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22. Consonantal Place of Articulation

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Sections

1 Introduction

An examination of the International Phonetic Alphabet chart (IPA 2007) yields a large number of consonantal places of articulation that are phonetically possible: bilabial, labio-dental, dental, alveolar, post-alveolar, retroflex, palatal, velar, uvular, pharyngeal, and glottal, as shown in Table 22.1.

	bilabial	labio-dental	dental	alveolar	post-alveolar	retroflex	palatal	velar	uvular	pharyngeal	glottal
plosive	p b			t d		ʈ ɖ	c ɟ	k g	q ɢ		ʔ
nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
trill	ʙ			r					ʀ		
tap/flap		ⱱ		ɾ		ɽ					
fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
lateral fricative				ɬ ɮ							
approximant		ʋ		ɹ		ɻ	j	ɰ			
lateral approximant				l		ɭ	ʎ	ʟ			

Table 22.1 The International Phonetic Alphabet (revised to 2005)

Some identify even more places of articulation. Ladefoged and Maddieson (1996: 44), in a major work on sounds of the

world's languages, present 17 places of articulation: bilabial, labio-dental, linguo-labial, interdental, laminal dental, laminal alveolar, lamino-post-alveolar (palato-alveolar), apical dental, apical alveolar, apical post-alveolar, sub-apical palatal (retroflex), palatal, velar, uvular, pharyngeal, epiglottal, and glottal. They divide these into five major target regions: labial (bilabial, labio-dental), coronal (laminal [linguo-labial, interdental, laminal dental, laminal alveolar, laminal post-alveolar], apical [apical dental, apical alveolar, apical post-alveolar], sub-apical [sub-apical palatal (retroflex)]), dorsal (palatal, velar, uvular), radical (pharyngeal, epiglottal), and laryngeal (glottal).

My goal in this chapter is to examine several issues surrounding consonantal place of articulation. I begin with an overview of the types of evidence used to justify the major place groupings, and then examine the evidence for subclasses within these and asymmetries in patterning between different places of articulation. I then review the features used to describe places of articulation. I end with a discussion of some additional issues relevant to the study of place of articulation.

2 The major places of articulation: A phonological perspective

The goal of a chart like that in **Table 22.1** or a list like that of **Ladefoged and Maddieson (1996)** is to characterize locations where constriction is possible. From the perspective of phonology, the points of constriction group into classes, with sub-places within a class, based on natural class patterning (**CHAPTER 17**: DISTINCTIVE FEATURES). As discussed above, **Ladefoged and Maddieson (1996**: 44) identify five major places of articulation: labial, coronal, dorsal, radical, and laryngeal. Other theories note a similar small number of major places. For instance, Articulator Theory and Revised Articulator Theory (e.g. **Sagey 1990**; **Halle *et al.*2000**: §4) distinguish labial, coronal (tongue blade), dorsal (tongue body), and tongue root or radical. Element theory distinguishes labials, palatals, coronals, and velars (e.g. **Harris and Lindsey 1995**). While there are differences between these theories, they agree on the existence of major zones, and I begin with evidence for these.

In the following discussion I examine types of evidence for the division into labial, coronal, dorsal, radical (also called tongue root and pharyngeal), and laryngeal places of articulation, as well as the sub-places within each. Each section is organized as follows. I first present a phonetic description of the class. I next examine phonological evidence for the class, including distribution, harmony patterns, co-occurrence restrictions, and other phonological processes. I then introduce subplaces within the major place, asking if what are categorized as place distinctions are best analyzed as such from a phonological perspective.

Before turning to evidence for the individual features, I review one argument for places of articulation in the oral cavity being divided into labial, coronal, and dorsal, based on the major articulator involved. **Sagey (1990)**, in an important work on place, presents an argument for this division based on complex articulations (**CHAPTER 29**: SECONDARY AND DOUBLE ARTICULATION). In a cross-linguistic survey, she finds that only a limited number of complex articulations occur. There are labial-velars (e.g. [kp]), probably the best studied. In addition, there are labial-coronals (e.g. [pt]), coronal-velars (e.g. [t͡ʃ]), and labial-coronal-velars (tkw). Unattested are, for instance, complex articulations consisting of two labial type articulations or two coronal type articulations. The possible place combinations found, Sagey argues, present an argument for these three major places of articulation.

2.1 Labial place of articulation

Labial includes bilabial, articulated with the upper and lower lips, and labio-dental, articulated with the tip of the tongue and the lower lip; in addition, **Ladefoged and Maddieson (1996**: 44) include a linguo-labial place of articulation, articulated with the upper lip and the tongue, but they treat this as a type of coronal. This sound has not figured in the phonological literature, and I do not discuss it here.

2.1.1 Evidence for labials as a phonological class

Considerable phonological evidence has been garnered for a class of labials, for example in some types of harmony (**CHAPTER 77**: LONG-DISTANCE ASSIMILATION OF CONSONANTS; **CHAPTER 75**: CONSONANT-VOWEL PLACE FEATURE INTERACTIONS; **CHAPTER 81**: LOCAL ASSIMILATION). **Campbell (1974)**, based on **Bright (1972)**, discusses rounding harmony in Tulu (Dravidian), where a high vowel becomes [u] after a preceding round vowel and after a labial consonant ([p m]).

Another example of harmony is more interesting for establishing that labials are a single class: in Igbo (Niger-Congo; **Hyman 1975**; **Sagey 1990**), an epenthetic vowel is round in the environment of labial and labialized consonants ([p b m f w k^w g^w $ŋ^w$ kp gb]), and unround in the environment of consonants of other places of articulation. Note that the labials include bilabials, labio-dentals, labialized consonants, and labial-velars.

Labials also participate as a class in co-occurrence restrictions (**CHAPTER 86**: MORPHEME STRUCTURE CONSTRAINTS). In the well-studied Arabic root co-occurrence restrictions, roots containing the labials [f b m] are dispreferred (e.g. **McCarthy 1988**). In Javanese (Austronesian), labials [p b m w] fail to co-occur in roots (**Uhlenbeck 1949**; **Yip 1989**). Muna (Austronesian; **Coetzee and Pater 2008**) shows restrictions that are similar to those in Arabic, with labials ([p b ɓ m ^{m}p ^{m}b f w]) combining less frequently than might be expected; manner factors enter in as well.

Zuraw and Yu (2009) examine the patterning of the infix *-um-* (or *-m-*) with different stem-initial consonants in several

Austronesian languages. They find that there is often unusual patterning of this affix when the stem begins with a labial. They focus on repair strategies that arise in response to labial…labial sequences; I extract evidence that their study provides for the labial class. In Mayrinax Atayal, *-um-* is generally an infix occurring following the first consonant of the stem, as in [kaiʔ, k-um-aiʔ] 'dig' (**P. J. Li 1995**: 285; **Zuraw and Yu 2009**: 201), but with labial-initial stems the infix fuses with the first consonant, yielding [m], as in [paqut, m-aqut] ask' (**Li 1995**: 286; **Zuraw and Yu 2009**: 201). This is attested with [p] and [β]-initial stems; no data is available on [m]-initial stems. In Muna, stem-initial [p] and [f] are replaced by [m]; the infix has no surface realization with [b], [6], [^{m}b], and [m]-initial stems; with [w]-initial stems it generally has no realization but might be [m]; with stems beginning with consonants of other places of articulation, the infix is generally found; vowel-initial stems are preceded by [m] (**Zuraw and Yu 2009**: 205). In Kulalao Paiwan, the infix is [-m-] except with stems starting with [p], [b], [v], or [m] (no data is available on [w]), where it has the form [-n-] (**Ferrell 1982**; **Zuraw and Yu 2009**: 211). Thus labials pattern as a class independent of sub-place of articulation in their interaction with the infix.

To summarize, bilabial stops, labio-dental fricatives, bilabial nasals, and, in Igbo, labialized consonants and doubly articulated consonants group together as a phonological class.

2.1.2 Labial sub-places of articulation

While sounds at both bilabial and labio-dental places of articulation exist, minimal contrasts between sounds at these places of articulation are sparse. **Ladefoged and Maddieson (1996**: 17) remark that it is not clear whether there are true labio-dental stops in any language; they list the Kukuya dialect of Teke (Niger-Congo, Bantu) as contrasting a labio-dental and bilabial nasal. While the status of contrasting bilabial and labio-dental stops and nasals is unclear, there are languages that contrast bilabial and labio-dental fricatives. Examples are given in (1), from Ladefoged and Maddieson.

(1) a. *Ewe (Kwa)*

é φá	'he polished'	é fá	'he was cold'
è βló	'mushroom'	é vló	'he is evil'

b. *Tsonga (Xiŋkuna dialect; Bantu)*

kuβaβa	'to be painful'	kuvumba	'to guess'

Ladefoged and Maddieson provide detailed discussion of the phonetic differences between bilabial and labio-dental fricatives in languages that distinguish these.

Languages with a contrast between a bilabial and labio-dental fricative raise an interesting question. In such languages, what is the primary phonological distinction between these places of articulation in terms of patterning? Bilabial and labio-dental fricatives are displayed as differing in place of articulation in languages like Ewe but in discussion of features that distinguish them, manner features are usually used; for instance, **Chomsky and Halle (1968)** choose [strident] (see **CHAPTER 28**: THE REPRESENTATION OF FRICATIVES). This choice is based largely on phonetic rather than phonological patterning. To establish that the contrast is one of place from a phonological perspective, phonological evidence of the type discussed above – e.g. co-occurrence restrictions, harmony classes – is required. An interesting test would be co-occurrence restrictions, with sub-places within a place of articulation failing to occur. Such cases are discussed extensively in **Hansson (2010)**, who provides numerous examples of coronal and dorsal consonant harmony. He notes no cases of labial consonant harmony, although he points out that these would be rare since the bilabial/labio-dental distinction is seldom contrastive.

Marshall (2008) provides phonological evidence for a manner distinction between a bilabial and labio-dental voiced continuant in Esan (Edoid). Based on nasal assimilation, she argues that /v/ is a fricative and /β/ is a sonorant: sonorants, including /β/, are nasalizable, while fricatives, including /v/, are not. From a phonological perspective, there is no evidence for a place distinction between /v/ and /β/ in Esan; rather they are distinguished by manner based on nasalizability. Sonorancy is a reasonable way of distinguishing the voiced bilabials and labiodentals, but is likely not appropriate for the voiceless ones.

