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The Articulation of Vowel Sounds

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First Year Students

In the production of vowel sounds, the articulators do not come very close together, and the passage of the airstream is relatively unobstructed. For this reason, it is much more difficult to feel the position of the tongue during vowel sounds, than in consonants. We can describe vowel sounds roughly in terms of the position of the highest point of the tongue and the position of the lips. (As we will see later, more accurate descriptions can be made in acoustic terms.) Figure 1.13 shows the articulatory position for the vowels in heed, hid, head, had, father, good, food. Of course, in saying these words, the tongue and lips are in continuous motion throughout the vowels, as we saw in the x-ray movie in example 1.1 on the book's website. The positions shown in the figure are best considered as the targets of the gestures for the vowels. As you can see, in all these vowel gestures, the tongue tip is down behind the lower front teeth, and the body of the tongue is domed upward. Check that this is so in your own pronunciation. You will notice that you can prolong the [h] sound and that there is no mouth movement between the [h] and the following vowel; the [h] is like a voiceless version of the vowel that comes after it. In the first four vowels, the highest point of the tongue is in the front of the mouth. Accordingly, these vowels are called front vowels. The tongue is fairly close to the roof of the mouth for the vowel in heed (you can feel that this is so by breathing inward while holding the target position for this vowel), slightly

less close for the vowel in hid (for this and most other vowels it is difficult to localize the position by breathing inward; the articulators are too far apart), and lower still for the vowels in head and had. If you look in a mirror while saying the vowels in these four words, you will find that the mouth becomes progressively more open while the tongue remains in the front of the mouth. The vowel in heed is classified as a high front vowel, and the vowel in had as a low front vowel. The height of the tongue for the vowels in the other words is between these two extremes, and they are therefore called mid-front vowels. The vowel in hid is a mid-high vowel, and the vowel in head is a mid-low vowel. Now try saying the vowels in father, good, food. Figure 1.13 also shows the articulatory targets for these vowels. In all three, the tongue is close to the back surface of the vocal tract. These vowels are classified as back vowels. The body of the tongue is highest in the vowel in food (which is therefore called a high back vowel) and lowest in the first vowel in father (which is therefore called a low back vowel). The vowel in good is a mid-high back vowel. The tongue may be near enough to the roof of the mouth for you to be able to feel the rush of cold air when you breathe inward while holding the position for the vowel in food. Lip gestures vary considerably in different vowels. They are generally closer together in the mid-high and high back vowels (as in good, food), though in some forms of American English this is not so. Look at the position of your lips in a mirror while you say just the vowels in heed, hid, head, had, father, good, food. You will probably find that in the last two words, there is a movement of the lips in addition to the movement that occurs because of the lowering and raising of the jaw. This movement is called lip rounding. It is usually most noticeable in the inward movement of the corners of the lips. Vowels may be described as being rounded (as in who'd) or unrounded (as in heed). In summary, the targets for vowel gestures can be described in terms of three factors: (1) the height of the body of the tongue; (2) the front–back position

of the tongue; and (3) the degree of lip rounding. The relative positions of the highest points of the tongue are given in Figure 1.14. Say just the vowels in the words given in the figure caption and check that your tongue moves in the pattern described by the points. It is very difficult to become aware of the position of the tongue in vowels, but you can probably get some impression of tongue height by observing the position of your jaw while saying just the vowels in the four words heed, hid, head, had. You should also be able to feel the difference between front and back vowels by contrasting words such as he and who. Say these words silently and concentrate on the sensations involved. You should feel the tongue going from front to back as you say he, who. You can also feel your lips becoming more rounded. As you can see from Figure 1.14, the specification of vowels in terms of the position of the highest point of the tongue is not entirely satisfactory for a number of reasons. First, the vowels classified as high do not have the same tongue height. The back high vowel (point 7) is nowhere near as high as the front vowel (point 1). Second, the so-called back vowels vary considerably in their degree of “backness.

