Human Communication

Humans love to talk. Whether it is face-to-face or on the phone, people constantly communicate with one another. In fact, with the increasing use of cellular phones, it seems like some people never stop talking!

Oral communication is something most people take for granted. Few people ever stop to think about how they are able to produce and understand language. A commonsense view is that a speaker starts with an idea and encodes it into language. Since the channel of communication for most people is oral language, producing language involves pushing air from the lungs up into the mouth and using the lips and tongue to produce different sounds. Understanding a message requires the listener to decode the acoustic signal into language to understand the original idea. All this seems to happen effortlessly. Speakers and listeners concentrate on what they are saying, not on how they are accomplishing the task. Communication with oral language seems so easy that, for most people, it is almost like breathing. Figure 3–1 represents this commonsense view of how communication takes place.

Human communication is considerably more complex than the commonsense view would suggest. Sending and receiving messages involves much more than encoding and decoding. For example, listeners predict what they will hear and then sample the acoustic signal to confirm their predictions. Listening is not a precise process. Otherwise, people would always hear exactly what others say. Communicating depends on listeners being able to make inferences to fill in information not included in the message. The social context also helps determine the meaning. Listeners' predictions are often based more on the setting than the acoustic signal. For example, at a store a customer might predict that the clerk
will say, “Have a nice day,” at the end of the transaction and not listen carefully to the words the clerk utters.

In addition to the context, listeners get other clues that help them understand messages. Speakers often use gestures to clarify their ideas. They point to things or people. Further, natural language includes a great deal of redundancy. Listeners get more than one clue when, for example, a speaker declares, “No! I won’t.” The two negatives here don’t signal a positive message. Instead, the speaker is giving two strong clues that he will not do something. The redundant nature of language allows people to communicate even when they miss some of the available clues.

Human communication is complex indeed. Even the same words, uttered with a different tone of voice, can signal different meanings. The boyfriend who doesn’t notice the difference between “Marry my daughter, will you” spoken in a threatening tone and the same phrase delivered in a pleading tone is in for a great deal of trouble. The situation and the roles and status of the speaker and listener all affect the meanings of messages.

Linguists have developed complex models to describe human communication (Bach and Hamish 1979). Speech acts theory attempts to account for the different factors involved in communication. For example, successful communication depends on speakers and listeners sharing knowledge of references. If a speaker refers to the Pentagon, he will assume that the listener knows that the reference is to the building that houses the central offices of the military of the United States. The speaker and listener may also share common feelings about people or places that are mentioned.

In addition, listeners have to decide if an utterance is literal or nonliteral, direct or indirect. “I have a frog in my throat” would normally be interpreted nonliterally, for example. And a question like “Is there any salt on the table?” is not simply a question, it is also an indirect request to pass the salt. If a listener treats
this utterance as a question and answers, “Yes, the salt is right in front of me,” communication will break down. Many utterances have both direct and indirect meanings. “The garbage is full” and “The potatoes are boiling over” are more than simple reports, they are indirect requests for the listener to do something.

Peggy Parish (1976) has written an amusing series of books whose main character, Amelia Bedelia, is a nonnative speaker of English. Amelia takes everything literally. She works as a maid for a family. When the husband tells her to “go fly a kite,” she does just that. When she reads a recipe that says the bread will rise, she watches the pan carefully to see if it will lift off the counter. Fortunately, Amelia always redeems herself with her wonderful cooking. What makes this series of books so amusing is that these kinds of communication breakdowns are quite rare. Most listeners know whether to interpret a message literally or nonliterally. However, English language learners like Amelia sometimes do not realize that certain expressions carry nonliteral meanings.

Even though the process is complex, most humans use language to communicate effectively each day. In this chapter we look at the physical process of producing meaningful sounds, but first we might ask why sound developed as the principal means of communication for most people.

Why Use Sound to Communicate?

Humans are social beings who seem driven to communicate. Deaf people develop the ability to communicate with gestures. Hearing people use sounds. Why did sounds, rather than visual signals, develop as the means of communication for hearing individuals? There are several practical reasons: In the first place, if people use sounds to express and receive ideas, their hands are free for other tasks. Thus, they can talk (not just whistle) while they work. In addition, sound travels around corners, so a wife in one room can tell her husband in another room that he should take out the garbage. Sound also works much better than gestures in the dark. For humans, then, communication using sounds has many practical advantages over other means of exchanging messages.