While few languages have a bilabial/labio-dental contrast within a manner of articulation, systems with bilabial stops and labio-dental fricatives are common. In systems with this contrast, it is interesting to ask whether, from a phonological perspective, the primary difference between these is one of manner (stop *vs.* fricative, both labial), one of place (bilabial *vs.* labio-dental, both obstruents), or both. **Dresher (2008: 20, 2009**: 51–52), building on **Trubetzkoy (1969**: 126), argues that both analyses are needed. One is exemplified by Greek, with the inventory in (2) (Dresher's organization).

(2) *Greek*

	labial	apical	sibilant	dorsal
voiceless stop	p	t	ts	k
voiceless fricative	f	θ	s	x
voiced fricative	v	ð	z	ɣ

Trubetzkoy's arguments are based on symmetry: in the sibilant and dorsal series, there is an unambiguous contrast between a stop and a fricative since the stops and fricatives occur at the same places of articulation. Trubetzkoy appeals to

parallelism, proposing that the same holds of the labials, with the difference between /p/ and /f/ based on manner rather than place: a feature is required to distinguish /k/ and /x/, and using that feature for /p/ and /f/ results in a minimal feature set and a more symmetrical inventory than if /f/ were considered to be labio-dental.

While the argument from Greek is based on inventory structure, a similar conclusion, this time based on phonological patterning, can be drawn from the D-effect found in many Athabaskan languages. In the D-effect, a morpheme referred to as *D* combines with a fricative to create a stop or affricate, maintaining the place of articulation of the fricative. The Mountain dialect of Slavey has the fricatives /f s ɬ ʃ x/. When combined with D, they are realized as [p ts tɬ tʃ k]. The labio-dental /f/ combines with *D* to produce a bilabial stop (**Rice 1989**). If these sounds share a place of articulation phonologically, the change is readily expressed as a shift of manner.

Returning to Dresher's discussion of Trubetzkoy, he notes that French differs from Greek (**2009**: 52). Dresher's French obstruent inventory is given in (3).

(3) *French*

	bilabial	labio-dental	apical	alveolar	pre-palatal	dorso-velar
voiceless	p	f	t	s	ʃ	k
voiced	b	v	d	z	ʒ	g

Trubetzkoy's evidence for this arrangement again appeals to symmetry; as **Dresher (2009**: 52) says, "there is no opposition between occlusives and spirants in French, because degree of occlusion cannot be regarded independently of position of articulation." In this case, the relevant phonological distinction between /p/ and /f/ would involve place rather than manner, with each place of articulation having a voiceless and voiced counterpart.

One might ask if there is phonological evidence for the sub-place distinction within labials, as Trubetzkoy and Dresher suggest for French. **Wu (1994)**, discussing Mandarin Chinese, presents tentative evidence for a place contrast between /p/ and /f/, although she ultimately attributes their difference in patterning to historical residue. Nevertheless, it is worthwhile reviewing the type of argument that she offers. In Mandarin many consonants show co-occurrence restrictions with vowels and secondary articulations, and those of the bilabial /p/ and the labio-dental /f/ are similar, but not identical. The bilabial stop /p/ participates in rounding of certain vowels, suggesting its labiality. It does not occur with a labial secondary articulation, which is treated by Wu as an OCP (Obligatory Contour Principle) effect. At the same time, it is palatalizable, and the sequence [pi] occurs.

The /f/ shares some properties with /p/. It participates in rounding of certain vowels, and it is not labializable. These properties group it with /p/, suggesting that it is labial. However, it also differs from /p/. In particular, /f/ is not palatalizable, and the sequence [fi] is not found. Wu suggests that /f/ shares with /p/ properties concerning labiality. She further notes that it shares properties with coronals, namely its patterning with respect to palatality. In the end Wu concludes that the synchronic evidence for treating both Mandarin /f/ as labial and coronal is problematic, as it does not fully share properties with coronals, and she suggests that the coronal-like co-occurrence restrictions represent a historical residue, since /f/ arises historically from a bilabial consonant followed by /iu/ or /io/. Nevertheless, the phonology is tantalizing, and suggests that a distinctive bilabial/labio-dental place distinction might be found in some languages, rather than a manner distinction, as in (3).

2.1.3 Summary

The labial class is phonetically motivated, and phonological evidence shows that labials pattern as a class. In languages without a bilabial/labio-dental contrast within a manner, there is phonological evidence from processes like the D-effect that a stop and fricative differ primarily in terms of manner. In languages with a bilabial/labio-dental contrast at a manner of articulation, little evidence is available, but what there is suggests that at least for voiced sounds, the primary phonological contrast may involve manner rather than place. I conclude the discussion of labials with questions. While, in phonetic charts, the distinction between bilabial and labio-dental is characterized as one of place, is this the most appropriate characterization from a phonological perspective? Are there differences cross-linguistically in terms of phonological patterning?

2.2 Coronal place of articulation

There is a rich literature on coronal places of articulation, with a chapter on coronals in this book (**CHAPTER 12**: CORONALS). For a few of the excellent resources on coronals, see **Hall (1997)** and the collection edited by **Paradis and Prunet (1991)**.

Hall (1997) provides a working definition of "coronal": coronals are produced with the tip and/or blade of the tongue. While there is debate, Hall argues that the following are coronal articulations: interdental, dental, alveolar, palato-alveolar, alveo-palatal, and retroflex. He further argues that palatal fricatives are non-coronals, while sounds that are generally analyzed as palatal non-continuants (stops, nasals) are better classified as alveo-palatal, and are coronal. Based on this, the inventory of coronal voiceless stops and fricatives is shown in (4) (**Hall 1997**: 130).

(4)

	interdental	dental	alveolar	palato-alveolar	alveo-palatal	retroflex
stop		t̪	t		c	ʈ
fricative	θ	s̪	s	ʃ	ɕ	ʂ

Coronals exhibit many complexities, and it is worthwhile introducing the discussion with examples of coronal inventories before addressing evidence for coronals as a class and coronal sub-places.

2.2.1 Coronal inventories

Some coronal obstruent inventories are shown in (5), from **Maddieson (1984)**, unless otherwise indicated, with symbols from Maddieson (sounds identified as unassimilated loans are not included).

(5) a. *Rotokas (North Bougainville)*

alveolar
t

b. *Yareba (Papuan)*

alveolar
t d dz s

c. *Finnish (Uralic)*

dental	alveolar
t̪ (d̪)	s

d. *Hungarian (Uralic)*

dental	palato-alveolar	palatal
t̪ d̪ t̪s̪ d̪z̪ s̪ z̪	ʧ ʤ ʃ ʒ	cɟ ɟj

e. *Pashto (Indo-Iranian)*

dental/alveolar	palato-alveolar	retroflex
t d ts dz s z	ʧ ʤ ʃ ʒ	ʈ ɖ ʂ ʐ

f. *Western Desert (Pama-Nyungan)*

dental	alveolar	retroflex
t̪	t	ʈ

g. *Nunggubuyu (Australian)*

dental	alveolar	palatal	retroflex
t̪	t	c	ʈ

h. *Malayalam (Dravidian) voiceless stops/affricates*

dental	alveolar	palato-alveolar/ palatal	retroflex
t̪ d̪	t	ʧ ʤ	ʈ ɖ

i. *Kalasha (Indo-Aryan; only voiceless stops/affricates shown)* (Arsenault and Kochetov, forthcoming)

dental	palatal	retroflex
t ts	tɕ	ʈ ʈʂ

The above are representative of the coronal obstruent inventories found cross-linguistically, from Rotokas with a single coronal obstruent to the coronal inventories of languages such as Pashto, Malayalam, and Kalasha, with affricates and fricatives as well as stops.

2.2.2 Evidence for coronals as a phonological class

There is considerable evidence that coronals pattern as a class. I summarize some below.

A well-known argument for the class of coronals involves co-occurrence restrictions. **Hall (1997**: 5), following **Davis and Hammond (1995**: 16–64), argues that there are co-occurrence restrictions in most varieties of American English against the sequence coronal + [j] + vowel.

(6) p b m f v k g + j + vowel
*θ ð t d s z ʃ ʒ ʧ ʤ n l r + j + vowel

The prohibition includes all English coronal consonants, and holds of syllable-initial clusters. Thus, clusters with /j/ are not allowed if the first segment is coronal, irrespective of its sub-place of articulation; they are otherwise.

Dixon (1980) discusses a variety of types of evidence from Australian languages for grouping coronal consonants as a class. One argument is based on neutralization and variation amongst coronals (**CHAPTER 80**: MERGERS AND NEUTRALIZATION). Typical Australian languages show a four-way coronal contrast, subdivided into apicals and laminals, with each further subdivided. **Dixon (1980)** points out that the coronal subclasses in some Banjalang dialects, apical and laminal, neutralize intervocalically; the place contrast is maintained elsewhere and other places of articulation are not involved. There is often free variation between apical and laminal articulations for the stop, with the choice differing by dialect.

Hamilton (1993) offers evidence from Australian languages for the class of coronals based on phonological patterning. For instance, coronals provide an environment for a phonological process in Nunggubuyu (**Heath 1984**: 69–71), where a palatal deletes in a derived environment before a coronal; with a following labial or velar, deletion does not occur. In Walmatjari (**Hudson 1978**: 11–12), there are suffixes beginning with a retroflex lateral; following a coronal, the initial consonant of the suffix assimilates in place of articulation to the coronal; following a non-coronal, other changes occur, but the consonant does not assimilate.

Moving away from Australia, there are languages with co-occurrence restrictions on different coronal places of articulation. In Päri (Western Nilotic), dental and alveolar stops and nasals contrast, and do not co-occur within a root (**Andersen 1988**; **Hansson 2010**). This harmony is actively enforced in suffixed forms. In another Nilotic language, Dholuo, the co-occurrence restriction holds of the dental and alveolar stops; there is a single nasal that does not participate. Pohnepian (Austronesian; **Rehg and Sohl 1981**) has contrastive dental and retroflex stops; these do not co-occur within a root.

Assimilation provides evidence for the coronal class, as in the Sanskrit *nati* process. Basically, a retroflex triggers retroflexion of a following /n/. Retroflexion is transparent with respect to intervening labial and dorsal consonants, but is blocked if a coronal of any place of articulation (dental, palatal, retroflex) intervenes; see **Hansson (2010)**.

(7) a. *non-coronal consonants between trigger and target*

iṣ-na:	iṣṇa:-	'seek (PRESENT STEM)'
vrk-na	vrkṇa-	'cut up (PASSIVE PARTICIPLE)'
kṣubh-a:na	kṣubha:ṇa-	'quake (MIDDLE PARTICIPLE)'

b. *coronal consonant between trigger and target*

mrd-na:	mrdna:-	'be gracious (PRESENT STEM)'
marj-a:na-	marja:na-	'wipe (MIDDLE PARTICIPLE)'

In addition, in assimilation in Sanskrit a dental assimilates to an adjacent coronal, but not to other places of articulation; see §4.

