

Figure 2.16 Movement trajectories for a point on the tongue rear (mean of 10 repetitions) during the Ewe words *ake* 'sand' and *aka* 'charcoal' (based on Maddieson 1993). Scales are in cm from arbitrary origins. Samples taken approximately 3 ms apart. A curve indicating the estimated location of part of the roof of the mouth has been drawn on the figure.

contrasting sounds that are more nearly in the velar region. These stops are apparently also further back than Hungarian palatals and have been described as palatovelar in Djingili (Chadwick 1975) and Garawa (Furby 1974). Chadwick (personal communication) and Kirton and Charlie (1978) suggest that they may have arisen from a simplification of consonant clusters such as

Table 2.6 Words illustrating contrasts between intervocalic stops and nasals in Yanyuwa

BILABIAL	LAMINAL DENTAL (DENTI- ALVEOLAR)	APICAL ALVEOLAR	APICAL POST- ALVEOLAR (RETROFLEX)	LAMINAL POST- ALVEOLAR (PALATO- ALVEOLAR)	PALATAL	VELAR
wubuwiggu 'for a small one (female)'	wudurumaja 'laugh!'	wuduru 'full of food'	wuduju 'in the stomach'	wudulu 'into the grass'	gujuii 'sacred'	wugugu 'grand- parent'
wumu wadala 'in the canoe'	wununu 'cooked'	wunala 'kangaroo'	wanura 'white egret'	nanalu 'tea'	luwajiu 'strip of turtle fat'	warjulu 'adolescent boy'

their term palatovelar, although we agree that these sounds are made further back than the sounds that are usually called palatal. In addition the velar stops in Yanyuwa appear to us to be made slightly further back than those in other languages; but they are in no way equivalent to stops classified as uvular in other languages.

A similar distinction to that in Yanyuwa may appear in some languages in the northwest of North America. Both Nuxalk (Nater 1984) and Kwakw'ala (Grubb 1977) are described as distinguishing 'palatovelars' from 'back velars'. Nater compares the 'palatovelar' stop of Nuxalk to the initial sound of the English word 'cube'.

While discussing sounds in the central oral region, we must note another problem in deciding precisely what is meant by a palatal articulation. In several languages our palatograms (and those of others, e.g. Doke 1931b) show that palatal sounds may have two contacts, a tongue tip (or blade) and alveolar ridge contact, and, probably simultaneously, a contact between the tongue front and rear of the hard palate. These contacts are best considered to be dis-

Table 2.7 Words illustrating contrasts involving palato-alveolar (laminal post-alveolar) affricates, and velar and uvular stops in Quechua

	LAMINAE POST-ALVEOLAR (PALATO-ALVEOLAR)	VELAR	UVULAR
UNASPIRATED	tj'aka 'bridge'	kujuj 'to move'	qaXu 'tongue'
ASPIRATED	tf ^h aka large ant	k ^h ujuj 'to whistle'	q ^h aXu 'shawl'
EJECTIVE	tf' aka 'hoarse'	kujuj 'to twist'	q' aXu 'tomato and locoto sauce'

Table 2.8 Words illustrating contrasting velar and uvular plosives and ejectives in K'ekchi

VELAR PLOSIVE	VELAR EJECTIVE	UVULAR PLOSIVE	UVULAR EJECTIVE
kaa 'grindstone'	k'a 'bitter'	qa 'our'	q'aq 'bridge'

describes this language as contrasting not only c, k, q but also ts, tf, ts, making it plain that the palatal stop is not an affricate, but actually contrasts with a series of affricates, as well as with velar and uvular stops.

There is very little published data on the difference between velar and uvular stops. Al-Ani (1970) has provided data for a single speaker of Arabic. He notes that the uvular stop lowers F2 for a following i or a. He also suggests that F2 is slightly raised in u following a uvular stop, but this is not so apparent in his spectrograms. What is evident, which he also notes, is that the major energy in the burst of the stop consonant is lower for q than for k.