Humans use sounds to communicate even though using sound means changing the way people breathe and eat. Akmajian and colleagues (Akmajian, Demers, et al. 1979) point out that “the rhythm of respiration during speech is radically different from the rhythm of respiration during normal breathing” (p. 72). To speak, a person must control the outflow of air. For that reason, during speech rather than breathing in and out in a normal pattern, a person extends the period of exhalation. “One of the greatest distortions of the breathing rate occurs during speech: breath is drawn in rapidly and let out over a much longer period than during normal breathing” (p. 72). People do this without any conscious awareness. Humans seem to naturally adjust their breathing to accommodate speech.
Young babies can nurse and breathe at the same time. If adults try to drink and breathe simultaneously, though, they begin to choke. That is because at birth, the larynx is higher so that the passage for food and the passage for air are clearly separated. A baby can breathe through the nose while taking in milk through the mouth. Once the larynx drops down, there is the possibility of food or drink going into the lungs rather than the stomach. Why would humans develop in a way that makes choking possible? The reason seems to be that once the larynx drops down, there is more room in the oral cavity for humans to produce sounds. In other words, the development of a greater capacity for speech outweighs the dangers of food or drink going into the lungs.

**The Complexity of Sound Production**

Speech production is sufficiently complex that most researchers agree that it is an acquired capacity. During normal communication, humans produce an average of eight phonemes (distinctive, meaningful sounds) per second (Akmajian, Demers, et al. 1979). Speakers are able to maintain this rate of production over a long period of time without fatigue. During phoneme production the brain sends signals to the lungs, vocal cords, tongue, and lips to contract or relax the muscles. Even the production of a single phoneme can be complex. For example, in producing a word like *construe*, a speaker starts to round the lips to make the sound represented by *ue* even before starting the *str* sequence. Some messages from the brain have to travel farther than others to the muscles that control speech. At the same time, some nerve bundles transmit messages more rapidly than others because they are thicker. For that reason, the command to round the lips is sent out earlier than the command to start the *str* sequence so that when it is time to produce the *ue* sound, the lips will be ready. In other words, “the lip rounding in the last vowel in ‘construe’ arrives three phonemes early” (Akmajian, Demers, et al. 1979, p. 74). The details of this complex operation are not important here. What is important is that the messages the brain sends out to tighten and relax the muscles that control speech are so complicated that they must be acquired. Akmajian et al. sum up this point: “These features of speech are complex and automatic physical gestures which cannot be learned, but are among the biologically innate features that facilitate the acquisition of speech by the human species” (p. 74).

Even though hearing individuals use sounds to communicate, the biologically innate features that facilitate communication among humans may not be tied to sounds. What humans seem to have is the ability to use language to comprehend and produce meanings. Petitto (2003), from her study of children learning sign, suggests that this capacity is not specifically an ability to deal with sound: “I propose that humans are born with a sensitivity to particular distributional,
rhythmical, and temporal patterns unique to aspects of natural language structure” (p. 1). Humans are equipped to understand and produce messages. This capacity develops in the process of natural communication.

**Using Linguistic Concepts to Evaluate Methods of Teaching People to Communicate**

*Linguistics* is the scientific study of language, and linguists study different aspects of language. For example, historical linguists study how language has changed over time. Sociolinguists study how people use language to communicate in social settings. Neurolinguists study language and the brain. Some linguists focus on specific aspects of language and specialize in studies of phonology, morphology, or syntax. Each area of study contributes important information.

In this book, we are especially interested in examining those aspects of linguistics that provide insights into how people learn to read and write and how people learn a second language. In the area of reading there has been a division between methods based on the idea that reading should be directly taught and learned and methods based on the view that reading is acquired. A current approach to teaching reading that has been supported by the U.S. Department of Education relies heavily on directly teaching the small parts of language—the phonemes and morphemes. Nevertheless, many teachers read to and with children in the belief that children can acquire literacy without direct instruction in parts of the language. Early approaches to second language teaching were based on the idea that second languages are learned. Instruction focused on the parts of the language, the grammar and vocabulary. Current methods are based on an acquisition model of second language development. Instruction focuses on providing comprehensible messages.

We believe that information from areas of linguistics such as phonology, morphology, and syntax can inform educators as they evaluate methods of teaching reading and methods of teaching second languages. We begin by discussing English phonology in this chapter. We then use linguistic concepts from phonology to evaluate methods of teaching reading and methods of teaching a second language.