There is thus clear evidence from several sources that in languages with more than one coronal place of articulation these can pattern as a class.

While in some cases evidence exists that all coronals of a language are in a single class – for instance, English (6) – the class of coronals may pattern together, but only within a manner class. An example comes from Nilotic languages (**Mackenzie 2009**; **Hansson 2010**), where harmony occurs between coronal stops and nasals, or just stops, depending on the language, but liquids and continuants do not enter into the harmony.

Stratification by manner exists in the consonantal root consonant co-occurrence restrictions in many Semitic languages, where sounds within a class are dis-preferred within a root. While coronal sonorants and stops, for instance, co-occur, coronal fricatives rarely co-occur within a root.

(8) *Arabic coronal co-occurrence restrictions* (Rose 1996: 75)

coronal sonorants	l r n
coronal stops	t d (plus emphatic counterparts)
coronal fricatives	ʃ ʒ s z θ ð (plus emphatic counterparts)

See **Coetzee and Pater (2008)** for discussion of place/manner effects in Muna.

Phonological evidence thus exists for the class of coronals as a whole; in some cases the patterning of coronals is stratified by manner.

2.2.3 Coronal sub-places of articulation

Because coronals allow several subclasses, the internal structure of the coronal region has received detailed attention. For this we look to languages with four distinctive places of articulation within coronals, where the distinction commonly called

apical/laminal receives wide support. **Evans (1995**: 727) notes that "There is an enormous amount of evidence – from phonotactics, morphophonemics, diachronic changes, and synchronic variation for these groupings," referring to apical (alveolar, retroflex) and laminal (dental, palatal) in the coronals of languages of Australia. **Hamilton (1993)** presents a variety of kinds of evidence for this subdivision.

Allophony presents one type of evidence. If there is a single apical and/or a single laminal place, allophonic variation may exist within it. For instance, in single laminal languages such as Watjarri (**Douglas 1981**: 203–204), alternations or variation between alveo-palatal and dental articulations occur, often conditioned by the following vowel. Some languages show variation in apical articulations, with non-contrastive alternation between alveolar and retroflex articulations in different vocalic environments; Wargamay is an example (**Dixon 1980**: 155–156).

Neutralization is a second type of evidence. In many Australian languages the two apical articulations neutralize to a single non-contrastive series word-initially, often symbolized as a retroflex but sometimes as an alveolar; **Hamilton (1993**: 32) remarks that only a few languages show an apical contrast word-initially. In some languages the laminal articulations neutralize syllable-finally, generally reported as palatal; **Hamilton (1993**: 33) notes that only a few languages exhibit this contrast syllable-finally.

Phonotactics treat apicals and laminals as natural classes: apical consonants are permitted in certain environments to the exclusion of laminals, and vice versa. For instance, in some languages both apicals occur as the initial member of a cluster, while laminals are not permitted in this position (e.g. Kalkatungu; **Blake 1979**); in other languages both laminals occur as the second member of a heterorganic cluster, while apicals are not allowed (e.g. Nunggubuyu; **Heath 1984**).

Phonological processes can reference apical or laminal. For example, Mara (**Heath 1981**) has a dummy syllable in certain cases between a prefix and a root when the root begins with an apical sonorant; it does not occur with other places of articulation, including laminals. In some languages a lenis laminal stop becomes a glide intervocalically; apicals are not affected (e.g. Djapu; **Morphy 1983**).

Local harmony occurs within the apical set and within the laminal set in some languages. In particular, clusters of heterorganic apical clusters and heterorganic laminal clusters are not permitted in some languages, while clusters of an apical and a laminal are allowed; Dhuwala-Dhuwal (**Morphy 1983**) is an example.

Dravidian languages also exhibit an apical/laminal contrast, as argued by **Arsenault (2008)**. For instance, word-initial apicals, both alveolar and retroflex, are dispreferred in these languages, with only laminals occurring.

Serbian provides evidence for apical and laminal classes, and for cross-classification between them; see **Morén (2006)** and **Radišć (2009)**. Serbian has coronal stops/affricates as follows (only voiceless stops illustrated).

(9) t ʦ ʧ ʨ

Evidence for constituency within the coronals comes from several processes. A process called iotation groups together the first and last of these as opposed to the other two: /t ʨ/ *vs.*/ʦ ʧ/. Mid-vowel fronting provides evidence for /ʧ ʨ/ as a class, with / ɔ/ fronted to [ɛ] in the environment of these places of articulation. Assuming that the first and fourth columns represent laminal articulations and the middle two apical articulations, based on descriptions of the sounds, apical/ laminal provides the classes involved in iotation. The further back of the apicals and laminals (last two columns) provide the environment for mid-vowel fronting. Thus, while the Australian languages do not appear to provide evidence for cross-classification within the apical and laminal subgroups, Serbian does provide for such classification.

While the division of coronals into apical and laminal receives support from languages with four coronal sub-places, other divisions appear to be possible. In Tahltan (Athabaskan), there are four coronal places of articulation (**Shaw 1991**; also §6.1); only voiceless stops and affricates are indicated.

(10) t tθ ʦ ʧ

The latter three enter into harmony, with the plain /t/ excluded. Assuming that the affricates are stops in Tahltan, with the consonants in (10) distinguished solely by place of articulation, as Shaw argues, then the phonology does not appear to support a primary apical/laminal distinction.

There may be asymmetries between the number of coronal places of articulation available at different manners of articulation. Polish obstruents offer an interesting example. Voiceless symbols are shown; all have voiced counterparts.

(11) t ʦ ʈʂ ʨ
s ʂ ɕ

The stops/affricates and fricatives at a place of articulation do not always pattern together phonologically. For instance, /t/ and /s/ undergo palatalization, but /ʦ/ (and other stop/affricates and fricatives) does not. In second velar palatalization, /k/

shifts to [ts], while [x] shifts to [ʂ]. Similarly, [t] and [s] both occur with high vowels [i] and [ɨ], while other coronal obstruents are restricted, with [ts ʂ tʂ] only with the central vowel and [ʦ tʦ] only with the front vowel. Based on such processes, **Jarmasz (2009)** concludes that /t/ and /s/ pattern together from a phonological perspective in terms of place of articulation, as do /ts/ and /ʂ/, with their phonology belying the phonetic organization.

To summarize, phonological evidence exists for a coronal class, and for subplaces within the coronals. The apical/laminal contrast is well supported by the phonology of many languages, but it is not clear that it is supported in all complex coronal systems.

Coronals do not necessarily pattern together within a language, but may be stratified by manner of articulation. Further, the phonological and phonetic organizations of different manners of articulation may be distinct. Thus, phonetic classification does not always point directly to phonological patterning of a particular sound.

2.2.4 Summary

Many questions arise within coronals, and I highlight one here. What is the manner status of coronal affricates? Affricates are sometimes assumed to be stops phonologically; for instance, **Jakobson *et al.* (1952)** use stridency to distinguish coronal stops and affricates. Others distinguish affricates from stops by manner: **Chomsky and Halle (1968)** use a feature [delayed release], and others use contour segment analyses of some sort (e.g. **Sagey 1990**); see **CHAPTER 16**: AFFRICATES. In the above discussion, I have assumed the place of articulation perspective based on arguments in the sources. However, Kalasha (Arsenault and Kochetov, forthcoming) illustrates different patterning of coronal stops and affricates at the same place of articulation, with co-occurrence restrictions within stops and within affricates, but not between stops and affricates. Again, the relationship between place and manner is important, and demands further study.

2.3 Velar and post-velar places of articulations

The phonology of velar and post-velar places of articulations is complex; see, for instance, **Bessell (1992)**, **McCarthy (1994)**, **Rose (1996)**, **Shahin (2002)**, and **CHAPTER 25**: PHARYNGEALS. I begin with dorsals, focusing on velars and uvulars, and then add radicals (tongue root, pharyngeal) and laryngeals into the mix.

2.3.1 Dorsals

I use the term “dorsal” to represent the general region, and “velar” and “uvular” to represent places of articulation within this region.

Ladefoged and Maddieson (1996: 44) include palatal, velar, and uvular consonants as dorsals, based on articulatory properties: all involve the tongue body rather than the blade as the active articulator. **Chomsky and Halle (1968)** treat palatals as non-coronals. As mentioned in §2.2, **Hall (1997)** argues that the term palatal as generally used does not represent a coherent class; he proposes that palatal fricatives are a type of dorsal while palatals of other manners of articulation are a type of coronal. Hall presents phonetic evidence and phonological evidence for his claim; the latter is summarized below.

Hall (1997: 15–16) cites evidence from Bzhedukh (West Circassian; **Colarusso 1988**). Bzhedukh has a rich inventory of coronal obstruents (transcription from **Hall 1997**: 16).

(12)	t	tʰ	tʼ	alveolar
	s			alveolar
	s̪		s̪ʼ	dental
	sw		swʼ	labialized alveolar
	ʂ	ʂʰ		retroflex
	ɕ	ɕʰ		alveolopalatal
	ɬ		ɬʼ	lateral

In addition, it has palatals.

(13)	ç	çʰ	palatal

Hall, following Colarusso, argues that palatal fricatives are not coronal, based on phonotactic generalizations about consonant clusters. In a cluster, the first consonant can be a labial, a voiceless uvular fricative, or a voiceless coronal stop or fricative. However, clusters cannot begin with a palatal fricative. As **Hall (1997**: 16) notes, this would be surprising if the palatal fricatives were coronal, since all other coronal stops and fricatives occur as the first consonant in a two consonant cluster. This argument perhaps establishes the status of the palatal as a non-coronal, but does not establish what it is; dorsal is a logical choice.

2.3.2 Evidence for dorsals as a phonological class

Considerable evidence exists for dorsals (velars, uvulars, palatal fricatives) as a class from allophonic patterning, co-occurrence restrictions, and harmony.

Velars, uvulars, and palatal fricatives enter into allophonic relations (CHAPTER 11: THE PHONEME). **Hall (1997)** notes that in German, the fricatives [ç x χ] are in complementary distribution, suggesting a common feature: they are dorsals, varying by sub-place.

Co-occurrence restrictions present another type of evidence for a single class. **Rose (1996)**, after **Bessell (1992)**, shows that Interior Salish has co-occurrence restrictions on place and manner; the place restrictions are summarized in (14). Identical places of articulation are disallowed within a manner; in addition, velar and uvular consonants fail to co-occur.