We analyzed recordings of 12 speakers of K'ekchi that had been made for us

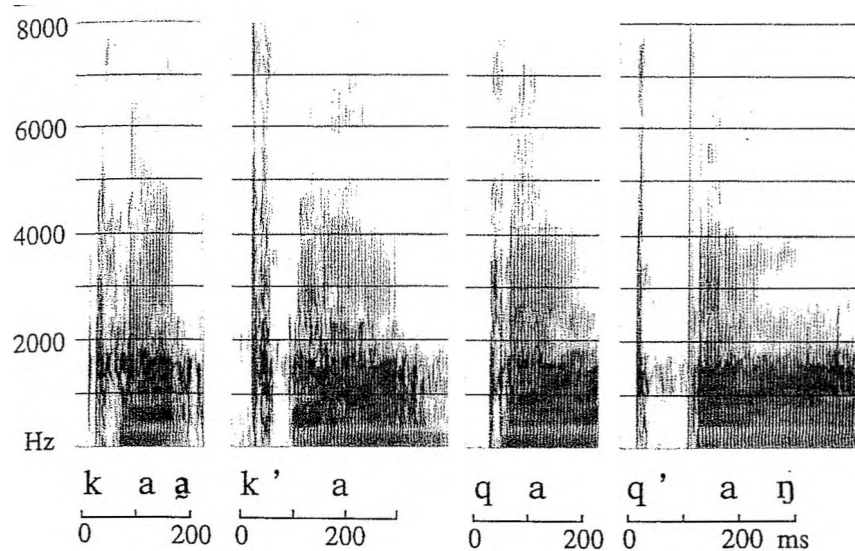


Figure 2.17. Spectrograms of contrasting velar and uvular plosives and ejectives in the K'ekchi words in Table 2.8.

the ejectives, which was 97 ms (s.d. 38) for the velars and 92 ms (s.d. 38) for the uvulars.

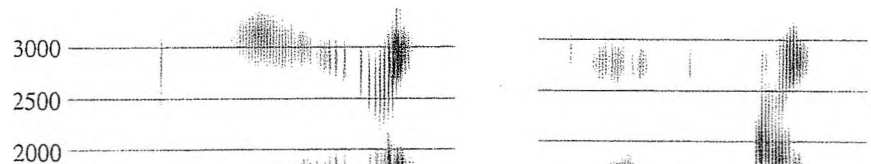
Pharyngeal and epiglottal sounds are made in the Radical region, below the uvula. No language makes stops consistently in the upper part of the pharynx, and it is logically impossible to make pharyngeal nasals (as we define nasals), since air cannot come out through the nose while the articulators make a complete closure in the pharyngeal region. Pharyngeal fricatives do occur, but they are not as common as might be supposed from the literature, as most of the sounds to which this label is attached (e.g. in Arabic and Hebrew) are actually

Table 2.9 Words illustrating contrasting pharyngeal and epiglottal fricatives, and epiglottal plosives, in the Burkikhan dialect of Agui (data from S. Kodzasov, personal communication)

VOICED PHARYNGEAL FRICATIVE	muʔ	'bridge'	mufar	'bridges'
VOICELESS PHARYNGEAL FRICATIVE	muh	'bam'	muh ar	'bams'
VOICELESS EPIGLOTTAL FRICATIVE	men	'whey'	meHer	'wheys'
VOICELESS EPIGLOTTAL STOP	jaʔ	'center'	jaʔar	'centers'
	seʔ	'measure'	seʔer	'measures'

and Ladefoged 1993). Spectrograms of medial single and geminate ʔ are shown in Figure 2.18. Note that this segment usually involves less than a complete closure when it is single and intervocalic, but the geminate involves a full closure. The IPA does not provide distinct symbols for voiced and voiceless epiglottal stops, having accepted the argument that the cavity between the glottis and the epiglottis is too small to permit voicing. We do not know of any language which makes such a distinction, but there are good reasons to consider the epiglottal stop in Dahalo to be phonologically voiced, for example, other single voiced stops also tend to undergo lenition when they are intervocalic.

The larynx, among its many other functions can also serve as a place of articulation for stops. Glottal stops occur in many languages. They frequently pattern with other consonants as in the complex clusters of Tsou (Wright and Ladefoged forthcoming), making it clear that glottal gestures must be taken into consideration when discussing places of articulation that are possible for stop consonants. We will exemplify glottal stops and consider their relationships to other sounds in chapter 3.



