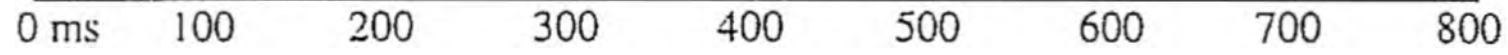


*Figure 8.18* (a) Audio waveform and (b) pharyngeal pressure in a dental click with a uvular ejective accompaniment.

Zhufhoasi, which is a dialect of !Xu , is another Khoisan language for which there is a considerable amount of published data (Snyman 1970, 1975, 1978, 1980). In this chapter we will use data from our own field recordings, which are comparable to those we have for !X66. This language, which is only remotely related to !X6o, has a slightly smaller number of clicks than !X66. It does not have bilabial clicks, and also has fewer click accompaniments. Examples of contrasts involving the alveolar click are shown in table 8.5, and in figures 8.19 and 8.20.

Most of the clicks illustrated in figure 8.19 are similar to those in !Xdo, and need little further discussion. The main differences are in VOT, with the Zhu | ’hoasi examples having more voicing and less aspiration. In addition, unlike the situation in 1X66, the VOT is much shorter for the aspirated click in row (3) and the click with glottal stop accompaniment in row (6) than for the click with voiceless aspirated nasal accompaniment in row (5). We do not know if these differences in timing reflect real differences between the two languages or if they are simply due to a difference in the rate of speech or to the particular speakers that were recorded on the different occasions.

Figure 8.20 shows the remaining Zhu | ’hoasi clicks in table 8.5. Again they are largely similar to the corresponding clicks in !X6o, except for differences in timing, which may be due to the individual circumstances of the recordings. However, this is not always the case. In row (7) there is a click in Zhufhoasi that we transcribed as g!$^{v}$ There is a similar click in !Xdo in row (11) of figure 8.12; we transcribed the !X6o click as g | kx, a voiced click followed by a voiceless velar affricate, noting at the time that there may be no velar closure after the anterior closure has been released, so that this maybe g'.kx or g!x. In Zhufhoasi the comparable dick is not only always fricative, but is also usually (but not always) voiced throughout We do not know of any language that contrasts the !X6o clicksglkxorglxwith the typical Zhufhoasi click g !$^{Y}$, although one might be considered a sequence of a voiced

| | | |
|---|---|---|
| 11 | gk!$^{x}$'aru | 'leopard' |
| 12 | grj!$^{h}$am | 'spider' |

click followed by a voiceless velar affricate or fricative, and the other a voiced click with a velar fricative accompaniment.

Another difference between the dialect of !X66 represented in figure 8.12 and Zhuphoasi is that the former has clicks such as k!’q and g!q’, whereas Zhuphoasi has clicks such as k!” and gk!$^{x}$’, illustrated in rows (9) and (11) in figure 8.20. We noted above that in other dialects of !X66 the clicks k!” and gk!” occurred instead of kl’q’ and g!q’. No language that we know of contrasts clicks of the form k!’q’ and k!$^{x}$’ or the voiced counterparts g!q’ and gk!*’. We should also note a sequence that does not occur in !X6b, but does occur in Zhu|’hoasi, as exemplified in row (12), a voiced velar nasal and voiceless aspirated velar nasal. This is another example of the complex voicing clusters that occur in these languages. (The particular token illustrated in figure 8.20 has only very weak voicing.)

We are now in a position to try to summarize the complete range of click accompaniments. The number of possible accompaniments is fairly considerable, as can be seen from table 8.6, which lists symbols and a short description for 21 accompaniments, together with one or more languages in which each occurs. As we have noted, some of these accompaniments might be better regarded as involving sequences of consonants. Khoisan languages have no constraint forbidding voiced and voiceless sequences of obstruents within a single cluster. All these sequences are included here so as to give a more complete overview of possible sounds involving clicks.

There are problems in trying to draw up a list such as that in table 8.6, in that it is not easy to say when two sounds in different languages should be regarded as phonetically the same. This is an issue that has plagued phoneticians for many years. It is at the heart of the International Phonetic Association's difficulty in trying to decide which symbols need to be represented on its chart (Ladefoged 1990). If two sounds contrast phonologically in a single language, of course they must have distinct phonetic qualities. But if two seemingly different sounds never occur in the same language, how can one