(14) *labial V labial
*coronal V coronal
*velar V velar
*uvular V uvular
*laryngeal V laryngeal
also
*velar V uvular
*uvular V velar

Thus the velars and the uvulars interact in excluding one another.

In Arabic, co-occurrence restrictions hold of dorsals just as they do of labials and coronals, dispreferring the co-occurrence of velar and uvular stops [g k q]. Note also the co-occurrence restrictions on gutturals, discussed below.

Dorsal harmony, involving velars and uvulars, provides evidence for velars and uvulars forming a class. **Hansson (2010)** discusses several cases. In Misantla Totonac (Totonacan), velar and uvular stops harmonize. The primary facts are given below; see **MacKay (1999)** and Hansson for details.

(15) *Misantla Totonac* (MacKay 1999)

/ut maka-ʃqat/	ˈʔʊt maˈqaʃˈqɛt	's/he scratches X (with hand)'
/ut maka-paʃ/	ˈʔʊt makaˈpaʃ	's/he bathes his/her hand'

A similar harmony occurs in the related Tlachichilco Tepehua.

(16) *Tlachichilco Tepehua* (Watters 1988)

/ʔuks-laqtsʼin/	ʔoqslaqtsʼin	'look at Y across surface'
/ʔuks-kʼatsa:/	ʔuksk'atsa:	'feel, experience sensation'

Hansson (2010) argues that Bolivian Aymara (Aymaran) has dorsal harmony. The language has plain, aspirated, and glottalized stops at velar and uvular places of articulation with restrictions on phonation type as well as place; I abstract away from the former. While velars co-occur and uvulars co-occur, a velar and a uvular do not.

(17) *Bolivian Aymara* (de Lucca 1987)

q-q, qh-qh, q'-q'
k-k, kh-kh, k'-k', k'-k
*k-q, q-k (any laryngeal properties)

Hansson notes that dorsal consonant harmony is cross-linguistically rare. In order to ascertain whether this is true, it is necessary to examine the occurrence of dorsal harmony in languages with contrastive velars and uvulars.

Given the debate about whether the bilabial/labio-dental distinction involves place or manner (§2.1), one might ask if the velar/uvular distinction always involves place. Some processes point to the conclusion that place is the primary dimension of contrast in languages with this distinction. In spirantization processes, just as /p/ spirantizes to [f], /k/ spirantizes to [x], and /q/ to [χ]. In the Athabaskan D-effect, /x/ hardens to [k] and /χ/ to [q] (e.g. Ahtna). This process shows the importance of place of articulation in distinguishing velars and uvulars.

When there is not a contrast between a velar and uvular within a manner, an inventory with velar stops and uvular fricatives is sometimes found. For instance Welsh (Celtic; **Ball and Müller 1992**) has voiced and voiceless velar stops, [k g], and a voiceless uvular fricative, [χ]. Welsh has mutations (see CHAPTER 117: CELTIC MUTATIONS); in Soft Mutation, /k/ becomes [g],

while in Aspirate Mutation, /k/ spirantizes, becoming the voiceless uvular fricative [χ]. This parallels mutation at other places of articulation: under Soft Mutation, /p/ becomes [b] and /t/ becomes [d]; under Aspirate Mutation, /p/ becomes [f] and /t/ mutates to [θ]. Basically, mutation triggers a manner change, maintaining place. Thus, while the stop and fricative differ in place and manner phonetically, phonologically they differ in manner, and the organization in (18) is appropriate:

(18)

dorsal stop	k g
dorsal fricative	χ

One can ask if a different phonological organization is possible, with a primary place difference realized as a manner distinction, as in (19).

(19)

velar	uvular
k	x

If, for instance, a language existed in which there were co-occurrence restrictions on obstruents of like place, and [k]–[x] combinations were allowed, we might conclude that the [x] patterned as a distinct place of articulation, realized phonetically as a spirant.

To summarize, dorsal includes velars, uvulars, and likely palatal fricatives. Evidence for this class is based on allophony, co-occurrence restrictions, harmony, and other phonological processes.

2.3.3 Laryngeals

I now consider laryngeal consonants. There is considerable discussion of laryngeal consonants in the literature, where they are accorded two treatments. They are often considered to lack a place of articulation (e.g. **Steriade 1987**), and they are also considered to be a type of pharyngeal (e.g. **Lombardi 2002**). In this section I present evidence for placelessness; evidence for their pharyngeal nature is given in §2.3.4.

The primary argument for the laryngeal class, glottal stop, and [h] being placeless comes from laryngeal transparency. The following evidence, from Kashaya (Pomoan), is from **Buckley (1994)**, summarized by **Rose (1996**: 100–101). Within a morpheme, vowels are identical across a laryngeal consonant (20a), while there are no general co-occurrence restrictions on vowels (20b).

(20)

a.	s'i?i	'flesh'	he'?en	'how'	ma?a	'food, eat'
	ni'hin	'to oneself'	behe	'bay nut'	juhu	'pinole'
	?aha	'mouth'				
b.	du'we?	'yesterday'	n'uqa:ʧ	'get lost'	maʧe-	'hold with foot'

This is an argument for laryngeal placelessness, under the assumption that specified places of articulation block assimilation. If laryngeals lack a specified place of articulation, vowel features can harmonize across them.

Laryngeals can pattern as a class. There may be co-occurrence restrictions, as in Interior Salish (14). In addition, laryngeals often result from obstruent debuccalization, with stops neutralizing to [ʔ] and fricatives to [h], as in the historical development of Kelantan Malay (**Trigo 1988**).

(21)

Standard Malay	*Kelantan Malay*	
?asap	?asa?	'smoke'
kilat	kila?	'lightning'
balas	balah	'finish'

2.3.4 Pharyngeal (radical, tongue root)

The final articulation region identified by **Ladefoged and Maddieson (1996**: 37), radical, includes pharyngeal and epiglottal sounds, i.e. sounds articulated in the region below the uvula.

Ladefoged and Maddieson identify one language with contrastive pharyngeal and epiglottal fricatives, the Burkikhan dialect of Aghul (Caucasian; **Ladefoged and Maddieson 1996**: 37–38).

(22)

voiceless pharyngeal fricative	muħ	'barn'	muħar	'barns'
voiceless epiglottal fricative	mɛʜ	'whey'	mɛʜɛr	'wheys'

From a phonological perspective, the class that is often called gutturals (uvulars, pharyngeals, laryngeals) has received

considerable attention (e.g. **Hayward and Hayward 1989**; **McCarthy 1994**; **Rose 1996**; **Shahin 2002**). Coronal emphatics are included in the gutturals; I do not discuss these.

(23) *Gutturals*

	uvular	pharyngeal	laryngeal
stop	q ɢ		ʔ
fricative	χ ʁ	ħ ʕ	h
approximant		ʀ	

Now-familiar types of evidence exist for treating gutturals as a class. Root co-occurrence restrictions in Arabic disprefer the co-occurrence of gutturals.

(24) χ ʁ ħ ʕ h ʔ

Uvular fricatives pattern with pharyngeals and laryngeals, while uvular stops pattern with velars, as seen earlier; thus the type of manner stratification observed with palatals is evident in uvulars as well.

Hayward and Hayward (1989), **McCarthy (1994)**, **Rose (1996)**, **Shahin (2002)**, and **CHAPTER 25**: PHARYNGEALS, among others, present evidence for a guttural class. In addition to co-occurrence restrictions, gutturals trigger phonological processes. In some Arabic dialects, gutturals are not allowed syllable-finally, triggering epenthesis. The epenthetic vowel is in brackets.

(25) *Negev Bedouin Arabic* (McCarthy 1994: 214; from Blanc 1970)

aʃrab	'I drink'	jah[a]rdʒ	'he speaks'
		aʕ[a]rf	'I know'
		aħ[a]lam	'I dream'
		aχ[a]bar	'I know'

Gutturals can trigger vowel lowering, as in Syrian Arabic, where the suffix /-e/ is realized as [a] following a guttural.

(26) *Syrian Arabic* (Cowell 1964: 138; McCarthy 1994: 219; Rose 1996: 75)

[-e] *after non-gutturals*		[-a] *after gutturals*	
daraʒ-e	'step'	waːʒh-a	'display'
ʃerk-e	'society'	mniːħ-a	'good'
madras-e	'school'	daggaːʁ-a	'tanning'

Transguttural vowel harmony occurs in some languages, illustrated with Iraqw (Cushitic).

(27) *Iraqw* (van der Hulst and Mous 1992: 103–104; Mous 1993: 37; Rose 1996: 77)

no harmony across non-gutturals			*harmony across gutturals*		
hamaatl-iim	[hamtliim]	'wash'	buuʔ-iim	[buʔuum]	'harvest pay'
baal-iim	[baaliim]	'defeat'	ufaaħ-iim	[ufaħaam]	'blow'

In D'opaasunte (Eastern Cushitic), a vowel is lower when the preceding consonant is guttural, ([χ ɢ ʕ ħ ʔ h]); it is higher after other consonants (**Hayward and Hayward 1989**). Hayward and Hayward use "A," an archiphoneme, to represent this vowel.

(28) *D'opaasunte* (Hayward and Hayward 1989: 183–184)

ʔan 'kod[ɛ]j	'I am working'	ʔan 'ɬ'oχ[a]j	'I am milking'
ʔan ħull[ɛ]j	'I am entering'	ʔan fAʔ[a]j	'I am loading'

In Standard Somali (Cushitic), a suffix has the form [-d] after a guttural ([q χ ʕ ħ ʔ g]) and [-t] elsewhere (**Hayward and Hayward 1989**: 184).

Laryngeals thus pattern as if they were placeless in some languages and as if they were guttural in others. Rose asks whether it is accidental how they pattern, or if there is a systematic way to determine this. She argues that laryngeals pattern with pharyngeals when pharyngeals or uvular continuants are present in a system; otherwise they pattern as if they lacked a specified place.

2.3.5 Summary

Dorsal consonants (velar and uvular) interact in many languages, and they also interact with further back consonants in some languages. As with labials and coronals, many questions remain, and I conclude with one. The sound commonly written with the symbol /ŋ/ is ambiguous in its patterning, in some languages patterning as a velar and in some as if it were placeless or laryngeal (e.g. **Trigo 1988**; **Rice 1996**; **de Lacy 2006**). Is this an appropriate analysis? Is it only the manner that represents these two places of articulation, perhaps better written as /ŋ/ and /N/, or can other manners of articulation also show this kind of ambiguity between patterning as a laryngeal and patterning as a velar?

