cross-category assimilations noted in section 2: while vowel-to-consonant assimilation occurs, apparent consonant-to-vowel assimilations are strikingly underattested (Ní Chiosáin and Padgett 1993). The most robust example of the latter, as we saw, involves palatalizing mutations as in Slovak, where /k,g,x,ɣ/ become [t͡ʃ,d͡ʒ,ʃ,ʒ] respectively before any of [j,i,e,æ]. Within a unified features approach, some have argued that these are instances of "coronalization" (Broselow & Niyondagara 1989; Mester & Itô 1989; Pulleyblank 1989; Lahiri & Evers 1991; Hume 1996), as in (31)a. A challenge for this claim is the absence of mutations resembling those in (31)b-c, or indeed resembling most of the logically possible consonant-to-vowel assimilations if place features can link to both VPlace and CPlace.[25]

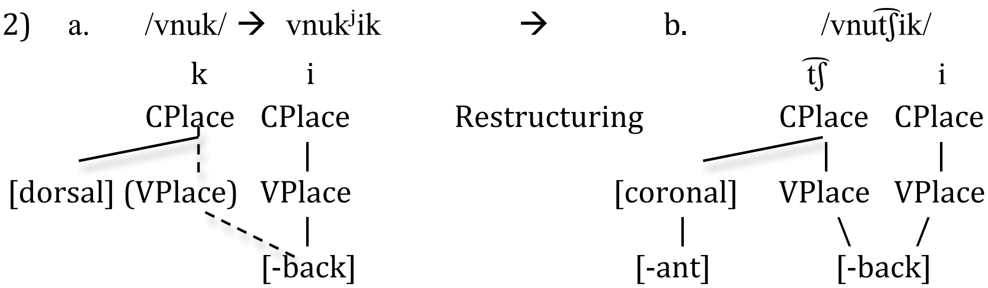
(31) a. /vnuk/ → [vnut͡ʃik] b. /vnup/ → [vnukɯk] c. /vnut/ → [vnupuk]



Ní Chiosáin and Padgett argue that consonants simply do not assimilate to vowels in this way, having their primary place displaced, and that the theory should not allow them to. There is a natural explanation within inherent vowel place theory for this asymmetry in the direction of "cross-category" assimilations: consonants can affect vowels because they can have secondary vocalic articulations (whether distinctive or redundant). But vowels by definition do not have CPlace features with which to affect a consonant; they only have VPlace features, features that can only impose secondary vocalic articulations on consonants. Put differently, *all* C-V interactions are interactions between vowel place features. To handle palatalizing mutations, Ní Chiosáin and Padgett, following many others,

[25] Ní Chiosáin and Padgett dismiss some claimed cases that are attested as sound changes but have no synchonic reflex. See that work for discussion of other apparent counterexamples.

assume that assimilation only partially derives the output, as in (32)a. Further changes from /kʲ/ to, e.g., [t͡ʃ], must be due to language-particular segmental well-formedness conditions, leading to something like (32)b.[26]

(32)


As Clements and Hume (1995:295-6, and see references therein) point out, however, such restructuring fails to explain why [coronal] in particular results in the context of a front vowel, just the fact that unified feature theory explains. On the other hand, one might seek perceptual explanations for such arbitrary articulatory connections, by means of auditory-based features (see Flemming 1995 [2002] for this case in particular), or perhaps via the "p-map" (Steriade 2001).

Another advantage to the inherent vowel place approach is that it allows for more nuance in the ways that consonants can affect vowels (Flemming 1995 [2002], 2003). For example, Flemming (2003) (citing Emeneau 1970; Ebert 1996) notes that vowels are backed before retroflex coronals in the Dravidian language Koḍagu. Therefore there are words having central or back rounded vowels before retroflex consonants, as in (33)a-b respectively, but there are no forms with front vowels before them such as (33)c.

