Classifying speech sounds

Our articulators enable us to make an infinite number of different speech sounds, but in our scientific study we need some way of bringing order into the apparent chaos of all these different sounds. We have already seen how the most fundamental division we make (and have made for thousands of years) is between vowels and consonants. Within each of these basic categories, we can make finer and finer distinctions. It is interesting to compare our science with another such as botany. The world is full of plants of amazing variety, and each of them must be put into a scientific category; to do this requires a taxonomy of plants, a framework for classification. If a new plant is discovered, a botanist will try to decide whether it belongs within an existing family group, or whether a new class must be created. We do the same with the great variety of speech sounds we find being used in the world's languages.

For each language we examine, we are able to identify a number of **phonemes** (introduced in Chapter 1) which function in that particular language as distinctive—they work to distinguish meanings of different words in the language. The difference between the phonemes /p/ and /b/ in English causes us to hear the difference between the words 'pin' and 'bin'; the difference between /ɪ/ and /æ/ makes the difference between 'bit' and 'bat'. In the theory of the phoneme, the phoneme is abstract (like a letter of the alphabet), and what you hear is the **realization** of the phoneme—its physical form. Phonemes can have several different physical forms, or **allophones**.

When we have decided what category a sound belongs in, we can represent it with a symbol. Some symbols have already been

introduced, but there are many more. As explained in Chapter 1, it is a long-established convention that when one wishes to distinguish between symbols for the phonemes of a particular language and IPA symbols for allophones, or for sounds in general, one should put the symbols between different brackets. Phoneme symbols should be between slant brackets: /e/, /s/ and so on; phonetic symbols should be between square brackets: [ø], [ʁ]. As an example, we will look at the word 'ostrich'. We can write this relatively simply in phonemic transcription as /ɒstrɪʧ/; however, we might want to be more precise about the exact pronunciation. The /r/ is usually a voiceless sound in this context and can be represented phonetically as [ɹ̥]. Most English speakers have rounded lips for /ʧ/, which is therefore transcribed phonetically as [ʧʷ]; they also tend to put a glottal stop [ʔ] in front of /ʧ/, though this sound is not a phoneme of English. A phonetic transcription of 'ostrich', then could look like this: [ɒstɹ̥ɪʔʧʷ].

When all the classification possibilities available to phoneticians have been listed, they can be put together in the form of a chart, the best-known of which is the **IPA** (International Phonetic Association) Chart. This is reproduced in Table 1.2 on pages 8–9.

Vowels

We have already looked briefly at vowels in the previous chapter. It has been claimed that the most basic vowels are [i] (similar to the vowel in the English word 'key') and [ɑ] (as in 'half'): similar vowels are found in the great majority of the world's languages, and they are the vowels that babies learn first. They are also different in one very important way: in [i], the tongue is close to the palate, while in [ɑ] the mouth is open, with the tongue low in the mouth. You can see the difference if you look in a mirror while saying these two sounds, one after the other. We therefore class [i] as a **close** vowel and [ɑ] as an **open** vowel.

We can find another very basic vowel: its symbol is [u]. Although the English vowel in 'who' is a reasonable example, we can find clearer cases in some other languages: the vowel in French 'vous', German 'du', or Spanish 'tu'. The [u] vowel differs from [i] in two important ways. The one which is easiest to observe is that the lips are rounded in [u], but unrounded or

spread (as for a smile) in [i]. More difficult to observe is that the back of the tongue is raised for [u] while in [i] it is the front of the tongue which is raised. As a result, we say that [i] is a **front** vowel, while [u] is a **back** vowel.

By looking at these three vowels, we have seen the most important features used for classifying vowels: a vowel may be close or open; front or back; rounded or unrounded. We can now look at where other vowels fit in this scheme—there are many different vowels in the world's languages, and we need to be able to put them in their place. On the open/close scale, we place two intermediate levels: mid-close and mid-open. In between front and back, we put central. At each point on the outside of the diagram we place two symbols: the left-hand item of each pair is unrounded, while the one on the right is rounded. There is a well-known diagram used to represent the vowel 'space', known as the Cardinal Vowel Diagram. This can be seen in Figure 3.1.

The vowels that we place on this diagram are **cardinal vowels**, and these are not the vowels of any particular language. Indeed, there is some doubt about whether one of these vowels, [Œ], has ever been observed as a phoneme in any language in the world, but it is nevertheless a vowel which we are capable of making, so we give it a symbol and a place on the diagram (in fact, the nearest sound to this rare beast that you are likely to hear is the sound of someone yawning loudly). Given this way of classifying vowels, we can give any vowel a phonetic label by describing its frontness, openness, and rounding: thus, using cardinal vowels as examples, we can say that [i] is a front close unrounded vowel, while [u] is a back close rounded vowel. The vowel [e] is a front mid-close unrounded vowel, while [ɔ] is a back mid-open rounded vowel.