2.4 Conclusion

In this section I have examined phonological evidence for the major places of articulation: labial, coronal, dorsal, radical, and laryngeal. In all cases, there is clear evidence for the class, and, at the same time, complexities involving such things as stratification by manner and interactions between place classes require further study.

3 Further constituency

We have seen evidence for five major places of articulation, three in the oral cavity and two further back. While there is general acceptance of this division in the literature, debate exists about whether these major places of articulation enter into relationships with one another, or, to put this another way, whether there is constituency among places of articulation (see CHAPTER 27: THE ORGANIZATION OF FEATURES). One might imagine that there is no relationship between them, with a flat structure. Alternatively, one might imagine that some of the places of articulation are more closely linked to one another than others are, with a constituent structure. I examine this with respect to labial, coronal, and dorsal, where two possible groupings are proposed. One involves grouping labials and dorsals to the exclusion of coronals, under a feature [grave] or [peripheral]. The other involves grouping coronals and dorsals to the exclusion of labials; the feature has been called [lingual]. One might imagine a grouping of coronals and labials to the exclusion of velars, a proposal that has not received support; see §5 on the controversy about the feature [anterior], which groups labials and front coronals.

3.1 Oral and pharyngeal

Before turning to these proposals, I briefly review proposals for the overall organization of place. **McCarthy (1994**: 223) argues within feature geometry for the bifurcation of place into two major constituents, which he terms Oral and Pharyngeal. Oral dominates Labial, Coronal, and Dorsal. Others have refined this proposal to, for instance, allow [RTR] as a dependent of Pharyngeal; see **Rose (1996)** for discussion of how to accommodate the guttural class.

3.2 Grouping labials and dorsals

Evidence is found in the literature for grouping labials and dorsals; see **Hall (1997)** for detailed references, including **Jakobson *et al.* (1952)**, **Jakobson and Halle (1956)**, **Hyman (1973)**, **Campbell (1974)**, **Odden (1978)**, and **Rice (1994)**. Hall gives the following evidence for labials and velars (and/or uvulars) patterning together, among others.

In Yurok (Algic), the 3rd person prefix is [ʔu] before non-coronals (labials, velars, labial-velars) and [ʔwe] before coronals. In Lhasa Tibetan the consonants [p k q] spirantize and voice intervocalically, while coronals do not. A vowel shift occurred in the history of Korean before labials and velars but not before dentals and alveo-palatals.

Many of the arguments presented by Hall are diachronic. There are also syn-chronic arguments for grouping labial and velar. One of the best-known arguments comes from Korean, where, in some speech forms, the coronal stop and nasal assimilate in place to a following adjacent consonant, and the labial stop and nasal assimilate to a following velar; the velar stop and nasal do not assimilate. If labial and velar are grouped together, their patterning can be understood: coronals assimilate to these places, identified as grave. In (29), a place of articulation assimilates to those to its right, but not vice versa. Thus a coronal (T) assimilates to both a labial (P) and a velar (K), while a labial assimilates only to a velar, and a velar does not assimilate.

(29) [T [P K]]

Lombardi (1996) identifies cases that suggest the need for grouping labials and velars (her [−coronal]) in post-lexical rules. For instance, between word sequences in Pohnepian (**Rehg and Sohl 1981**; **Rehg 1984**), a labial is realized as a labial nasal when followed by a labial, and a velar is realized as a velar nasal before another velar.

(30) *labial + labial*
e kala/p p/aan soupisek 'he'll always be busy'
e kala[m p]aan soupisek
velar + velar
e sai/k k/eŋwini 'he hasn't yet taken medicine'
e sai[ŋ k]eŋwini

However, with a sequence of coronals, the first does not become a nasal.

(31) e mei/t t/aŋaaŋa 'Aren't you lazy!'
*e mei[n t]aŋaaŋa

Thus evidence for grouping labials and dorsals is both diachronic and synchronic.

3.3 Grouping coronals and dorsals

Arguments for grouping coronals and velars as linguals are also found. **Rubach (1993)**, followed by **Lombardi (1996)**, adduces evidence from Slovak (Slavic), where /æ/ backs to [a] post-lexically in an environment that Rubach calls [−labial]. There is a contrast between these vowels following a labial (32), but not elsewhere.

(32) masa 'mass'
mæso 'meat'

The diminutive suffix illustrates the alternation between [a] and [æ]. The suffix is a front vowel after a labial (33a), following a non-labial it is [a], with palatalization of the preceding consonant (33b, 33c).

(33) a. holub 'pigeon' holub-æ 'young pigeon'
b. had 'reptile' haad'a 'young reptile'
c. vnuk 'grandchild' vnuʧa 'young grandchild'

Rubach argues that the suffix is underlyingly front; it triggers palatalization and is backed following a coronal and a velar (see CHAPTER 121: SLAVIC PALATALIZATION).

The facts are complicated by the presence of a diphthongization process where /æ/ becomes [ia]. The forms in (34) show lengthening in the genitive plural, with /a/ lengthening to [aa].

(34) lano 'strong' laan (GEN PL)
pivo 'beer' piiv (GEN PL)

While generally vowels lengthen in the genitive plural, diphthongization occurs in some environments, including with /æ/, which diphthongizes to [ia].

(35) hovædo 'beast' hoviad (GEN PL)
mæso 'meat' mias (GEN PL)

Diphthongization also occurs following an alveo-palatal consonant.

(36) ʒaba 'frog' ʒiab (GEN PL)

Backing of the vowel occurs after a velar.

(37) /kæd/ okadit' 'to incense' okiadzat' (IMPERFECTIVE)

Rubach argues that this provides evidence for [−labial], with non-labials inducing backing of /æ/. An alternative analysis is perhaps possible, where a consonant preceding the low front vowel /æ/ absorbs the frontness of that vowel, being realized as a palatal consonant; this is not possible with a labial. **Clements and Hume (1995)** present evidence that they say might support the need for [lingual], as do **Browman and Goldstein (1989)**. This evidence relies on understanding the features of vowels; I do not review it here.

While proposals for grouping places of articulation into constituents come largely in the feature geometry literature, such proposals are mimicked in the Optimality Theory literature, where feature geometry has not been a major concern. In particular, **de Lacy (2006)** proposes constraints on place of articulation; I give the markedness constraints in (38); there are mirroring faithfulness constraints.

(38) *dorsal
*dorsal, labial
*dorsal, labial, coronal
*dorsal, labial, coronal, laryngeal

The effect of these constraints is to group dorsals and labials together, to the exclusion of coronals.

3.4 Summary

There are proposals for grouping major places of articulation. Labial and dorsal are argued to pattern together as opposed to coronal; coronal and dorsal are argued to pattern together as opposed to labial. There is relatively strong support from consonants for grouping labials and dorsals, and less support for grouping coronals and dorsals, with much of the evidence relying on consonant–vowel interactions.

4 Asymmetries in place of articulation

Some evidence exists that the major places of articulation are organized into constituents, as discussed in §3. In addition to constituency, questions of equipollency have been important in the place literature. Are the major places of articulation equipollent, or equivalent in nature, or do asymmetries in patterning of places of articulation with respect to one another exist? In particular, are there cases in which a place of articulation patterns as if it were absent, as suggested in the discussion of transparency (§2.3)? This type of asymmetry has been interpreted as linked to phonological markedness and has been implemented representationally as underspecification, or absence of particular features in underlying representation, and, with constraints, as evidence for markedness hierarchies; see CHAPTER 4: MARKEDNESS and CHAPTER 12: CORONALS for discussion.

4.1 Coronal unmarkedness

There is a rich literature on the patterning of coronals, with arguments that coronals pattern asymmetrically with respect to other places; this is often interpreted as unmarkedness of coronals with respect to other places of articulation. Various types of evidence are evinced to support this conclusion. Coronals may serve as epenthetic consonants (e.g. Axininca Campa (Arawakan)), and often result from neutralization, both considered to be indicators of unmarkedness. Neutralization to coronal is illustrated in (39).

(39) *Saami (Uralic): Word-final consonants neutralize to coronal* (Odden 2005: 244)

	nom sg	*essive*
ahhkub-in	ahhkut	'grandchild of woman'
ʧuoivvag-in	ʧuoivvat	'yellow-brown reindeer'

In addition, coronals are frequent targets of assimilation, but are less likely to be assimilation triggers, another diagnostic taken to indicate coronal unmarkedness (CHAPTER 81: LOCAL ASSIMILATION). Catalan is shown here, with a four-way place of articulation contrast in word-final nasals.

(40) *Catalan (Romance) word-final place of articulation contrasts* (Hualde 1992: 379)

ʎum 'light'
gran 'big'
baɲ 'bath'
baŋ 'bank'

The plain coronal, /n/, assimilates to the place of articulation of the following consonant.

(41) *Coronal nasal assimilates to following places of articulation* (Hualde 1992: 395)

so/n/	'they are'	so[m] pɔks	'they are few'
		so[ŋ] grans	'they are big'

The labial and velar nasals fail to assimilate to the place of articulation of a following consonant; see (42c) for patterning of the palatal.

(42) a. *Labial nasal fails to assimilate in place* (Hualde 1992: 395)

so/m/	'we are'	so[m] pɔks	'we are few'
		so[m] grans	'we are big'

b. *Velar nasal fails to assimilate in place* (Hualde 1992: 404)

a[ŋ]	'bank'	ba[ŋ] bɔ	'good bank'

c. *Palatal nasal fails to assimilate in place or decomposes to* j-N, *with assimilation* (Hualde 1992: 395)

a/ɲ/	'year'	a[ɲ] pətit	'small year'
a/ɲ/		a[jm] passat	'past year'

There is discussion of the analysis of the final velar nasal (**Hualde 1992** argues that it is underlyingly /Nk/, with a placeless nasal); in any case, it fails to assimilate.

Based on the patterning of different places of articulation in languages such as Catalan, coronal place is argued to be unmarked, or asymmetric, in its ability to assimilate, as coronals shift to other places of articulation, and the other places of articulation fail to assimilate (or might assimilate only within their place of articulation).

As noted above, these asymmetries are expressed in two major ways. In the literature on structured representations, this is interpreted as coronal under-specification. In theories that eschew underspecification, hierarchies are proposed, where, of labial, coronal, and dorsal, coronals are identified as the least marked and dorsals as the most marked; see (38) and, for instance, **Lombardi (2002)** and **de Lacy (2006)**.

4.2 Challenges to coronal unmarkedness

While coronals are often considered to be universally unmarked with respect to other places of articulation, challenges to this claim are apparent when the phonological patterning of other places of articulation is examined.