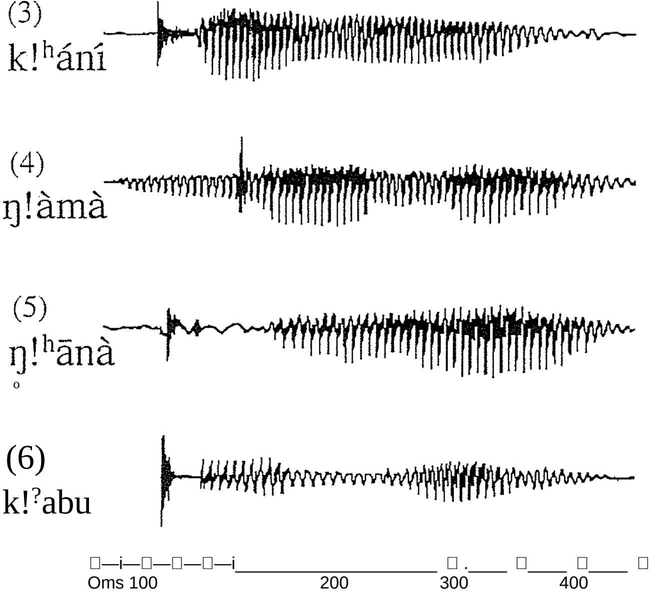


*Figure S.19* Waveforms of the first six Zhu|’h6asi alveolar clicks in table 8.5.

decide whether they are indeed different?

The first six items in table 8.6 present no problems in this respect, but it is worth considering why phoneticians have no difficulty in recognizing that there are six different sounds although they do not all contrast in a single language. The first four are all contrastive in two of our exemplifying languages, !X6o and Zhu|’hoasi. The fifth and sixth, the clicks with breathy voiced plosive and breathy voiced nasal accompaniments, occur only in Nguni languages here exemplified by Xhosa. As we noted earlier, the description of these sounds as being breathy voiced is largely a phonological designation of them

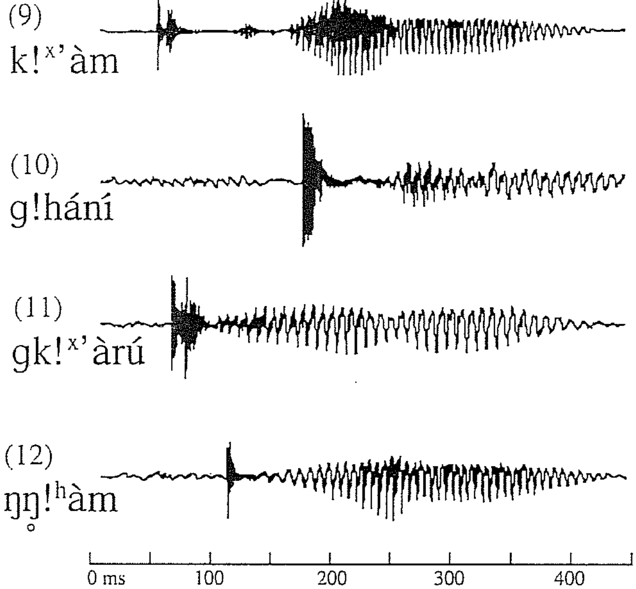


*Figure 8.20* Waveforms of the last six Zhu|’hōasi alveolar clicks in table 8.5.

as being tone depressors (Traill, Khumalo, and Fridjhon 1987). Accordingly, the breathy voiced velar plosive accompaniment might be considered as simply the Nguni variant of the voiced velar plosive accompaniment, as these languages do not have this possibility. But there are two points against this interpretation. Firstly, this solution is not available in the case of the breathy voiced velar nasal accompaniment, as there is a contrasting voiced velar nasal accompaniment in these languages. This makes it evident that a breathy voiced accompaniment has to be recognized as distinctive for some clicks. Secondly, these languages also contrast voiced velar plosives and breathy voiced velar plosives in the non-click

| | | |
|---|---|---|
| 5 g! | Breathy voiced velar plosive | Xhosa |
| 6 rj! | Breathy voiced velar nasal | Xhosa |
| 7 r)!h | Voiceless aspirated velar nasal (delayed aspirated) | Nama,!Xdo, Zhuphoasi |
| 8 k!7 | Voiceless velar plosive and glottal stop | Nam a,1X66, Zhu\|'hbasi |
| 9 k!x | Voiceless affricated velar plosive | !X66, Zhuphoasi |
| 10 g!h | Voiced velar plosive followed by aspiration | ?X66, Zhu\| Tidasi |
| 11 gk!' | Voiced velar plosive followed by voiceless velar fricative | !X66, Zhu \| boasi |
| 12 k!x' | Affricated velar ejective | Zhu I'hoasi |
| 13 g!kx' | Voiced velar plosive followed by voiceless affricated ejective | Zhu \| 'hoasi |
| 14 rjr)!h | Voiced velar nasal followed by voiceless aspirated velar nasal | Zhu I'hoasi |
| 15 9! | Voiceless velar nasal | 1X66 |
| 16 ?g! | Preglottalized velar nasal | !X66 |
| 17 G! | Voiced (optionally prenasalized) uvular plosive | !X66 |
| 18 q! | Voiceless unaspirated uvular plosive | 1X66 |
| 19 k!'q' | Voiceless velar ejective, followed by uvular ejective | !X66 |
| 20 g!q' | Voiced velar plosive, followed by uvular ejective | !X6o |
| 21 Glh | Voiced uvular plosive, followed by aspiration | 1X66 |