**English Phonology**

*Phonetics* is the study of sounds across languages. Many linguists use the International Phonetic Alphabet to describe sound systems. This alphabet has symbols to represent all the sounds that have been found in human languages. *Phonology* is the study of the sounds used by speakers of a particular language. A *phoneme* is
a sound that makes a difference in meaning in a language. Different languages use different sets of phonemes to communicate ideas. English has about forty phonemes while Spanish has about twenty-two.

To determine whether a sound functions as a phoneme in a language, a linguist tries to find two words that differ by just one sound. For example, in English, pet and bet are words that signify different meanings, and the only difference in sound is the difference between the “p” sound in pet and the “b” sound in bet, so a linguist might hypothesize that “p” and “b” are two phonemes in English. The linguist would then look for other pairs of words like pan and ban to confirm the hypothesis that “p” and “b” are phonemes of English. These words are referred to as minimal pairs because they differ by just one phoneme. The presence of a minimal pair is evidence that a sound functions as a phoneme in a language.

No language has a writing system that uniquely represents each sound in the language. That is, no alphabet has a one-to-one correspondence between sounds and letters. Instead, one letter may represent different sounds, and one sound may be represented by different letters or letter sequences. In English, for example, the same sound is represented by the c in cat and the k in kite. At the same time, the letters ea have different sounds in tea, bread, steak, and idea. Linguists wishing to study the sound system of a language need a more consistent method to analyze the sounds than an alphabet provides. For that reason, they use phonemic transcription.

In phonemic transcription, each sound is represented by one and only one written mark. Phonemic transcription makes use of many of the letters of the alphabet but uses them in a consistent way. For instance, the first sound of cat and kite is always written with a /k/. Phonemes are indicated by putting them between slash marks. To show the first phoneme in pet, a linguist would write /p/. A linguist could also show more details in the pronunciation of a sound by using phonetic transcription. The first sound in pet could be written as [pʰ]. Phonetic transcription is written within square brackets. The small raised h represents a puff of air that speakers produce as they make the /p/ sound at the beginning of a word. This feature, aspiration, is phonetic, not phonemic, because in English, aspiration is never used to signal a change in meaning.

Linguists describe phonemes by telling where and how they are produced. Each phoneme has unique articulatory properties. For example, /p/ is produced by stopping the air with the lips. The place of articulation is referred to as bilabial (the two lips), and the manner of articulation is called a stop, since the air is completely stopped for a moment and then released to make the sound. During the production of this sound, the vocal cords do not vibrate, so this type of sound is called voiceless or unvoiced. Each phoneme can be described by its place and manner of articulation and whether or not it is voiced.
Even though phonemes have physical properties that can be studied, a phoneme is a perceptual unit, not a physical entity. Phonemes actually differ in their physical production depending on the other sounds around them. For example, although the /p/ in pet is aspirated, the /p/ in sip is not. Listeners ignore this physical difference and perceive both sounds as the phoneme /p/. The phonemes of a language don’t sound the same each time they are produced, but all the variations are perceived as instances of the same sound by speakers of a language. That is why linguists claim that phonemes are perceptual, not physical units. In the next section, we explain how the phonemes of English are produced.

**The Physiology of Speech**

The speech sounds of English and other languages are formed by changes in the vocal tract, the area between the vocal cords and the lips. Figure 3–2 shows the key physical features involved in speech production. As air comes up from the lungs, it passes through a narrow area, the glottal region, which contains the vocal cords. These are elastic bands of tissue located in the larynx. They can be brought close together so that the air passing through causes them to vibrate. This causes what is referred to as voicing. Or they can be held apart so no voicing occurs.

The air continues up through the pharynx into the oral cavity. If the flow of air is not constricted, a vowel sound is produced. Different vowel sounds result from movements of the tongue and lips. These change the shape of the oral cavity so that different sounds are produced. For all vowels, the air flows freely. Consonant sounds are formed when the air is constricted as it moves toward the lips. This constriction can involve simply slowing the air down or stopping it completely. The different consonant sounds depend on how and where the air is slowed or stopped. For English consonant sounds, the air may be constricted at the lips, the teeth, the alveolar ridge (the hard ridge behind the upper front teeth), the hard palate, and the soft palate, or velum. Air can also pass through the nasal cavity if the velum is lowered.