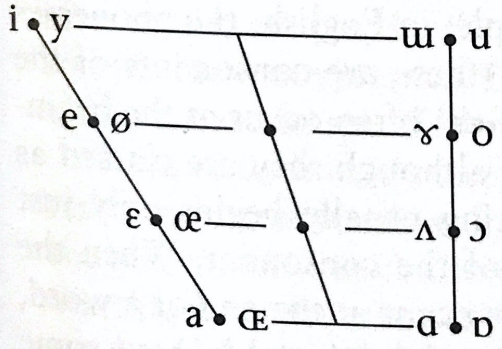

FIGURE 3.1 *The cardinal vowels*

There are many other ways in which vowels differ from each other, though the features we have looked at in this section are the most important ones. Some languages have nasalized vowels in addition to normal ones; in these, some of the air-flow is allowed to escape through the nose. French is a well-known example—the vowels in 'fin', 'bon', 'dans', and 'brun' are nasalized. Among other European languages, Portuguese and Polish also have nasalized vowels. There are also differences in vowel length, and some languages contrast long and short vowels. It has been claimed (but not accepted by everyone) that the Estonian language distinguishes short, medium and long vowel and consonant phonemes.

Consonants

As we saw in Chapter 2, all true consonants are the result of obstructing the flow of air through the vocal tract. When we classify consonants, we look at the following characteristics:

1 Whether the sound is **voiced** or **voiceless**.
2 The **place** (or places) **of articulation** where the obstruction is made.
3 The **manner of articulation** or type of obstruction.
4 The **airstream** used to make the consonant.

In the following examples slant brackets are used for transcriptions of English phonemes, and square brackets for allophones of English and other examples.

1 Voicing is sometimes seen as a binary (yes/no) matter—a sound is either voiced or it isn't. It is 'in fact' rather more complex than this—some sounds are voiced for only part of their time. For example, in English, the phonemes /b/, /d/, and /g/ (these are consonants of the type called **plosives**) often occur at the beginning of a word; although they are classed as voiced, the voicing usually begins only just before the end of the consonant. When the same consonants occur at the end of a word, we find the reverse: /b/, /d/, and /g/ have some

ed plosives 'bin' /bɪn/; /dɪn/; 'go' /gəʊ/

er voiced consonants /meɪ/; 'no' /nəʊ/; 'low'

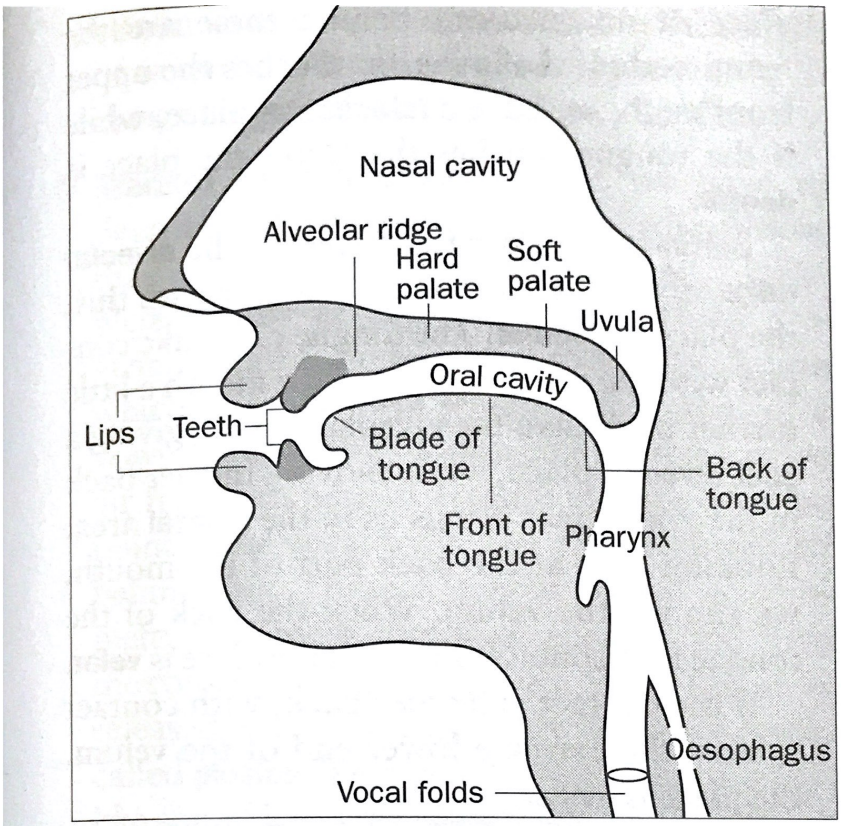

FIGURE 3.2 *Places of articulation*

voicing at the beginning, but then this dies away. Often the 'voiced' English **fricatives** /v/, /z/, and /ʒ/ behave in much the same way. Compared with these, other sounds such as /m/, /n/, and /l/ usually display full voicing, as do [b], [d], [g] in many other languages.

voiced fricatives 'van' /væn/; 'zoo' /zuː/; 'measure' /meʒə/

2 Place of articulation. We have already seen in the preceding chapter how consonants are made, and the relevant articulators can be seen in Figure 3.2. In the descriptions that follow, the examples are from BBC English unless otherwise specified.