Lastly we must mention consonants made with more than one place of articulation, involving two simultaneous articulator^y gestures. These gestures will be discussed in chapter 10 which is specifically concerned with multiple gestures.

2.2 . Contrasting Places of Articulation

We have now described some (we hope most) of the phonetic events that are significant in characterizing the place of articulation (the moving articulator and the target location for the movement in the articulatory gesture) of consonants. Table 2.10 summarizes the contrasts among the majority of the articulatory gestures mentioned in this chapter that we know to occur within languages. We have heard all these contrasts ourselves, except for those in Jaqaru (Hardman 1966) and Kuvi (Zvelebil 1970), which are accordingly named in italics. In addition, we have heard some, but not all, of the contrasts in Agui; the one italicized contrast is from Magometov (1967). If the 17 gestures specified in table 2.1 are all individually controllable, each of them might be expected to contrast with each of the others. This would make a total of 134 possible contrasts, for which only 80 have an exemplifying language in table 2.10. Our next task is to consider the status of the missing items.

Six of the missing slots on the chart are in the labiodental row and have been marked ssssss. In this row the contrasts all involve fricatives. It would be comparatively easy to name languages in which sibilant fricatives of different kinds contrast with f or v, and so fill in these gaps. But, as we will see in chapter 7, it is not always clear how the articulations in sibilants should be characterized, so we thought it better to leave these sounds out of consideration at this stage of the discussion. However, we do not consider the gaps marked ssssss to be truly missing contrasts.

Of the remaining 48 contrasts that have not been noted, 11 are associated with missing linguo-labials (marked with #####), and one with a missing

Table 2.10 A matrix giving examples of contrasting places of articulation. (Data from our own observations)								
	(2) LABIO- DENTAL	(3) LINGUO- LABIAL	(4) INTERDENTAL	(5) APICAL DENTAL	(6) LAMIN AL DENTAL	(7) .APICAL ALVEOLAR	(8) LAMINAL ALVEOLAR	(9) APICAL POST ALVEOLAR
(1) BILABIAL	4> f Ewe	p t V'enen Taut	m n Malayalam	P l Temne	p t Toda	p t Toda	P l Temne	b d Hindi
(2) LABIODENTAL		f ? V'enen Taut	f § English (American)	f § English (British)	ssssss	ssssss	ssssss	ssssss
(3) LINGUO-LABIAL			—————			t t Venen Taut	#####	
(4) INTERDENTAL					—	n n Malayalam	—	—
(5)					l ! !xoo		t l Temne	
(6) LAMINAL DENTAL						t t Toda		t t Hindi
(7) APICAL ALVEOLAR								t t Yanyuwa
(8) LAMINAL ALVEOLAR								
(9) APICAL POST-ALVEOLAR								
(10) LAMINAL POST-ALVEOLAR								

except in the case of italicized language names, for which the references are in the text.)

(10) LAMINAL POST ALVEOLAR	(11) SUB-APICAL PALATAL	(12) PALATAL	(13) VELAR	(14) UVULAR	(15) PHARYNGEAL	(16) EPIGLOTTAL	(17) GLOTTAL
p i Yanyuwa	P t Toda	P C Yanyuwa	P k English	P q Quechua	pppppp	p ? Agui	p ? Tsou
ssssss	ssssss	f ? German	f X Gaelic	f X German	f h Agui	WWW	f h English
	#####		t k Taut	#####	4144444444		#####
n n Malayalam	n a Malayalam	n Ji Malayalam	n ij Malayalam	—	pppppp	—	e h English (<i>America!</i>)
—	—	—	t k Temne	—	pppppp	§ H Arabic	Q h English (<i>British</i>)
t t Yanyuwa	t t Malayalam	t C Malayalam	t k Malayalam	t q Urdu	pppppp	£ 2 Dahalo	£ ? Dahalo
t t Malayalam	t t Malayalam	t C Ngwo	£ k English	t q Quechua	pppppp	t 2 Dahalo	t ? Tsou
—	—	—	£ k Temne	—	pppppp	—	—
t t Yanyuwa	r r r r	t c Logba	£ k Hindi	t q Urdu	pppppp	£ ? Dahalo	£ ? Dahalo
	n q. Malayalam (<i>some dialects'</i>)	& j Ngwo	t k Yanyuwa	M q Quechua	pppppp	XT ? Dahalo	_t' Dahalo