Linguists may refer to vowel sounds as *syllabics*, because each syllable contains a vowel, and consonant sounds as *nonsyllabics*, because consonants by themselves do not constitute a syllable. Syllables consist of a series of alternating vowel and consonant sounds. There is a limit on the number of consonant sounds that can be produced in sequence because consonants involve blocking the air in different ways. In English, syllables can begin with up to three consonant sounds. In *stream*, for example, the three consonant phonemes are /str/. Linguists use the terms *vowel* and *consonant* to refer to sounds rather than letters of the alphabet. However, since the vowel sounds of English are usually represented by a small set of letters,
those letters are often referred to as vowels, and the other letters are called consonants. In the sections that follow, it is important to keep in mind that we are referring to the sounds, not the letters.

In the following sections, we describe the physical aspects of producing the vowel and consonant phonemes of English. Knowing where sounds are produced can be helpful in understanding students’ spelling. For example, if a student spells ten as den, it is useful to know that /t/ and /d/ are produced in the same place in
the mouth. Educators who know something of the physiology of speech production can better understand invented spellings that emergent writers produce.

**English Vowels**

English has a complex system of vowels consisting of short, long, and reduced vowels. The short vowels are also called *lax* vowels, and the long vowels are called *tense*. These terms reflect the relative tension of the muscles as the sounds are produced. Reduced vowels occur in unstressed syllables. All vowels in English are voiced. The vibration from the vocal cords provides the energy needed for a vowel sound. Different vowels are formed by changing the shape of the vocal tract as the vibrating air molecules pass from the vocal cords toward the lips.

Vowels vary considerably across dialects, and the number of vowel phonemes varies as well. For example, some people pronounce *cot* and *caught* with two different vowel sounds. For others, these words are pronounced the same. Speakers who distinguish *cot* and *caught* by their pronunciation have two different phonemes, while other people have only one. In our description of vowel sounds, we have chosen to present the phonemes common to most dialects of American English.

**Short vowels** There are six short vowel sounds. English spelling usually represents each of these short sounds with just one letter. Figure 3–3 shows where the short vowels are produced. The table represents the areas of the mouth when looking from the left side as in Figure 3–2. For example, /i/ is made in the front of the mouth, high up. What does that mean, though? Although there is considerable variation among speakers, and although the placement of a vowel depends on the other sounds in the word, in general this vowel is produced by moving the tongue toward the front of the mouth and raising the tip of the tongue up toward the roof of the mouth. In a word like *sit*, this is the movement of the tongue for the vowel. For each vowel phoneme, we include a word in parentheses that contains that vowel sound.

A good way to feel the differences among these vowels is to say the words on the chart in sequence from high front to low back: *pit, pet, pat, putt, put, pot*. In

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<th>Front</th>
<th>Central</th>
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<tbody>
<tr>
<td>High</td>
<td>i (pit)</td>
<td>u (put)</td>
<td></td>
</tr>
<tr>
<td>Mid</td>
<td>e (pet)</td>
<td>a (put)</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>æ (pat)</td>
<td></td>
<td>a (pot)</td>
</tr>
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</table>

Figure 3–3. Short vowels of English
the first three words the tongue moves toward the front of the mouth, and the vowel sound is made by moving the tongue slightly lower for each phoneme. For *pat*, most speakers open their jaw slightly to make this lower vowel sound. The word *put* is produced with the tongue in the middle of the mouth. For *put*, the tongue moves slightly up and back and the lips are rounded, which has the effect of lengthening the vocal tract. The last word, *pot*, is produced with the tongue low and back.

Many native speakers of English have difficulty in feeling these variations in tongue position. Native speakers of English produce these sounds effortlessly without conscious awareness of the tongue movements. It may help to make these sounds in front of a mirror to try to observe where the tongue is for each sound. English language learners often have difficulty distinguishing between words that differ by just one of these vowel sounds. However, during normal conversation, they can use other cues to determine the meaning. Trying to distinguish minimal pairs by saying two sets of words (sit and set, sit and sit) and determining if the two words in the sets are the same or different in exercises does not seem to help improve listening comprehension because this exercise removes normal context clues.

