

Figure 10.23 Spectrograms contrasting Russian plain and palatalized bilabial stops in the words *pot* 'sweat', *piotr* 'Peter', *Hab* 'pock-marked', and *řabi* 'ripples' spoken by a male speaker from St Petersburg. The top line also shows the sequence *pj* in *pjot* 'drink' (3 sg.).

constriction. Since bilabial sounds do not require any specific position of the tongue for their articulation, the tongue body can assume an i-like position during their production without any conflict with the demands of the primary articulation. Plain and palatalized bilabials in initial and final position in Russian are illustrated in the spectrograms in figure 10.23. It can be seen that the high F2 position associated with palatalization is more extreme at the release of the initial labial stop than it is at the onset of the final one (even, as in these examples, when the initial consonant is also palatalized and contributes to raising F2). This figure also illustrates the distinction between palatalization and a sequence with *j*. In *přotr* 'Peter' the transition away from the palatal position, indicated by a falling F2, begins immediately on consonant release. In contrast, in *přot* 'drinks' there is a short steady state before the transition begins.

sition like that for a front vowel with a position for a consonant that is not also front will result in a modification of the primary place of articulation. Velars in all languages show variability in primary constriction location due to vowel context (though the range of variation is greater in some than in others). Palatalization of velars can be thought of therefore as producing the variant of a velar that would normally appear in a high front vowel context when the vowel context is in fact something other than a high front vowel.

Pharyngealization

The remaining type of secondary articulation involving the tongue body is pharyngealization. As with other secondary articulations, this is a feature of vowels, as discussed in chapter 9. It is most familiar from those dialects of Arabic in which the distinction between the traditional classes of plain and "emphatic" coronals is made by forming a secondary constriction in the pharynx (not all Arabic varieties make the distinction in this way; some have velarization rather than pharyngealization). Tracings of the contrast between [s] and [sʔ], based on x-ray photographs in Bukshaisha (1985) of a Qatari Arabic speaker, are shown in figure 10.24. Comparison across languages suggests that there are distinguishable higher and lower secondary pharyngeal gestures, just as there are higher and lower primary gestures in the pharyngeal area, as

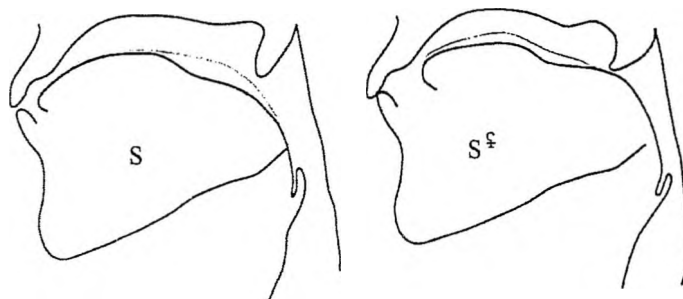


Figure 10.24 X-ray tracings of s and sʔ spoken by a Qatari Arabic speaker in the words sad 'to prevail' and sʔad (name of the letter).

A further secondary articulation type, labiodentalization, is noted by Ladefoged (1968) as occurring in Kom and Kuteb. The phenomenon in question involves the narrowing of the passage between the lower lip and the upper teeth, as in simple labiodental segments, while another articulator's position is being held. In the phonology of Kom (Hyman 1980), this phenomenon is regarded as an aspect of the vowel system of the language, to be compared with other instances of fricative vowels described in chapter 5. The nucleus of a syllable can consist of a syllabic sound which ranges from a high back rounded vowel to a lax *v*. In the phonetic domain, the labiodental articulation characteristic of this vowel can be anticipated in a range of preceding consonants, including velar stops and coronal affricate and fricative segments. In *iku* 'death' the stop is released into a quite strong voiceless bilabial fricative which is followed by a voiced more vowel-like articulation, as can be seen in the spectrogram on the left of figure 10.25. The fact that the labial constriction is coarticulated with the velar closure can be seen from the sharp drop of the second formant before the closure. In *i3u* 'sky' the coronal fricative has a voiced labiodental fricative offglide. The 3 segment is probably also produced with some labial constriction. The consequences of this coarticulation include the presence of a lower range of frequencies in the frication from those that would be expected from the coronal articulation alone. It is unlikely that there is a second source of frication during the coronal segment; if so, this coarticulated variant would exemplify the rare possibility of a doubly-articulated fricative. More likely, the different acoustic effect is a result of modification of the outlet channel in front of the frication source.