consonant series. This also makes it plausible to consider the voiced velar plosive accompaniment and the breathy voiced velar plosive accompaniment as potentially contrastive. It seems as if the first six accompaniments are all potentially contrastive and therefore they must be considered as phonetically distinct sounds.

A different problem arises in the case of the seventh item, the voiceless aspirated nasal accompaniment. There is instrumental evidence showing that these sounds differ in Nama and !X66. Ladefoged and Traill (1984) showed that in Nama there is a voiceless velar nasal with a pulmonic egressive airstream. Traill (1991) showed that in !X6o there is also a voiceless velar nasal, but an ingressive pulmonic airstream. Moreover these differences have phonological implications, in that the Nama voiceless aspirated nasal clicks show some voicing assimilation when they occur intervocalically so that they have a voiced velar nasal onset, but the 1X66 sounds are less likely to show such an assimiladone. Items (12) and (13) in Zhuphoasi, k!$^x$ and gk!$^x$, are comparable with items (19) and (20) in !X6o, k!’q’ and g!q’, in the sense that the Zhuphoasi forms occur in !X6o as dialectal variants of the forms listed for !Xdo. Another pair of items that are fairly similar are (14), qg!$^h$, the voiced velar nasal followed by a voiceless aspirated velar nasal in Zhuphoasi, and(15), yl, the voiceless velar nasal, in !Xob. There are no strong arguments for regarding these non-contrasting sounds as distinct at a phonetic classificatory level. But, just as we held in the case of the different voiceless aspirated nasal accompaniments that they were not likely to be used contrastively, so we simply offer it as our opinion that the opposite is true in these cases: these pairs of sounds are sufficiently distinct to justify classifying them as different phonetic items that are potentially contrastive.

The other items, (16) through (21), occur in !X6o, but have no counterparts in Zhuphoasi. The preglottalized velar nasal accompaniment does not occur outside !Xdb; and Zhuphoasi also lacks all the contrastive uvular accompaniments.

Table 8.6 shows that if we include possible sequences involving more than one segment, then there might be 5 x 21 = 105 ways of beginning a word with a click. As we have seen in table 8.4, 83 of these actually occur as phonologically contrastive items in !X66. If we consider items (10, 11, 13, 14, 19, 20, 21) to be sequences, then there are still 14 x 5 = 70 phonetically distinct click segments, 55 of which occur in !X66. We should also note the limits of the list that we have given in table 8.6. When we consider the wide variety of click accompaniments that do occur, then a number of other possibilities must be considered as just accidental gaps that might have occurred but are not attested. Combinations using additional phonation types would be possible. We should also consider other airstream mechanisms that might be used. It is comparatively easy to produce a voiced velar implosive while producing a click. In fact, it is probably easier for most non-Khoisan phoneticians to say cf!a than it is to say glq’a. But implosives never occur as click accompaniments.

Some clicks are complex articulations; but many are simple sounds, judging from the fact that they are fairly easy to produce. Almost any child can, and probably does, make bilabial, dental and lateral clicks as extralinguistic noises. Nor have we found any real difficulty in teaching students to integrate these sounds into syllables, although many have difficulty in avoiding nasalizing such as g!ʰai, 'fall', with a voiceless pulmonic ingressive nasal, and complex sequences ofclicks and ejectives such as that in k||’q’aa, 'grass' are among the most difficult articulations that we know of in common words in the world's languages. But most people can easily learn to say simple !Xóo words such as k|aa, 'move off,' so that it is surprising that plain clicks do not occur in more languages.