**Long vowels** The seven long vowels of English are all made by starting with a vowel and adding a glide. As the vowel is produced, the tongue moves from one part of the mouth to another. These vowels are also called *diphthongs*, from Greek roots meaning "two sounds," because the sound quality changes as each long vowel is produced. The long vowels are indicated with two letters in the transcription system being used here. The first letter indicates the tongue position at the beginning of the sound, and the second letter shows the direction of the glide. The tongue glides up and toward the palate for vowels represented with a /y/ and up and toward the velum for those with a /w/ (see Figure 3-2 for these parts of the mouth). Figure 3-4 lists the long vowels of English.

The long vowel phonemes are present in the words *beet, bait, boot, boat, boy, bite, and bout*. English spelling, in most cases, reflects the length of these vowels, representing them with two letters. The tongue starts toward the front

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<th>Central</th>
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<tr>
<td>High</td>
<td>iy (beet)</td>
<td>-</td>
<td>uw (boot)</td>
</tr>
<tr>
<td>Mid</td>
<td>ey (bait)</td>
<td>əw, oy (boat, boy)</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>əj, aw (bite, bout)</td>
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<td></td>
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FIGURE 3-4. Long vowels of English
and moves slightly up for beet and bait. To produce boot, a speaker moves the
tongue from the high back position slightly higher and farther back, and, at the
same time, enhances the effect by rounding the lips to lengthen the vocal tract.
The tongue starts in the middle back area and moves up and toward the front
for boy. To produce the vowel in boat, the tongue starts in the middle back area
and moves up toward the roof of the mouth in the back. It starts down low in
the back for bite and then glides up toward the roof of the mouth as the vowel
is produced. For bout it also starts low in the back, but then it glides up to the
back.

**Reduced vowels** English has two other vowels, which are called *reduced vowels.*
These vowels are produced with a weaker airflow, so the syllables in which they
appear do not receive stress. Reduced syllables occur in words with two or more
syllables. For example, in the first syllable of about, the vowel sound is a kind of
"uh" that is unstressed. This is the same sound that occurs in a one-syllable word
like putt, where it gets some stress. This mid, central unstressed or reduced vowel
is called a *schwa.* It is a very common sound in English. It is the sound many
English speakers make when they are trying to think of something to say. The
mouth is relaxed, and the tongue is in a neutral position. The symbol for the
schwa is an inverted e and is written as /ə/.

The other reduced vowel in English is produced with the tongue slightly higher
up in the mouth. It is a high, central vowel. This sound occurs in unaccented or un-
stressed syllables of words with two or more syllables. For example, it is the vowel
sound in the second syllable of medicine and the last syllable in jumping. This sound
is like the /i/ sound in sit except that it is produced with less force of air. This vowel
is often called a *barred i* and is written as /i/. One of the difficulties of English
spelling is that many different vowel sounds are reduced to schwa or barred i, and
these sounds can be spelled with almost any vowel letter. Figure 3-5 summarizes the

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<tbody>
<tr>
<td><strong>High</strong></td>
<td>iy (beet)</td>
<td>(i) (jumping)</td>
<td>uw (boot)</td>
</tr>
<tr>
<td></td>
<td>r (pit)</td>
<td></td>
<td>u (put)</td>
</tr>
<tr>
<td><strong>Mid</strong></td>
<td>ey (bait)</td>
<td>(a) about</td>
<td>ow (boat)</td>
</tr>
<tr>
<td></td>
<td>e (pet)</td>
<td>a (putt)</td>
<td>oy (boy)</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>æ (pat)</td>
<td></td>
<td>a (pot)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ay (bite)</td>
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<td></td>
<td></td>
<td></td>
<td>aw (bout)</td>
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</table>

*Figure 3–5. Vowel phonemes of English*
information about vowels. The chart represents a speaker’s mouth from a side view, with the speaker facing left. The two reduced vowels are placed in parentheses. A key word for each vowel sound is written to the right of the phoneme. Educators may wish to learn to use this system to transcribe English vowels. Phonemic transcription is a useful first step in analyzing sound-to-spelling correspondences.