4.2.1 Languages with more than one coronal sub-place

When one considers languages with more than one coronal place of articulation, the facts around assimilation are often different. For instance, in Sanskrit (Indo-Aryan), with labial, dental, retroflex, palatal, and velar places of articulation, the dental assimilates, but only to coronal places of articulation, not to non-coronal places, as in (43) and (44).

(43) *Sanskrit: Dental assimilates to other coronal sub-places* (Arsenault 2008)

a. *Assimilation of dental in dental–coronal sequences*

tat + ɖaukate	taɖɖaukate	'it approaches'
etat + ʧattram	etaʧʧattram	'this umbrella'
pa:tas + ʈalati	pa:taʂʈalati	'the foot is disturbed'
tatas + ʧa	tataʃʧa	'and then'
ta:n + ɖimbha:n	ta:nɖimbha:n	'those infants'
ta:n + ʤana:n	ta:nʤana:n	'those people'

b. *Assimilation of dental in coronal–dental sequences*

i:ɖ + te	i:ʈʈe	'he worships'
iʂ + ta-	iʂʈa-	'desired'

(44) *Sanskrit: No assimilation of dental to non-coronal places of articulation*

maha:n + bha:gah	maha:nbha:gah	'great poet'
maha:n + kavih	maha:nkavih	'illustrious'

There are thus differences between languages with a single coronal place and ones with multiple coronal places of articulation, as discussed by **Avery and Rice (1989)**. In the former, the coronal may be the target for general assimilation,

while in the latter the coronal may assimilate, but locally, to other coronal places of articulation; it fails to assimilate to labials and velars.

Many Slavic languages exhibit a third pattern: the velar can undergo a shift in place of articulation, resulting in a coronal. This is exemplified for Serbian in (45).

(45) a. *Serbian: First palatalization* (Radišić 2009)

ru/k/a + itsa	ru[ʧ]itsa	'hand'
pra/x/ + iti	pra[ʃ]iti	'dust'

b. *Serbian: Second palatalization* (Radišić 2009)

ɔra/x/ + i	ɔra[s]i	'nut'
pɛ/k/ + i	pɛ[ts]i	'to bake'

Coronals also shift their place of articulation in iotation, but remain coronal.

Thus, while in languages such as Catalan coronals shift to another major place of articulation in assimilation, in Sanskrit coronals are assimilation targets, but only assimilate to other coronals, and in many Slavic languages, coronals shift to other coronals and velars shift to coronals. To use the terminology of phonological markedness, based on such shifts we might identify the velar as unmarked in languages like Serbian, and the coronal as unmarked in languages like Catalan and Korean. Given the nature of the coronal inventories in languages like Sanskrit and Serbian, with more than one coronal sub-place allowed in assimilator position, one might conclude based on target asymmetries, as did **Avery and Rice (1989)**, that coronals are unmarked generally, attributing their patterning in languages with more than one coronal sub-place to the fact that there is more than one sub-place. The existence of more than one coronal sub-place indeed appears to affect the patterning of coronals, and in the following discussion I set these languages aside and examine assimilation and neutralization in the absence of a rich coronal inventory, beginning with neutralization. I consider languages with labial, coronal, and dorsal places of articulation.

4.2.2 Neutralization, epenthesis, and the emergence of the unmarked

Neutralization is considered to yield the unmarked (CHAPTER 80: MERGERS AND NEUTRALIZATION). Languages with word-final neutralization are shown in (46). These languages exhibit passive neutralization, with morphotactics that disallow other places of articulation for stops word-finally. In addition to coronal stops, languages exist where only labial stops occur in this position, or where only dorsal stops are allowed in this position.

(46) a. languages allowing only a coronal stop: Saami, Finnish

b. languages allowing only a labial stop: Nimboran (Papuan; **Anceaux 1965**), Basari (Niger-Congo; **Abbott and Cox 1966**)

c. languages allowing only a dorsal stop: Quichua (Quechua; **Orr 1962**)

While there are statistical differences, with coronals (and laryngeals) more common as the only place of articulation allowed when no contrasts exist in stops word-finally, overall, the range of places of articulation occurs cross-linguistically in this position. If neutralization is a diagnostic for unmarkedness, and if coronal is universally unmarked, these patterns are unexpected. Epenthesis mirrors neutralization, with at least laryngeal, coronal, and dorsal consonants serving as epenthetic. While **de Lacy (2006)** and **de Lacy and Kingston (2006)** argue that dorsal obstruents are never epenthetic synchronically, cases are reported. For instance **Svantesson *et al.* (2005)** propose an epenthetic [g] in Mongolian (Halh dialect) and related languages, and **Duanmu (2000)** notes an epenthetic voiced consonant that varies between a glottal stop, a voiced glottal fricative, a voiced velar continuant, and a velar nasal before a non-high vowel in Mandarin.

In neutralization and epenthesis, in the absence of a contrast, it appears that any place of articulation is possible phonetically. Moreover, in assimilation, different places of articulation can serve as assimilation target. For instance, while in many languages with an /m/–/n/ contrast the coronal serves as assimilation target, in Seri the labial is target (**Marlett**

1981). Different phonologists account for these asymmetries in different ways, and the role that constraints and representations play continues to be a topic of interest: see Hume (2003); de Lacy (2006); Rice (2009); CHAPTER 12: CORONALS; among others.

Within a language, there are often asymmetries in the patterning of consonants at different places of articulation. There are statistical generalizations: laryngeals and coronals tend to show phonological properties generally identified as unmarked, while labials and velars tend to show those identified as marked (§4.1). Languages with more than one coronal place within a manner do not tend to show the characteristics associated with coronal unmarkedness for that manner (§4.2.1). Nevertheless, based on the facts of neutralization and epenthesis outlined in §4.2.2, each language must be evaluated with respect to asymmetries in patterning, with languages showing variation that is not predicted by a model that seeks to identify a single place of articulation as unique in its properties. This thus calls into question a model of patterning of place of articulation that relies simply on a single representation for coronals or that has a fixed place hierarchy without intervening factors.

5 Features

I have examined the major places of articulation and their internal structure along with evidence for constituency and asymmetries in the patterning of consonants of different places of articulation. I now provide a brief review of features to distinguish places of articulation (CHAPTER 17: DISTINCTIVE FEATURES).

Jakobson *et al.* (1952) introduce acoustically based distinctive features. They distinguish four major place categories with [grave] grouping labials and velars and [diffuse] grouping labials and dentals. Sub-place distinctions are captured with manner features: labio-dental, interdental, palatal, and velar continuants are [−strident], and bilabial, dental/alveolar, alveo-palatal, and uvular continuants [+strident].

Chomsky and Halle (1968) propose a feature system to capture phonological contrasts and account for the non-contrastive feature composition of derived segments. They primarily use articulatorily features, introducing the consonantal place features [anterior] and [coronal] in addition to [high], [low], [back], and [round]. The feature [strident] distinguishes bilabial and labio-dental continuants and interdental and dental/alveolar continuants, while [distributed] distinguishes coronal sub-places, and [anterior] further distinguishes interdental and dental-alveolar from alveo-palatal and retroflex sub-places.

The sound pattern of English (*SPE;* Chomsky and Halle 1968) features have encountered serious criticism on both empirical and conceptual grounds. With respect to place, one challenge is the inability to define a class of labial consonants and round vowels (e.g. Campbell 1974). The feature [anterior] is also problematic, since anterior sounds in the *SPE* sense do not pattern as a natural class (e.g. Dixon 1980; Gnanadesikan 1994).

Sagey (1990), building on work by Halle (e.g. 1983), argues for four major places of articulation – Labial, Coronal, Dorsal, and Tongue Root (Radical)– expressed by monovalent features, dominating binary features. Building on Sagey, Halle, and others, Hall (2007: 332) gives a chart of obstruent places of articulation, which is shown in Table 22.2. I follow him in separating stops and fricatives, and show voiceless consonants only. The table perhaps represents an overall North American consensus about place of articulation features. Nevertheless, many issues remain; I list a few in (47).

	p	ʈ	t	ʇ	c	k	q	ts	ʧ	φ	f	θ	ʂ	s	ʂ	ʃ	ç	x	χ	ħ
continuant	−	−	−	−	−	−	−	−	−	+	+	+	+	+	+	+	+	+	+	+
labial	✓									✓	✓									
round	−									−	−									
coronal		✓	✓	✓	✓			✓	✓			✓	✓	✓	✓	✓	✓			
anterior		+	+	−	−			+	−			+	+	+	−	−	−			
distributed		+	−	−	+			+	−			+	+	−	−	+	+			
dorsal						✓	✓											✓	✓	
back						+	+											+	+	
low						−	−											−	−	
high						+	−											+	−	
pharyngeal																				✓
strident								+	+	−	−	−	+	+	+	+	−	−	−	−

Table 22.2 Features for obstruent places of articulation (after **Hall 2007**). A check (✓) in a cell indicates the presence of a unary feature; in rows with checks, the absence of a check indicates the absence of this feature. In rows with + and –, absence of any mark indicates that the feature is not relevant for that sound

(47) a. What distinguishes bilabials and labio-dentals? Hall leaves this open, suggesting that a feature [labio-dental] might be required.

b. How are palatals represented? Are all palatals coronal (see §2.2; **Hall 1997**)? Do all palatal sounds have the same representation? Similar questions can be raised for retroflexes.

c. Are [anterior] and [distributed] appropriate to distinguish coronal subplaces? In particular, the role of [anterior] remains controversial.

d. How are gutturals distinguished featurally?

e. Do features group into classes? In particular, do lingual and/or grave classes exist?

f. Is a mix of monovalent and bivalent features appropriate?

The feature systems developed out of *SPE* are largely articulatorily based, seeking unique representations for distinct sounds from a cross-linguistic perspective; see **Halle (2002)** for an overview. Other feature theories have been proposed. **Harris and Lindsey (1995)**, building on particle theory, element theory, and Government Phonology, present what they call autonomous interpretation, with segments comprised of independently interpretable elements that are based on spectral rather than articulatory properties. With respect to place, the element [U] occurs in labials, [I] in palatals and palatalized consonants, and [A] in uvulars and pharyngeals; [@] occurs in non-coronal, non-palatal, non-labial, and non-low vowels, suggesting its presence in velars; there is controversy about distinguishing coronals. While the foundations of elements are spectral rather than articulatory, there is agreement that major places of articulation exist, with subdivisions within them. **Flemming (2002)** proposes that both articulatory and auditory features are necessary, based on evidence from enhancement, assimilation of vowels to consonants and vice versa, and neutralization. Thus, one must ask if the articulatory features that have played such an important role in phonological theory offer the best means to capture place distinctions; see also §6.3.