The Kuteb 'labiodentalization' is a positional variant of the labial-velar approximant *w* in clusters that begin with a fricative or affricate. Ladefoged (1968) shows that this articulation can also be anticipated in a preceding segment, as in the laminagram reproduced as figure 10.26. A similar phenomenon has been more recently observed in Angami, a Tibeto-Burman language of Northwest India. In Kom, Kuteb and Angami labiodentalization is not a contrastive feature, but it does constitute a striking characteristic of the phonetic structure of these languages.

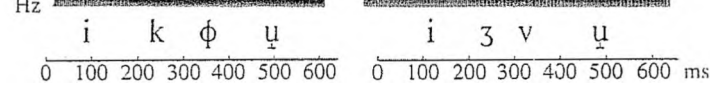


Figure 10.25 Spectrograms illustrating the effect of Kom fricative vowel u, inducing labiodental offglide of preceding consonants in the words *iku* 'death', and *iju* 'sky'.

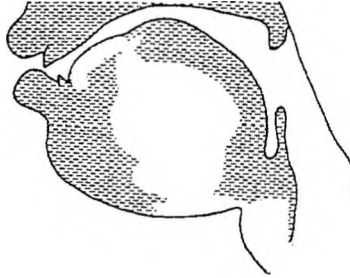


Figure 10.26 Laminagram of Kuteb laminal post-alveolar fricative *z* as pronounced before *v* allophone of *w* (after Ladefoged 1968).

A final candidate for the status of a secondary articulation is sulcalization. This is a term that describes a deep grooving of the back of the tongue (Catford 1977a). A deep groove is typical of productions of *s* in English, as can be seen from the data on English *s* in chapter 3. It seems likely that the grooved shape helps to focus the airflow toward the obstacle at the teeth so that high-amplitude noise is produced for this sibilant. We do not know whether such grooving is typical of all sibilants. Catford (1977a) suggests that it is not. His observations indicate that different degrees of sulcalization may characterize sounds with differing places of articulation within a language, and may also contribute to the differences between languages, but they do not by themselves distinguish segments within any language.

esses of palatalization in this historical sense, and are not what we would now call palatalized consonants. In fact, an important source of differences of place among consonants in the history of individual languages is the process by which simple coarticulation in particular contexts becomes fixed as secondary articulations on consonants, and in turn these complex consonants evolve into new blended articulations that can no longer be separated into primary and secondary components. Today's secondary articulations may be the primary articulations of the future.

One of our hopes for this book is that it might provide a basis for future work on phonological feature theories. The great variety of data that we have presented shows that the construction of an adequate theory of universal features is much more complex than hitherto thought. In this brief coda we will summarize just the main oppositions that such a theory will have to take into account. We should emphasize that we are not presenting this summary as a feature theory in the usual sense. It is simply an account of the major phonetic categories that languages employ. Furthermore, we would like to recall the introductory remarks in chapter 1, where we suggested that the description of phonetic events involves the establishment of parameters along which variation can be measured, and a set of categorial values along these parameters. These categorial values can be regarded as labels for classifying similar distinctions in different languages. But one of the main themes of this book is that many phonetic phenomena need to be described as variants of these categories. We have shown that there is a continuous range of values within the parameters. Thus we saw that when a wide range of data from different languages is considered, it is difficult to say that there is a certain specific number of places of articulation. It is equally hard to determine a specific number of states of the glottis. Similarly, we found that there is no sharp division between ejectives and plosives accompanied by a glottal stop. We also noted that there is a gradient between one form of voiced plosive and what is clearly a voiced implosive; there are not two clearly defined classes. The same kind of notion appears throughout the book, becoming, perhaps, most apparent towards the end in the discussion of vowels. Comparing vowels in different languages obviously involves considering values of parameters rather than fixed categories. Nonetheless, the notion of distinguishable categories is basic to understanding the way that languages

maintain contrast between lexical items, and we also noted that there are readily apparent preferences for what we have called modal possibilities on many of the phonetic parameters. Bearing these points in mind, we can now summarize the major phonetic categories.