In total, there are fifteen vowel phonemes, six short vowels, seven long vowels, and two reduced vowels. This system is further complicated by the effect of an /r/ phoneme following a vowel. Vowel sounds are made by slight adjustments of the tongue up or down and front or back. The /r/ phoneme is made by raising the tip of the tongue and curling it back somewhat. This action has an effect on the preceding vowel, giving it a quality it does not usually have. Which vowel phoneme best represents the sounds in dear, four, and tour? We won’t attempt to make the fine distinctions needed to represent these vowel sounds here, but it is not surprising that children have trouble learning to spell English words with these so-called r-controlled vowels. Other factors can influence vowels as well. For example, when a vowel is followed by a nasal sound, the vowel picks up some of the nasal quality. The vowel sound in wet is different from the same phoneme in went. Children learning to spell English often leave out the n in went because they perceive the nasal sound as part of the vowel, not as a separate phoneme.

Educators who understand the complexity of the English vowel system can better appreciate the difficulty children have as they attempt to represent these sounds as they write. Since there are about fifteen sounds, American English spelling uses various combinations of the available letters to represent them. In addition, English learners often have difficulty learning the vowel sounds of English. Spanish and Japanese, for example, have only five vowel phonemes, and none of them corresponds exactly to any English vowel. An understanding of the vowel phonemes of English can be helpful for any educator working with English learners or students learning to spell English words. This knowledge is also useful for educators trying to decide on the best way to teach students to read. We should add here that the best way to help students become more proficient spellers is to involve them in problem-solving activities so they can make sense out of the English spelling system. We return to this topic in Chapter 5. In addition, students who read extensively are much better spellers than those whose reading is limited.

**English Consonant Phonemes**

Consonant phonemes are produced by restricting or stopping the flow of air as it passes through the vocal tract. Consonants can best be described by telling where and how the air is constricted and by noting whether the sound is voiced.
English Phonology

| Figure 3-6. English consonants |

or voiceless. Consonants generally appear in matched pairs, one voiced and the other voiceless. Figure 3–6 shows the consonant phonemes of English. The place of articulation is indicated along the top of the chart, and the manner of articulation is shown on the side. In the sections that follow, we describe each type of phoneme.

Stops

There are three pairs of stops. Stop phonemes are formed by completely blocking the air for an instant and then releasing it. The first two stops, /p/ and /b/, are formed by stopping the air by closing the lips. Thus, they are called bilabials (two lips). These are the sounds at the beginning and end of *pop* and *bib*. Bilabials are some of the first sounds babies produce, so that is why parents and grandparents, in many languages, are called by words starting with /p/, /b/, or /m/, as in *papa*, *baba*, and *mama*. Note that all these names also contain the low, back vowel /a/, which is one of the first vowels children produce. The only difference between /p/ and /b/ is in voicing. English uses voicing to distinguish these sounds, and English speakers attend to this meaningful clue. In other languages, such as some dialects

| Figure 3-7. Stops |
of Arabic, the two bilabial stops are simply two ways of producing one phoneme, so speakers of those languages do not pay attention to the voicing difference since it doesn’t signal a change in meaning. Arabic speakers learning English, then, might have trouble hearing the difference between words like pig and big if they are presented the words in isolation. Of course, context clues would prevent them from getting these two words confused during normal communication.

The next two stops are /t/ and /d/. These phonemes are present at the beginning and end of words like tot and dad. The sounds are made by placing the tip of the tongue behind the front teeth along the alveolar ridge to block the air for a moment. Many of the consonants of English are produced in the alveolar region. In other languages, like Spanish and Japanese, these sounds are produced by placing the tongue against the back of the front teeth to form a dental stop. For that reason, the /t/ and /d/ phonemes sound slightly different in Spanish and Japanese than they do in English.

The last stops, /k/ and /g/, are formed by raising the blade of the tongue up against the velar region in the back of the mouth to temporarily block the air. These phonemes occur at the beginning and end of words like kick and gig. The three pairs of stops are set apart in the vocal tract. One is made with the lips at the front of the mouth, one in the middle, and the other at the very back. This separation helps listeners distinguish the stops from one another.

Fricatives

Fricatives are produced by constricting the airflow through the vocal tract. The resulting friction sets the air molecules in motion as they pass through the narrow opening. This action produces a sound. The fricatives also come in pairs, except for /h/. There are nine fricatives in English.

The labiodental pair, /f/ and /v/, are made by biting down on the lower lip. This slows the air and produces the sounds heard at the beginning and end of fluff and verve. The interdental fricatives, /θ/ and /ð/, are made by putting the tongue between the teeth and forcing air through the opening. Even though people have different spaces between their teeth, the tongue can be used to produce a similar sound for people with quite different tooth gaps. The names for these two
phonemes come from the Greek words *theta* and *eth*. The difference in sound between these two phonemes is more difficult to hear than some of the others, but it is evident in pairs like *thigh* (the /θ/) and *thy* (the /ð/). Words like *with* can be pronounced using either sound depending on the speaker’s dialect and on the sound that follows. These phonemes can also occur at either the beginning of words or the end, as shown in *thin* and *bath* for /θ/ and *then* and *bath* for /ð/.