serve to diminish the number of gaps in the table. There are 11 missing pharyngeals (marked ppppp), but at least two could be filled in, as Agui has two sibilants which we are not considering at this point. Similarly in the epiglottal column, we could have filled in the contrast in the laminal alveolar row, if we had considered the Arabic sibilant *s* to be laminal alveolar, as it is when pharyngealized (see discussion in chapter 10).

There are three cases, marked *r r r*, involving retroflex sounds, with either apical post-alveolar or sub-apical gestures. Ladefoged and Bhaskararao (1983) showed that some languages use one of these possibilities and others the other, making this a reliable phonetic contrast. We conclude that the missing contrasts involving retroflex stops of either kind are also accidental gaps, due to the fact that only a comparatively small number of languages have these sounds. Further evidence to this effect is provided by the case of Kuvi. The best known languages with sub-apical retroflex stops belong to the Dravidian family. Contrastive glottal stops do not occur in most of these languages, so there might well have been a gap in the chart for the *t* vs ? contrast. But phonemic glottal stops do occur in Kuvi (Zvelebil 1970, Reddy, Upadhyaya and Reddy 1974), a little known Central Dravidian language, allowing this gap to be filled in.

It is not clear whether the remaining gaps are accidental or not. These gaps, which are marked with dashed lines, are associated with the laminal interdental, apical dental and laminal alveolar gestures. Contrasts among these gestures are very rare. In our own data, laminal interdental stops do not contrast with either apical dental or laminal alveolars; and these latter two gestures contrast only in Temne and Limba. There is only limited evidence for within language contrasts among apical dental, apical alveolar and laminal dental sounds. We do not know of any within language contrasts of this kind among plosives or nasals, although Albanian seems to contrast apical dental and apical alveolar laterals (Bothorel 1969-70). The clearest evidence for the necessity of distinguishing between apical dental and apical alveolar sounds comes from the specification of the place of articulation in clicks. In many Khoisan languages such as !Xdo there are two clicks symbolized | |. We will

somewhere between these two extremes. The moveable articulators shown in figure 2.1 are the basis for setting up a classificatory system in which there are five active articulator classes: Labial, Coronal, Dorsal, Radical and Laryngeal. Broader classes of this sort predict quite well the types of articulations that can be combined in complex segments, as Halle (1983) pointed out. We also note that, in the normal flow of speech, when segments drawn from two different-articulator classes adjoin each other they will often overlap in their production whereas adjoining segments from the same class tend to produce a blended articulation. We have extended Halle's original set of three active articulator classes so as to allow a distinction between Dorsal and Radical articulations, as it is quite possible for epiglottal articulations to occur simultaneously with velar articulations. We have also added Laryngeal because of the similarity between glottal stops and stops made at other places of articulation, and because glottal stops can co-occur with all the other possibilities. We will discuss the various combinations between these classes in chapter 10, but there is another important prediction that the broad classification makes. In a very high proportion of the world's languages, segments with the same manner must be drawn from different active articulator classes. Thus a typical stop inventory is far more likely to contain p, t, k rather than t, t, t or c, k, q.

The five distinct types of articulatory gestures based on independence of articulators can be regarded as establishing a set of major place features. Each of the larger number of individual places we have been discussing can be grouped under one of these major place features, as shown in table 2.11. We have placed the linguo-labial place under the Coronal group, as the active articulator in this case is the tongue blade. As this place cannot be simultaneously combined with another Coronal articulation, the classification is appropriate. However, linguo-labial place cannot be combined with another Labial articulation either. There would thus be good reason to place it under the Labial class as well. This case illustrates the fact that the boundaries between classes are not rigid. Likewise, the numbered elements in figure 2.2 and tables 2.10 and 2.11 are more like the modal possibilities within sets of articulations. They are simply labels for commonly found articulatory possibilities within