In this chapter we will consider the kinds of vowel sounds that occur in the world's languages. But before we do this we should try to define what we mean by a vowel. In many linguistic descriptions sounds are classified as either vowels or consonants. The original intuition behind this classification was that vowels are sounds that may be pronounced alone, but consonants must be sounded with a vowel. In many languages the sounds called vowels can form a word by themselves, but the sounds called consonants must be accompanied by a vowel. The phonetic basis of the distinction between vowels and consonants is not straightforward. An important contribution on this topic was made by Pike (1943) who began by splitting segments in another way. He first of all made a distinction between vocoids and contoids, with a vocoid being defined as a central resonant oral. He then went on to define a vowel as a syllabic vocoid. In practice this is very similar to the definition given by Chomsky and Halle (1968) in the latter part of *The Sound Pattern of English.* Their definition is that a vowel is a segment with the features [+ syllabic, - consonantal], with [- consonantal] sounds being defined as those that do not have a central obstruction of the oral tract. In many ways this is functionally equivalent to the later practice of autosegmental phenologists in defining a vowel as a [- consonantal] segment attached to a V slot. Whichever definition is used it is equivalent to saying that a vowel is defined by features that ensure that there are no major strictures in the vocal tract; and that it is syllabic.

We know what we mean by there being no obstructions in the vocal tract, but what, from a phonetic point of view, do we mean by syllabic? There is no phonetic parameter that can be used to define syllabicity in articulatory, or physiological terms. When Pike proposed his definition, he suggested that syllables correspond to the valleys between peaks in strictural degree. Thus the

(Ladefoged 1982). This is a neurophysiological, or cognitive view of the syllable, making the syllable a phonological rather than a phonetic unit. Syllables are identifiable as the primary elements over which the rhythmic patterns of language can be observed, or the primary domain over which sequential constraints apply, or coarticulatory adjustments can be made. Vowels are defined by the physiological characteristic of their having no obstruction in the vocal tract, and by their function within a phonologically defined syllable. At the end of the chapter we will consider semivowels, which we will take to be sounds that are like vowels in that they have no obstructions in the vocal tract, but unlike vowels in that they are not syllabic.

## 9.1 Major Vowel Features

Many of the features required for linguistic descriptions of vowels have been established for some time. An excellent summary of their application to the world's languages was given by Lindau (1978). The discussion here will follow a similar framework; we will summarize our differences at the end of the chapter.

The basic parameters of most vowel systems are the three scales whose endpoints are traditionally called high and low, front and back, and rounded and unrounded. Figure 9.1 shows the location of a set of reference vowels, the cardinal vowels described by Jones (1956), within the space defined by these dimensions. In our examination of the vowels of the world's languages we will continue to use the traditional terms high/low and back/front, and we will refer to these dimensions as Height and Backness. These terms were originally proposed as descriptions of actual articulatory characteristics of vowels, and taken to specify the highest point of the tongue. However, although we will use the traditional articulatory labels, we do not mean to imply that we necessarily think that these terms can be directly interpreted as indicating the shape of the vocal tract, as it is not at all clear that the classes of vowels defined by tongue body positions are the same as those defined by the traditional use of these

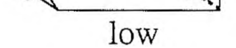


*Figure 9.1* The primary Cardinal Vowels displayed in terms of the major dimensions of vowel quality.

terms. The mean position of the tongue in the saggital plane during nine American English vowels as produced by five speakers is as shown on the left of figure 9.2 (based on data and calculation of means by factor analysis as described in Harshman, Ladefoged and Goldstein 1977). Dots have been placed on the highest point of the tongue in each vowel, and the resulting spacing of vowels is given on the right of the figure. As can be seen, the tongue height of u is below that of i, that of u is below that of e and the tongue height of o is below that of ae. Traditional descriptions of English vowels would classify i, i, u, u all as high vowels, but with i, u lower than i, u; o as mid and ae as low. Diagrams showing the height of the center of the tongue body (as advocated by Fischer-Jorgensen 1985) would reveal much the same relationships as in figure 9.2.

There are a number of alternative possible ways of quantifying the position of the tongue in vowels. The most well known is that used by Stevens and House (1955) and Fant (1960), who point out that, from an acoustic phonetic point of view, the most important articulatory characteristics of vowels are the position of the point of maximum constriction of the vocal tract, and the cross-sectional area of the vocal tract at that point. Figure 9.3 shows the vowels in figure 9.2 arranged in this way. The groupings in this figure do not form any obvious natural classes from a linguistic point of view.

There is an interesting possible compromise between the two characterizations we have considered so far. In this view each vowel is characterized in terms of the distance of the highest point of the tongue from the roof of the mouth, as shown in figure 9.4. For the front vowels below the hard palate this is effectively the same as the position of the highest point of the tongue as in figure 9.2. For the back vowels it is somewhat different, especially as it must be remembered that the height of the soft palate is directly correlated with the height of the vowel, so that the low vowels are in fact closer to the roof of the