6 Other issues

6.1 Laterals

Lateral consonants are a topic of controversy; see CHAPTER 31: LATERAL CONSONANTS. Much of the debate revolves around their manner: they are generally treated as a type of sonorant, with argument as to their continuancy; see **Mielke (2005, 2008)** for recent discussion. There is also debate as to whether laterals are coronal, or whether distinctive laterals exist at other places of articulation (e.g. **Blevins 1994**). Laterals raise a further issue in that there are languages in which they pattern as a distinct place of articulation, with manner and phonation distinctions of other places of articulation.

Athabaskan languages provide clear examples of the patterning of laterals as a place of articulation. Ahtna has the following stops, affricates, and fricatives (**Kari 1990**: 12).

(48)

	labial	alveolar	lateral	alveo-palatal	front velar	back velar	glottal
voiceless unaspirated stop	p	t	tɬ	ts	k	q	ʔ
voiceless aspirated stop	p^h	t^h	$tɬ^h$	ts^h	k^h	q^h	
glottalized stop		t′	tɬ′	ts′	k′	q′	
voiced fricative	(v)		l	z	j	ɣ~ʁ	
voiceless fricative	h^w		ɬ	s	x	χ	h

Stem-final non-glottalized stops spirantize in certain paradigms, with neutralization to a fricative (**Kari 1990**: 665):

(49)

q	χ
k	s
ts	s
tɬ	ɬ

The spirantization of the front velar to [s] is surprising, but otherwise a stop/ affricate is realized as a fricative of the same place of articulation. If lateral represents a place of articulation, this pattern is unsurprising. Note also the development of the Proto-Athabaskan *ts series (*ts *ts^h *ts' *s *z) to a /tl/ series [tɬ $tɬ^h$ tɬ′ ɬ l]) in Koyukon (**Jetté and Jones 2000**), a development which can be explained as a shift in place of articulation of the series.

6.2 Consonant-vowel interactions

I have not discussed consonant-vowel interactions, since this chapter concerns consonantal place; see **CHAPTER 75**: CONSONANT–VOWEL PLACE FEATURE INTERACTIONS. **Flemming (2002)** also addresses consonant-vowel interactions and the types of features required. To give a few examples, vowel-triggered palatalization can involve the addition of a secondary articulation; it can also involve a shift in primary place, with perhaps the most dramatic being the shift from a velar to a coronal, found in many Slavic languages; e.g. (45). There is often interaction between low vowels and dorsal sub-places, with low vowels conditioning uvulars (e.g. Xibe (Tungusic); **B. Li 1996**) or vice versa (e.g. Totonac; **MacKay 1994**). Low vowels or retracted tongue root vowels often interact with pharyngeal consonants; e.g. (26). Round vowels and labial consonants can pattern together, as in Igbo (§2.1). In addition, there are interactions between back vowels and retroflex consonants. Vowels and consonants may pattern together in natural classes as well, for instance, in conditioning rules.

There has been considerable debate as to how to handle such interactions. **Clements (1991)** argues for a unified theory of consonant and vowel place, as do element-based theories (see **Harris and Lindsey 1995** for an overview), while others argue for distinct place features (e.g. **Padgett 2002**) for consonants and vowels.

6.3 Evidence for innate features

An important premise since distinctive features were introduced is that features are innate, with a small universal set. Much research has been directed at defining what set and identifying its phonetic foundations, with the understanding that an appropriate and complete set of features would allow an account of cross-linguistic sound patterning.

I have pointed out in various places that what is characterized as the same sound from a phonetic perspective can show different phonological patterning. To some degree this is dependent on the sound system of the language, a point that has long been observed, as the following quote from Trubetzkoy shows.

> The ambiguous character of lateral articulation, which causes such difficulties in *phonetic* systematization, is something that can quite easily be resolved in *phonological* systemization, the more so since the important thing here is only to establish to which other phoneme the particular "lateral" phoneme stands in a relation of opposition, and to determine the nature of such an oppositive relationship. (**Trubetzkoy 1969**: 140)

In the discussion of evidence for places of articulation, we have seen debate about how to classify particular sounds. For instance, what are phonetically two places of articulation might pattern as one, as with [p] and [f], where [p] is bilabial and [f] labio-dental, but they enter into co-occurrence restrictions, for instance, as a single place of articulation. Similarly, [k] and [χ] can form a pair in spirantization, despite the fact that one is velar and the other uvular.

In addition, what looks like a single place of articulation might pattern as two distinct places. This is dramatic in Polish (11), where the retroflex stop and the retroflex fricative differ in patterning.

Furthermore, a single place of articulation may be classified in two groups. For instance, there is evidence from co-occurrence restrictions that uvulars are both dorsal and radical, with stops patterning with velars and fricatives with radicals. Palatals appear to be divided between dorsal (fricatives) and coronal (other manners).

Cross-linguistically, coronals do not appear to be divided in the same way in all languages. While in many languages there is evidence for segregating coronal inventories into two main places of articulation, often characterized as apical and laminal, there are languages with similar contrasts, but this categorization does not seem to be appropriate.

Such variation in cross-linguistic patterning might be responded to in different ways. One path is to continue the search for a small set of universal features, seeking to revise and refine it and find ways of understanding whether there are foundations for different patternings, based, for instance, on inventory contrasts or prosodic position. The understanding of consonantal place has deepened over the years through this method.

An alternative has recently been proposed, to abandon the assumption that features are innate. **Mielke (2005, 2008)**, among others, argues that features are not innate, but emergent (see also CHAPTER 17: DISTINCTIVE FEATURES). The limited number of features that is observed is not surprising, given the shape of the vocal tract and perceptual apparatus. Some ambivalence in patterning is expected for sounds that are phonetically ambiguous. It is thus perhaps time to challenge universality and focus on differences in patterning and what they reveal.

7 Summary

Consonantal place features are perhaps the best studied of all features, and the understanding of place of articulation has deepened over the years. There is little disagreement about the major regions of labial, coronal, dorsal, radical, and laryngeal, with evidence from numerous languages to support these distinctions. At the same time, some sounds do not appear to fit neatly into these classes. Labio-dentals might involve both a labial and a coronal component, and some gutturals pattern with both dorsals and radicals. The sub-places within these major places are less well established, with continuing debate particularly around the nature of the coronal sub-places.

There has been an attempt to identify a particular place of articulation as universally unmarked, based on patterning asymmetries. A good understanding of this requires a careful study of coronal inventories and contrasts, and it appears that much is determined by the language, although there are statistical differences in what patterns as unmarked. The different types of patterning lead one to ask whether the program to establish universal features for place of articulation, while an excellent research strategy, should be abandoned in favor of emergent features based on patternings found in individual languages, with the overwhelming similarities between languages attributable to production and perception. While consonantal place of articulation has received much attention, a focus on this topic, looking broadly and at individual places of articulation, will continue.

REFERENCES

Abbott, Mary & Monica Cox. 1966. *Collected field reports on the phonology of Basari*. Legon: Institute of African Studies, University of Ghana.

Anceaux, Johannes C. 1965. *The Nimboran language: Phonology and morphology*. The Hague: Martinus Nijhoff.

Andersen, Torben. 1988. Consonant alternation in the verbal morphology of Päri. *Afrika und Übersee* (71) . 63–113.

Arsenault, Paul. 2008. On feature geometry of coronal articulations. *Toronto Working Papers in Linguistics* (29) . 1–21.

Arsenault, Paul & Alexei Kochetov. Forthcoming. Retroflex harmony in Kalasha: Agreement or spreading? *Papers from the Annual Meeting of the North East Linguistic Society* (39) .

Avery, Peter, B. Elan Dresher & Keren Rice (eds.) *Contrast in phonology: Theory, perception, acquisition*. Berlin & New York: Mouton de Gruyter.

Ball, Martin J. & Nicole Müller. 1992. *Mutation in Welsh*. London, New York: Routledge.

Bessell, Nicola J. 1992. *Towards a phonetic and phonological typology of post-velar articulations*. Ph.D. dissertation, University of British Columbia.

Blake, Barry J. 1979. *A Kalkatungu grammar. (Pacific Linguistics B57.)* Canberra: Australian National University.

Blanc, Haim. 1970. The Arabic dialect of the Negev Bedouins. *Proceedings of the Israeli Academy of Science and Humanities* (4) . 112–150.

Blevins, Juliette. 1994. A place for lateral in the feature geometry. *Journal of Linguistics* (30) . 301–348.

Bright, William. 1972. The enunciative vowel. *International Journal of Dravidian Linguistics* (1) . 26–55.

Browman, Catherine P. & Louis Goldstein. 1989. Articulatory gestures as phonological units. *Phonology* (6) . 201–251.

Buckley, Eugene. 1994. *Theoretical aspects of Kashaya phonology and morphology*. Stanford: CSLI.

Campbell, Lyle. 1974. Phonological features: Problem and proposals. *Language* (50) . 52–65.

Chomsky, Noam & Morris Halle. 1968. *The sound pattern of English*. New York: Harper & Row.

Clements, G. N. 1991. Place of articulation in consonants and vowels: A unified theory. *Working Papers of the Cornell Phonetics Laboratory* (5) . 77–123.

Clements, G. N. & Elizabeth Hume. 1995. *The internal organization of speech sounds*. In Goldsmith (1995), 245–306.

Coetzee, Andries W. & Joe Pater. 2008. Weighted constraints and gradient restrictions on place co-occurrence in Muna and Arabic. *Natural Language and Linguistic Theory* (26) . 289–337.

Colarusso, John. 1988. *The northwest Caucasian languages: A phonological survey*. New York: Garland.

Cowell, Mark W. 1964. *A reference grammar of Syrian Arabic (based on the dialect of Damascus)*. Washington, DC: Georgetown University Press.

Davis, Stuart & Michael Hammond. 1995. On glides in American English. *Phonology* (12) . 15–182.

de Lacy, Paul. 2006. *Markedness: Reduction and preservation in phonology*. Cambridge: Cambridge University Press.

de Lacy, Paul & John Kingston. 2006. *Synchronic explanation*. Unpublished ms., University of Massachusetts, Amherst & Rutgers University.

Dixon, R. M. W. 1980. *The languages of Australia*. Cambridge: Cambridge University Press.

Douglas, Wilfred H. 1981. Watarri. In R. M. W. Dixon & Barry J. Blake (eds.) *Handbook of Australian languages*, (vol. 2) , 197–271. Amsterdam: John Benjamins.