(33)	a.	ɯɖi	'the whole'	b.	uɖɯ-	'to put on (sari)'	c.	*iɖ
		kɯːɭɯ	'lower, below'		kuːɭɯ	'cooked rice'		*iːɭ
		ɤɳe	'double'		oɳak-	'to dry'		*eɳ
		kɤːɖɯ	'ruin'		koːɖɤ	'monkey'		*eːɖ

Flemming cites studies showing that retroflexes can be articulated with a retracted tongue body. Unlike other coronals, they tend not to be articulated with a *fronted* tongue body, because this leads to articulatory difficulty. As Flemming points out, unified feature theory predicts that even retroflex coronals should cause vowel fronting, if fronting is [coronal] spreading. But this does not occur.

Third, because it posits that all C-V interactions are within-category, by means of vowel place features, inherent vowel place theory does not require any adjustment of our understanding of tiers or interaction. Vowels do not block consonantal place dissimilations,

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[26] Though expressed as a rule here, in line with all of this discussion, the idea is commonly expressed in Optimality Theory by means of constraint rankings such as *kʲ >> t͡ʃ. This ranking, along with a high-ranking constraint driving [-back] assimilation, will lead to the output [t͡ʃ].

because they do not have consonant place features. Consonants block vowel dissimilations or assimilations only when they *do* have vowel place specifications.

What about the "weakness" of "cross-category" effects? As we noted at the end of section 2, they are weaker than "within-category" effects by a range of diagnostics. Why are they comparatively infrequent? Why are they confined to roughly segmental adjacency? Why do "within-category" effects always win out over "cross-category" ones when both are in theory possible (*/pʲɨ/ → [pʲu])? Why do "cross-category" effects often seem to target only "underspecified" vowel types? Why do they sometimes need to "gang up" to cause effects?

We might attribute these signs of weakness to the intrinsic weakness of inherent vowel place features. As discussed at the outset of this section, the effects that "plain" consonants have on neighboring vowels are rather brief and slight. The hypothesis here has been that such effects can play a direct role in the phonology. However, feature theory, at least as traditionally conceived, provides no means of encoding this hypothesized difference between, e.g., "strong" (contrastive) and "weak" (inherent, redundant) [+round]. Until this idea is fleshed out, it is only a promissory note of the inherent vowel place approach.

Another weakness of the inherent vowel place approach to C-V interactions is that it has no immediate explanation for the natural classes of consonants and vowels evidenced by vowel strengthenings as in Porteño Spanish /jelo/ (or /ielo/) → [ʒelo] 'ice', and consonant lenitions as in Irish /b,m/ → [w] (see section 4). For processes like these, the unified feature approach has a clear advantage.

7. Conclusion

Consonant-vowel interactions are a rich source of data for phonological theory. This chapter has focused on the ways in which they have influenced the theory of feature make-up and structure, and for reasons of space it has approached even this circumscribed area selectively. Though much of the field has shifted its focus away from these representational questions in recent years, with a concomitant rise in the focus on questions of constraint interaction, this shift has not tended to shed new light on the questions raised in this chapter. It is to be hoped that new trends in the field will eventually allow us to address these questions in a newly productive way.

See also 77 PALATALISATION; 90 VOWEL PLACE; 108 CONSONANT PLACE; 111 LONG-DISTANCE ASSIMILATION OF CONSONANTS; 113 SLAVIC PALATALISATION; 119 PHARYNGEALS; 130 ORGANISATION OF FEATURES; 133 SECONDARY ARTICULATION AND DOUBLY ARTICULATED CONSONANTS.

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References

Alderete, John. 1997. Dissimilation as local conjunction. In K. Kusumoto (ed.), *Proceedings of the North East Linguistics Society 27*, 17-31. Amherst, MA: GLSA, Dept. of Linguistics, University of Massachusetts.