The Sounds of Vowels

Studying the sounds of vowels requires a greater knowledge of acoustics than we can handle at this stage of the book. We can, however, note some comparatively straightforward facts about vowel sounds. Vowels, like all sounds except the pure tone of a tuning fork, have complex structures. We can think of them as containing a number of different pitches simultaneously. There is the pitch at which the vowel is actually spoken, which depends on the pulses being produced by the vibrating

vocal folds; and, quite separate from this, there are overtone pitches that depend on the shape of the resonating cavities of the vocal tract. These overtone pitches give the vowel its distinctive quality. Look back at Figure 1.12 to see what these overtone pitches look like in a spectrogram. The second vowel in apartment is labeled in that figure, and when you look at it in the spectrogram one key visual feature is that there are three dark bands running horizontally through the vowel. These bands occur at different frequencies for different vowels. Here we will consider briefly how one vowel is distinguished from another by the pitches of the overtones.

ormally, one cannot hear the separate overtones of a vowel as distinguishable pitches. The only sensation of pitch is the note on which the vowel is said, which depends on the rate of vibration of the vocal folds. But there are circumstances in which the overtones of each vowel can be heard. Try saying just the vowels in the words heed, hid, head, had, hod, hawed, hood, who'd, making all of them long vowels. Now whisper these vowels. When you whisper, the vocal folds are not vibrating, and there is no regular pitch of the voice. Nevertheless, you can hear that this set of vowels forms a series of sounds on a continuously descending pitch. What you are hearing corresponds to a group of overtones that characterize the vowels. These overtones are highest for the vowel in heed and lowest for the vowel in either hawed, hood, or who'd. Which of the three vowels is the lowest depends on your regional accent. Accents of English differ slightly in the pronunciation of these vowels. In the audio examples that accompany this chapter, you can hear these vowels whispered.

There is another way to produce something similar to this whispered pitch. Try whistling a very high note, and then the lowest note that you can. You will find that for the high note you have to have your tongue in the position for the vowel in

heed, and for the low note your tongue is in the position for one of the vowels in hawed, hood, who'd. From this, it seems as if there is some kind of high pitch associated with the high front vowel in heed, and a low pitch associated with one of the back vowels. The lowest whistled note corresponds to the tongue and lip gestures very much like those used for the vowel in who. A good way to learn how to make a high back vowel is to whistle your lowest note possible, and then add voicing.

Try saying just the vowels in had, head, hid, heed in a creaky voice. You should be able to hear a change in pitch, although, in one sense, the pitch of all of them is just that of the low, creaky voice. When saying the vowels in the order heed, hid, head, had, you can hear a sound that steadily increases in pitch by approximately equal steps with each vowel. Now say the vowels in hod, hood, who'd in a creaky voice. These three vowels have overtones with a steadily decreasing pitch. Example 1.4 has an audio file of Peter Ladefoged saying the vowels in the words heed, hid, head, had, hod, hawed, hood, who'd in his British accent. The first four of these vowels have a quality that clearly goes up in pitch, and the last four have a declining pitch. In summary, vowel sounds may be said on a variety of notes (voice pitches), but they are distinguished from one another by two characteristic vocal tract pitches associated with their overtones. One of them (actually the higher of the two) goes downward throughout most of the series heed, hid, head, had, hod, hawed, hood, who'd and corresponds roughly to the difference between front and back vowels. The other is low for vowels in which the tongue position is high and high for vowels in which the tongue position is low. It corresponds (inversely) to what we called vowel height in articulatory terms. These characteristic overtones are called the formants of the vowels. The one with the lower pitch (distinguishable in creaky voice) is called the first formant, and the higher one (the

one heard when whispering) is the second formant. The notion of a formant (actually the second formant) distinguishing vowels has been known for a long time. It was observed by Isaac Newton, who, in about 1665, wrote in his notebook: “The filling of a very deepe flaggon with a constant streame of beere or water sounds ye vowells in this order w, u, w, o, a, e, i, y.” He was about twelve years old at the time. (The symbols used here are the best matches to the letters in Newton’s handwriting in his notebook, which is in the British Museum. They probably refer to the vowels in words such as woo, hoot, foot, coat, cot, bait, bee, ye.) Fill a deep narrow glass with water (or beer!) and see if you can hear something like the second formant in the vowels in these words as the glass fills up.