We need to look in more detail at the vocal tract and its **articulators** in order to identify the places, and this can be seen in Figure 3.2. Starting from the outer end of the vocal tract, we have the lips, which give us the **bilabial**

bilabial 'bin' /bɪn/; 'pin' /pɪn/; 'man' /mæn/

place of articulation. Behind these are the front teeth; if the lower lip touches the upper front teeth, we have a **labiodental** place, while if the tongue touches the teeth, the place is **dental**.

Behind the upper front teeth is the **alveolar ridge**, and if the tongue is in contact with this, the place is **alveolar**. The tongue can make contact with the upper surface of the mouth a little further back than the alveolar region, giving a **post-alveolar** place, while moving further back in the vocal tract brings us to the **palatal** area. Looking now at the back part of the mouth, we can see the velum. When the back of the tongue is in contact with this, the place is **velar**.

If the contact is further back, with contact against the extreme lower end of the velum, the place is **uvular**.

Moving downwards towards the larynx, we can see the pharynx, and if we constrict this we get a **pharyngeal** place. A constriction between the vocal folds, inside the larynx, has a **glottal** place of articulation, since the space between the vocal folds is known as the glottis.

In addition to these places in the mouth, there is another characteristic of some sounds which is traditionally classed as a place of articulation: this is **retroflex**. In a retroflex sound, the front part of the tongue is curled backwards so that if it makes contact with the upper surface of the mouth, it is the tip of the tongue, or even the underside, which makes contact. Consonants of this sort are commonly found in languages of the Indian subcontinent. 'Retroflex' is not really a place, but a shape of the tongue, and does not really belong in any of the normal categories of sound classification. Retroflexion is found also in vowels—it is often heard in the speech of Americans in vowels where there is an 'r' in the spelling, such as 'car', 'more', 'bird'.

3 Manner of articulation. Here we have to describe the type of obstruction to the airflow that is formed. This can range from a complete closure of the vocal tract, which prevents any air from escaping, to an articulation which in most ways is identical to that of a vowel. A **plosive** is a consonant which stops air from escaping. A closure is made at some point in the vocal tract, and air is compressed behind this. There is a brief period of complete, or almost complete, silence, and then the compressed air is released. When this air is released, there is a very short explosive noise, called **plosion**. This may be followed by a [h]-like sound known as **aspiration**.

A **nasal** consonant involves a complete closure in the oral cavity, but air is allowed to escape through the nose, since the velum is lowered for the production of this type of consonant.

A **fricative** requires a constriction which allows the air to escape with difficulty, so that a hissing sound is produced. An **affricate** is a consonant which starts as a plosive, but instead of ending with plosion, ends with a fricative made in the same place.

There is a class of sounds which are very brief: **tap** and **flap**. To make a tap, the tongue is briefly flicked up against the roof of the mouth, interrupting the flow of air for a short time. A flap is similar, but the tongue is curled back and then flicked forward against the alveolar ridge. An unusual and difficult sound is the **trill**. Various articulators are mobile enough to vibrate if the air-flow is suitable

The tongue-tip and the uvula are suitable for trilling and are used for this in a number of languages. If you trill your lips, you produce what is sometimes called a 'raspberry' or, in America, a 'Bronx cheer'.

Finally, there is a class of sounds which are collectively called **approximants**. One of these is the **lateral**: in this type, the centre of the tongue is in close contact with the roof of the mouth, but the sides of the tongue are lowered so that air can escape along the sides of the tongue. A **post-alveolar** approximant is a rather vague concept, but the term is normally used to refer to the 'r' sound of the English of America and England, where the tongue is slightly curled backwards but does not make contact with the upper surface of the mouth.

lateral approximant 'led' /led/; 'hill' /hɪl/
post-alveolar approximants 'red' [ɹed]; 'hurry' [hʌɹi]; American English 'car' [kɑɹ] 'cart' [kɑɹt]

4 Airstream mechanism. Finally, we should (if we are being as precise as possible) also specify the airstream mechanism of a consonant: it may be **pulmonic**, made by the movement of air out of or (much more rarely) into the lungs, **glottalic**, made by moving air inwards or outwards by lowering or raising the larynx in the throat, or **velaric**, made by making a velar closure (as for [k] or [g]) and sliding the tongue backwards or forwards to move air inwards or outwards. When the air is moved outwards, we call it **egressive**, while inward movement is called **ingressive**.

Having established these principal ways of classifying consonants, we can make up labels which define any given consonant. We will assume for now that we are looking at egressive pulmonic consonants (made with air expelled from the lungs).

[s] is a voiceless alveolar fricative
[g] is a voiced velar plosive
[l] is a voiced alveolar lateral approximant
[tʰ] is a voiceless aspirated alveolar plosive.

These labels are important in phonetics for specifying a sound in an unambiguous way, but it can take a long time to learn how to use them properly.