Anderson, John & Colin Ewen. 1987. *Principles of Dependency Phonology*. Cambridge: Cambridge University Press.
Anttila, Arto. 2002. Morphologically conditioned phonological alternations. *Natural language and linguistic theory* 20.1. 1-42.
Archangeli, Diana & Douglas Pulleyblank. 1994. *Grounded Phonology*. Cambridge, Massachusetts: MIT Press.
Bird, Steven & Ewan Klein. 1990. Phonological events. *Journal of linguistics* 26. 33-56.
Boersma, Paul. 1998. *Functional phonology: formalizing the interactions between articulatory and perceptual drives*. The Hague: Holland Academic Graphics.
Brame, Michael. 1972. On the abstractness of phonology: Maltese. In M. Brame (ed.), *Contributions to Generative Phonology*, Austin: University of Texas Press.
Bright, William. 1972. The enunciative vowel. *International journal of Dravidian linguistics* 1.1. 26-55.
Broselow, Ellen & A. Niyondagara. 1989. Feature geometry of Kirundi palatalization. *Studies in the Linguistic Sciences* 20(1). 71-88.
Browman, Carol & Louis Goldstein. 1992. "Targetless" schwa: An articulatory analysis. In G. Docherty & R. Ladd (eds.), *Papers in Laboratory Phonology II: Gesture, Segment, Prosody*, 26-56. Cambridge: Cambridge University Press.
Buckley, Eugene. 2000. On the naturalness of unnatural rules. *Proceedings of the Second Workshop on American Indigenous Languages. UCSB working papers in linguistics 9.*
Campbell, Lyle. 1974. Phonological features: Problems and proposals. *Language* 50. 52-65.
Cheng, Lisa Lai Shen. 1991. Feature geometry of vowels and co-occurence restrictions in Cantonese. In A. L. Halpern (ed.), *Proceedings of WCCFL 9*, 107-124. Stanford: CSLI.
Chomsky, Noam & Morris Halle. 1968. *The sound pattern of English*. New York: Harper & Row.
Clements, G. N. 1976. Palatalization: linking or assimilation? In S. S. Mufwene, C. A. Walker & S. B. Steever (eds.), *Papers from CLS 12*, 96-109. Chicago: Chicago Linguistic Society.
Clements, G. N. 1991. Place of articulation in consonants and vowels: a unified theory. *Working Papers of the Cornell Phonetics Laboratory*, 77-123. Ithaca: Cornell University.
Clements, G. N. & Engin Sezer. 1982. Vowel and consonant disharmony in Turkish. In H. v. d. Hulst & N. Smith (eds.), *The Structure of Phonological Representations*, 213-255. Dordrecht: Foris.
Clements, G.N. & Elizabeth V. Hume. 1995. The internal organization of speech sounds. In J. A. Goldsmith (ed.), *The handbook of phonological theory*, 245-306. Cambridge, MA: Blackwell.
Colarusso, John. 1992. *A grammar of the Kabardian language*. Calgary, Alberta: University of Calgary Press.
Coleman, John & John Local. 1991. The "no crossing constraint" in autosegmental phonology. *Linguistics and Philosophy* 14. 295-338.
Cowell, M. 1964. *A Reference Grammar of Syrian Arabic*. Washington, DC: Georgetown University Press.
Ebert, Karen. 1996. *Koḍava*. Munich: Lincom Europa.
Elorrieta, Jabier. 1992. The feature specification of uvulars. In D. Bates (ed.), *Proceedings of WCCFL 10*, 139-149. Stanford: CSLI Publications.