Dresher, B. Elan. 2008. The contrastive hierarchy in phonology. In Peter Avery, B. Elan Dresher & Keren Rice (eds.) *Contrast in phonology: Theory, perception, acquisition*, 11–33. Berlin & New York: Mouton de Gruyter.

Dresher, B. Elan. 2009. *The contrastive hierarchy in phonology*. Cambridge: Cambridge University Press.

Duanmu, San. 2000. *The phonology of Standard Chinese*. Oxford: Oxford University Press.

Evans, Nicholas D. 1995. *Current issues in the phonology of Australian languages*. In Goldsmith (1995), 723–761.

Ferrell, Raleigh. 1982. *Paiwan dictionary*. Canberra: Australian National University.

Flemming, Edward. 2002. *Auditory representations in phonology*. London & New York: Routledge.

Gnanadesikan, Amalia E. 1994. The geometry of coronal articulations. *Papers from the Annual Meeting of the North East Linguistic Society* (24) . 125–139.

Goldsmith, John A. (ed.) 1995. *The handbook of phonological theory*. Cambridge, MA & Oxford: Blackwell.

Hall, T. A. 1997. *The phonology of coronals*. Amsterdam & Philadelphia: John Benjamins.

Hall, T. A. 2007. Segmental features. In Paul de Lacy (ed.) *The Cambridge handbook of phonology*, 311–334. Cambridge: Cambridge University Press.

Halle, Morris. 1983. On distinctive features and their articulatory implementation. *Natural Language and Linguistic Theory* (1) . 91–105.

Halle, Morris. 2002. *From memory to speech and back: Papers on phonetics and phonology 1954–2002*. Berlin & New York: Mouton de Gruyter.

Halle, Morris, Bert Vaux & Andrew Wolfe. 2000. On feature spreading and the representation of place of articulation. *Linguistic Inquiry* (31) . 387–444.

Hamilton, Philip. 1993. *On the internal structure of the coronal node: Evidence from Australian languages*. Unpublished ms., University of Toronto.

Hansson, Gunnar Ólafur. 2010. *Consonant harmony: Long-distance interaction in phonology*. Berkeley: University of California Press.

Harris, John & Geoff Lindsey. 1995. The elements of phonological representation. In Jacques Durand & Francis Katamba (eds.) *Frontiers of phonology: Atoms, structures, derivations*, 34–79. Harlow: Longman.

Hayward, Katrina & Richard Hayward. 1989. "Guttural": Arguments for a new distinctive feature. *Transactions of the Philological Society* (87) . 179–193.

Heath, Jeffrey. 1981. *Basic materials in Mara: Grammar, texts, and dictionary. (Pacific Linguistics C60.)* Canberra: Australia National University.

Heath, Jeffrey. 1984. *Functional grammar of Nunggubuyu*. Canberra: Australian Institute of Aboriginal Studies.

Hualde, José Ignacio. 1992. *Catalan*. London & New York: Routledge.

Hudson, Joyce. 1978. *The core of the Walmatjari language*. Canberra: Australian Institute of Aboriginal Studies.

Hulst, Harry van der & Maarten Mous. 1992. Transparent consonants. In Reineke Bok-Bennema & Roeland van Hout (eds.) *Linguistics in the Netherlands 1992*, 101–112. Amsterdam & Philadelphia: John Benjamins.

Hume, Elizabeth. 2003. Language specific markedness: The case of place of articulation. *Studies in Phonetics, Phonology and Morphology* (9) . 295–310.

Hyman, Larry M. 1973. The feature [grave] in phonological theory. *Journal of Phonetics* (1) . 329–337.

Hyman, Larry M. 1975. *Phonology: Theory and analysis*. New York: Holt, Rinehart & Winston.

IPA. 2007. *Handbook of the International Phonetic Association: A guide to the use of the International Phonetic Alphabet*. Cambridge: Cambridge University Press.

Jakobson, Roman & Morris Halle. 1956. *Fundamentals of language*. The Hague: Mouton.

Jakobson, Roman, C. Gunnar M. Fant & Morris Halle. 1952. *Preliminaries to speech analysis: The distinctive features and their correlates*. Cambridge, MA: MIT Press.

Jarmasz, Lidia-Gabriela. 2009. Natural classes of coronal obstruents in Polish. *Toronto Working Papers in Linguistics* (30) . 35–52.

Jetté, Jules & Eliza Jones. 2000. *Koyukon Athabaskan dictionary*. Fairbanks: Alaska Native Language Center.

Kari, James. 1990. *Ahtna Athabaskan dictionary*. Fairbanks: Alaska Native Language Center.

Ladefoged, Peter & Ian Maddieson. 1996. *The sounds of the world's languages*. Oxford & Malden, MA: Blackwell.

Li, Bing. 1996. *Tungusic vowel harmony: Description and analysis*. The Hague: Holland Academic Graphics.

Li, Paul Jen-kuei. 1995. Atayal. In Darrell T. Tryon (ed.) *Comparative Austronesian dictionary: An introduction to Austronesian studies. Part 1: Fascicle* (1) , 283–292. Berlin & New York: Mouton de Gruyter.

Lombardi, Linda. 1996. Postlexical rules and the status of privative features. *Phonology* (13) . 1–38.

Lombardi, Linda. 2002. Coronal epenthesis and markedness. *Phonology* (19) . 219–251.

Lucca, Manuel de. 1987. *Diccionario préctico aymara-castellano castellano-aymara*. La Paz: Editorial Los Amigos del Libro.

MacKay, Carolyn. 1994. A sketch of Misantla Totonac phonology. *International Journal of American Linguistics* (60) . 369–419.

MacKay, Carolyn. 1999. *A grammar of Misantla Totonac*. Salt Lake City: University of Utah Press.

Mackenzie, Sara. 2009. *Contrast and similarity in consonant harmony processes*. Ph.D. dissertation, University of Toronto.

Maddieson, Ian. 1984. *Patterns of sounds*. Cambridge: Cambridge University Press.

Marlett, Stephen A. 1981. *The structure of Seri*. Ph.D. dissertation, University of California, San Diego.

Marshall, Christina. 2008. *The phonetics and phonology of Esan nasalization*. M.A. thesis, University of Toronto.

McCarthy, John J. 1988. Feature geometry and dependency: A review. *Phonetica* (45) . 84–108.

McCarthy, John J. 1994. The phonetics and phonology of Semitic pharyngeals. In Patricia, Keating (ed.) *Phonological structure and phonetic form: Papers in laboratory phonology III*, 191–233. Cambridge: Cambridge University Press.

Mielke, Jeff. 2005. Ambivalence and ambiguity in laterals and nasals. *Phonology* (22) . 169–203.

Mielke, Jeff. 2008. *The emergence of distinctive features*. Oxford: Oxford University Press.

Morén, Bruce. 2006. Consonant-vowel interactions in Serbian: Features, representations and constraint interactions. *Lingua* (116) . 1198–1244.

Morphy, Frances. 1983. Djapu, a Yolngu dialect. In R. M. W. Dixon & Barry J. Blake (eds.) *The handbook of Australian languages*, (vol. 3) , 1–188. Amsterdam: John Benjamins.

Mous, Maarten. 1993. *A grammar of Iraqw*. Hamburg: Buske.

Odden, David. 1978. Further evidence for the feature [grave]. *Linguistic Inquiry* (9) . 141–144.

Odden, David. 2005. *Introducing phonology*. Cambridge: Cambridge University Press.

Orr, Carolyn. 1962. Ecuador Quichua phonology. In Benjamin F. Elson (ed.) *Studies in Ecuadorian Indian languages*, (vol. 1) , 60–77. Norman, OK: Summer Institute of Linguistics.

Padgett, Jaye. 2002. Feature classes in phonology. *Language* (78) . 81–110.

Paradis, Carole & Jean-François Prunet (eds.) 1991. *The special status of coronals: Internal and external evidence*. San Diego: Academic Press.

Radišić, Milica. 2009. The double nature of the velar /g/ in Serbian. *Toronto Working Papers in Linguistics* (30) . 91–103.

Rehg, Kenneth L. 1984. Nasal substitution rules in Ponapean. In Byron W. Bender (ed.) *Studies in Micronesian linguistics*, 317–337. Canberra: Australian National University.

Rehg, Kenneth L. & Damian G. Sohl. 1981. *Ponapean reference grammar*. Honolulu: University of Hawai'i Press.

Rice, Keren. 1989. *A grammar of Slave*. Berlin & New York: Mouton de Gruyter.

Rice, Keren. 1994. Peripheral in consonants. *Canadian Journal of Linguistics* (39) . 191–216.

Rice, Keren. 1996. Default variability: The coronal-velar relationship. *Natural Language and Linguistic Theory* (14) . 493–543.

Rice, Keren. 2009. On coronals: Are they special? *Toronto Working Papers in Linguistics 30*. 1–15.

Rose, Sharon. 1996. Variable laryngeals and vowel lowering. *Phonology* (13) . 73–117.

Rubach, Jerzy. 1993. *The Lexical Phonology of Slovak*. Oxford: Clarendon Press.

Sagey, Elizabeth. 1990. *The representation of features in nonlinear phonology: The articulator node hierarchy*. New York: Garland.

Shahin, Kimary. 2002. *Postvelar harmony*. Amsterdam & Philadelphia: John Benjamins.

Shaw, Patricia A. 1991. *Consonant harmony systems: The special status of coronal harmony*. In Paradis & Prunet (1991), 125–157.

Steriade, Donca. 1987. Locality conditions and feature geometry. *Papers from the Annual Meeting of the North East Linguistic Society* (17) . 595–617.

Svantesson, Jan-Olof, Anna Tsendina, Anastasia Karlsson & Vivan Franzén. 2005. *The phonology of Mongolian*. Oxford: Oxford University Press.

Trigo, Loren. 1988. *On the phonological derivation and behavior of nasal glides*. Ph.D. dissertation, MIT.

Trubetzkoy, Nikolai S. 1969. *Principles of phonology*. Translated by Christiane A. M. Baltaxe. Berkeley & Los Angeles: University of California Press. Originally published 1939 as *Grundzüge der Phonologie*. Göttingen: van der Hoeck & Ruprecht.

Uhlenbeck, Eugenius M. 1949. *De structuur van het javaanse morpheem*. Bandoeng: Nix.

Watters, James. 1988. *Topics in Tepehua grammar*. Ph.D. dissertation, University of California, Berkeley.

Wu, Yuwen. 1994. *Aspects of Mandarin segmental phonology*. Ph.D. dissertation, University of Toronto.

Yip, Moira. 1989. Feature geometry and cooccurrence restrictions. *Phonology* (6) . 349–374.

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