The basic framework that we have adopted is shown in figure 11.1. We began by discussing contrasts in Place, and went on to discuss contrasts involving other Manners of articulation and Nasality. In these discussions we considered variations in Laryngeal actions. When we discussed different Manners of articulation, we also considered different Airstream mechanisms.

The major place features and individual places of articulation were summarized in table 2.11. We can regard these possibilities as an expansion of the Place term in figure 11.1 as shown in table 11.1.

In chapter 3 and subsequent chapters we considered various manners of articulation, leading to an expansion of the MANNER term in figure 11.1 as shown in table 11.2. The most important distinction among manners is that of STRUCTURE. It is not clear how TAP and TRILL relate to this parameter, but the other four terms form an ordered set. Traditional phonetic classifications would include Nasal and Lateral among the manners, but we have taken these to be independent parameters. In chapter 4 we showed that there is a wide variety of possible nasal sounds, but we did not have to consider degrees of nasality, so no further expansion of the NASAL term is needed. Similarly we noted that sounds could differ in degree of laterality, but from a phonological point of view, sounds are either CENTRAL or LATERAL.

Each of the terms in the third column of table 11.2 was considered in some detail, the first two being discussed in separate chapters (chapter 3 Stops, and chapter 5 Fricatives). The fricative chapter discusses some special considerations affecting this class of sounds that have been omitted in this summary; here we mention only the difference between Sibilant and Non-Sibilant. TAP and TRILL are major concerns of chapter 7 Rhotics. Discussions of APPROXIMANTS occur in chapter 6 Laterals, and in chapter 7 Rhotics, but the most common

PLACE		CORONAL		(palato-alveolar)
		APICAL		Apical dental Apical alveolar Apical post-alveolar
		SUB-APICAL		Sub-apical palatal (retroflex)
		DORSAL		Palatal Velar Uvular
		RADICAL		Pharyngeal Epiglottal
		LARYNGEAL		Glottal

Table 12.2 Manners of articulation

MANNER	<i>f</i>	STRICTURE <	STOP	
			FRICATIVE	* Sibilant Non-Sibilant
			APPROXIMANT	
			VOWEL	
			TAP	
			TRILL	

VOWELS	ROUNDING	PROTRUSION	{ Retracted
		COMPRESSION	f Compressed I Separated
	TONGUE ROOT		f +ATR I -ATR (Pharyngealized)
t RHOTIC			Rhotacized

Table 11.4 Types of phonation

{	GLOTTAL STRICTURE	Voiceless Breathy voice Modal voice Creaky voice Closed
	GLOTTAL TIMING	Aspirated Unaspirated
	GLOTTAL MOVEMENT	Raising Lowering

type of approximant is a semivowel. For this reason approximants receive their fullest discussion in the chapter devoted to VOWELS. The same parameters apply to both such approximants and vowels, as shown in table 11.3. These parameters are also available for describing secondary articulations.

Throughout the book we considered a variety of phonation types. We can take these into account by expanding the LARYNGEAL term in Figure 11.1 as shown in table 11.4.

Variations in airstream mechanisms were considered partly in the Chapter on clicks, but also in other chapters, notably Chapter 3 Stops, and Chapter 5 Fricatives. A possible expansion of the AIRSTREAM term in figure 11.1 is shown in table 11.5. This arrangement is different from the traditional approach

geal parameter of movement.

We will not attempt to turn this set of oppositions into a coherent set of universal features for use in phonological descriptions. Producing the present book has taken many years, and we are happy to let other linguists take this next step.