Emeneau, M. B. 1970. Koḍagu vowels. *Journal of the American Oriental Society* 90. 145-158.
Flemming, Edward. 1995 [2002]. *Auditory representations in phonology*. Doctoral dissertation, UCLA [published in 2002 by Routledge, New York].
Flemming, Edward. 2003. The relationship between coronal place and vowel backness. *Phonology* 20.3. 335-373.
Fortescue, Michael. 1984. *West Greenlandic*. London: Croom Helm.
Frisch, Stefan A., Janet B. Pierrehumbert & Michael B. Broe. 2004. Similarity avoidance and the OCP. *Natural language and linguistic theory* 22.1. 179-228.
Gudschinsky, Sarah C., Harold Popovich & Frances Popovich. 1970. Native reaction and phonetic similarity in Maxakali phonology. *Language* 46. 77-88.
Halle, Morris. 1995. Feature geometry and feature spreading. *Linguistic inquiry* 26.1. 1-46.
Hammond, Michael. 1988. On deriving the Well-formedness Condition. *Linguistic inquiry* 19. 319-325.
Harris, James W. & Ellen M. Kaisse. 1999. Palatal vowels, glides, and obstruents in Argentinian Spanish. *Phonology* 16. 117-190.
Herzallah, R. 1990. *Aspects of Palestinian Arabic Phonology: A Nonlinear Approach*. Cornell University.
Hulst, Harry van der. 1989. Atoms of segmental structure: components, gestures and dependency. *Phonology* 6. 253-284.
Hume, Elizabeth. 1990. Front vowels, palatal consonants and the rule of umlaut in Korean. In J. Carter, R.-M. Déchaine, B. Philip & T. Sherer (eds.), *Proceedings of the North-Eastern Linguistic Society 20*, 230-243. Amherst: GLSA.
Hume, Elizabeth. 1994. *Front Vowels, Coronal Consonants, and their Interaction in Nonlinear Phonology*. London: Garland.
Hume, Elizabeth. 1996. Coronal consonant, front vowel parallels in Maltese. *Natural language and linguistic theory* 14. 163-203.
Hyman, Larry. 1970. How concrete is phonology. *Language* 46.1. 58-76.
Hyman, Larry. 1972. *A phonological study of Feʔ-feʔ-Bamileke*. Studies in African linguistics, supplement 4.
Hyman, Larry. 1973. The feature [grave] in phonological theory. *Journal of phonetics* 1. 329-337.
Ihiunu, Peter & Michael Kenstowicz. 1994. Two notes on Igbo vowels. Cambridge, MA: Unpublished paper, MIT.
Ito, Junko. 1984. Melodic dissimilation in Ainu. *Linguistic inquiry* 15. 505-513.
Itô, Junko & Armin Mester. 1996. Rendaku I: constraint conjunction and the OCP. Handout of talk presented at the Kobe phonology forum.
Johnson, Keith. 2003. *Acoustic and auditory phonetics*. Cambridge, MA: Blackwell.
Kaye, Jonathan, Jean Lowenstamm & Jean-Roger Vergnaud. 1985. The internal structure of phonological elements: A theory of charm and government. *Phonology* 2. 305-328.
Keating, Patricia. 1988. Palatals as complex segments: x-ray evidence. *UCLA working papers in phonetics 69*, 77-91. UCLA.
Keating, Patricia. 1991. Coronal places of articulation. In C. Paradis & F. Prunet (eds.), *The Special Status of Coronals: Internal and External Evidence*, 29-48. San Diego: Academic Press.
Keating , Patricia & Aditi Lahiri. 1993. Fronted velars, palatalized velars, and palatals. *Phonetica* 50. 73-101.

Lahiri, Aditi & V. Evers. 1991. Palatalization and coronality. In C. Paradis & J.-F. Prunet (eds.), *The Special Status of Coronals*, 79-100. San Diego: Academic Press.
Lees, Robert. 1961. *The phonology of Modern Standard Turkish*. Bloomington: Indiana University Publications.
Lightner, Theodore M. 1972. *Problems in the Theory of Phonology, Vol 1: Russian Phonology and Turkish Phonology*. Edmonton: Linguistic Research, Inc.
Lombardi, Linda. 2003. Markedness and the typology of epenthetic vowels. Ms., University of Maryland, College Park. ROA-578.
Maddieson, Ian. 1984. *Patterns of Sounds*. Cambridge: Cambridge University Press.
McCarthy, John J. 1979. *Formal Problems in Semitic Phonology and Morphology*. MIT.
McCarthy, John J. 1986. Features and tiers: the structure of Semitic roots. Paper presented at Brandeis University.
McCarthy, John J. 1988. Feature geometry and dependency: A review. *Phonetica* 43. 84-108.
McCarthy, John J. 1994. The phonetics and phonology of Semitic pharyngeals. In P. A. Keating (ed.), *Papers in Laboratory Phonology III*, 191-233. Cambridge: Cambridge University Press.
Mester, Armin. 1986. *Studies in tier structure*. PhD dissertation, GLSA, University of Massachusetts, Amherst.
Mester, Armin & Junko Itô. 1989. Feature predictability and underspecification: Palatal prosody in Japanese mimetics. *Language* 65. 258-293.
Ní Chiosáin, Máire. 1991. *Topics in the phonology of Irish*. University of Massachusetts, Amherst.
Ní Chiosáin, Máire. 1994. Irish palatalisation and the representation of place features. *Phonology* 11.1. 89-106.
Ní Chiosáin, Máire & Jaye Padgett. 1993. Inherent VPlace. Report No. LRC-93-09, Linguistics Research Center, University of California, Santa Cruz.
Ní Chiosáin, Máire & Jaye Padgett. 2001. Markedness, segment realization, and locality in spreading. In L. Lombardi (ed.), *Segmental phonology in Optimality Theory: constraints and representations*, 118-156. Cambridge: Cambridge University Press.
Odden, David. 1991. Vowel geometry. *Phonology* 8. 261-289.
Odden, David. 1994. Adjacency parameters in phonology. *Language* 70. 289-330.
Padgett, Jaye. to appear. Russian consonant-vowel interactions and derivational opacity. In W. Brown, A. Cooper, A. Fisher, E. Kesici & N. Predolac, Zec, Draga (eds.), *Proceedings of the eighteenth Formal Approaches to Slavic Linguistics meeting.*, Ann Arbor: Michigan Slavic Publications.
Prince, Alan & Paul Smolensky. 1993 [2004]. *Optimality theory: constraint interaction in generative grammar*. Ms., Rutgers University, New Brunswick, NJ, and University of Colorado, Boulder [Published by Blackwell, 2004].
Pulleyblank, Douglas. 1988. Vocalic underspecification in Yoruba. *Linguistic inquiry* 19. 233-270.
Pulleyblank, E. G. 1989. The role of coronal in articulator based features. In C. Wiltshire, R. Graczyk & B. Music (eds.), *Papers from CLS 25*, 379-393. Chicago: Chicago Linguistic Society.
Rischel, Jørgen. 1974. *Topics in West Greenlandic phonology*. Copenhagen: Akademisk Forlag.
Rose, Sharon. 1996. Variable laryngeals and vowel lowering. *Phonology* 13.1. 73-117.

Rubach, Jerzy. 1993. *The Lexical Phonology of Slovak*. Oxford: Clarendon Press.
Sagey, Elizabeth. 1986. *The Representation of Features and Relations in Nonlinear Phonology*. Cambridge, MA: MIT.
Sagey, Elizabeth. 1988. On the ill-formedness of crossing association lines. *Linguistic inquiry* 19. 109-118.
Schane, Sanford. 1984. The fundamentals of particle phonology. *Phonology* 1. 129-155.
Schane, Sanford. 1987. The resolution of hiatus. In A. Bosch, B. Need & E. Schiller (eds.), *CLS 23: Parasession on Autosegmental and Metrical Phonology*, 279-290. Chicago: Chicago Linguistic Society.
Schultz-Lorentzen, C. W. 1945. A grammar of the West Greenlandic language. *Meddelelser om Grønland* 129.
Scobbie, James. 1991. *Attribute value phonology*. PhD dissertation, University of Edinburgh, United Kingdom.
Selkirk, Elisabeth. 1988. Dependency, place and the notion "tier". University of Massachusetts, Amherst.
Selkirk, Elisabeth. 1993. [Labial] relations. University of Massachusetts, Amherst.
Steriade, Donca. 2001. Directional asymmetries in place assimilation: a perceptual account. In E. Hume & K. Johnson (eds.), *The role of speech perception in phonology*, 219-250. New York: Academic Press.
Stevens, Kenneth N. 1998. *Acoustic phonetics*. Cambridge, MA: MIT Press.
Upadhyaya, Suseela P. 1968. *Mapila Malayalam (a descriptive and comparative study)*. Poona: Doctoral dissertation, University of Poona.
Yip, Moira. 1988. The Obligatory Contour Principle and phonological rules: A loss of identity. *Linguistic inquiry* 19. 65-100.
Yip, Moira. 1989. Feature geometry and cooccurrence restrictions. *Phonology* 6. 349-374.