The phonemes /s/ and /z/ are made by putting the tip of the tongue against the alveolar ridge, as in producing /tʃ/ or /ʒ/, but unlike the stops, the tip of the tongue is lowered enough to let some air go through. These phonemes occur at the beginning of words like *sip* and *zip* and the end of words like *kiss* and *fuzz*. It is easy to hear the difference in voicing in this pair. The vocal cords vibrate during /z/ but not in making an /s/. One way to detect voicing in more difficult cases is to block the ears while making the sound. That makes the vibration of the vocal cords easier to perceive.

The next two sounds, /ʃ/ and /ʒ/, have a small mark above them called a haček. This diacritic mark distinguishes these sounds from /s/ and /z/. They are produced by flattening the tongue along the roof of the mouth, the alveopalatal area. The /ʃ/ phoneme occurs at the beginning or end of many words, such as *ship* and *dish*, but the /ʒ/ is less common. It never starts a word, except for a borrowed word or a name, like *Zsa Zsa*. Speakers of some dialects pronounce this sound at the end of words borrowed from French, like *garage* and *rouge*. Most commonly, this /ʒ/ occurs in the middle of a word, like *confusion*. It is often represented by *si* in spelling.

The /h/ phoneme is a special case. It can be produced in different ways, but it is often made by slowing the air as it passes through the glottal area. In a word like *hop*, the /h/ can be felt in the throat, causing some vibration before the onset of the vowel sound. This sound is voiceless.

**Affricates**

Affricates are formed by briefly stopping the air and then releasing it with some friction. Thus, affricates are a combination of a stop and a fricative. English has two affricates, /tʃ/ and /ʒ/. The /tʃ/ is a combination of /t/ and /ʃ/, while the /ʒ/

<table>
<thead>
<tr>
<th>Affricates</th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Interdental</th>
<th>Alveolar</th>
<th>Alveopalatal</th>
<th>Velar</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>voiceless</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>voiced</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 3–9. Affricates**
combines /d/ with /z/. The /ć/ can be heard at the beginning and end of church and the /j/ occurs twice in judge. English spelling reflects the combined sounds in affricates by spelling some words that end in /ć/ with -tch as in watch and /j/ with -dge as in badge. However, English words do not begin with tch or dg, and this is something that children learning to spell need to figure out.

Stops, fricatives, and affricates generally come in voiceless and voiced pairs. The last three types of consonant phonemes, nasals, liquids, and glides, have more the quality of vowels because the air is not stopped or constricted as much, and all three of these kinds of phonemes are voiced.

**Nasals**

English has three nasal consonants. These are /m/, /n/, and /ŋ/. The first two have the sounds of the letters m and n in words like Mom and Nan. The last one has the sound of ng in ring. In fact, the symbol looks like an n with the tail of a g. This sound occurs only at the end of a syllable in English, never at the beginning.

English nasals are voiced. They are produced by stopping the air in the oral cavity and lowering the velum so that the airflow can pass through the nasal cavity. The phoneme /m/ is produced by blocking the air with the lips, the /n/ by stopping the air at the alveolar ridge, and the /ŋ/ by blocking off the velar area. Thus, these three nasals are produced in much the same way as the stops /b/, /d/, and /g/. This can be shown by making a sound like /m/, stopping the air from going out of the nose, and then opening the mouth. The result should sound like a /b/. The relationship between stops and nasals is also noticeable when a person has a cold. Then an /n/ comes out sounding like a /d/ because air can’t flow smoothly through the nasal cavity.

<table>
<thead>
<tr>
<th></th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Interdental</th>
<th>Alveolar</th>
<th>Alveopalatal</th>
<th>Velar</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nasals</strong></td>
<td>voiced</td>
<td>m</td>
<td></td>
<td>n</td>
<td></td>
<td>ŋ</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 3–10. Nasals*

**Liquids**

There are two phonemes called liquids, a descriptive term to denote the smooth sounds associated with /l/ and /r/. The sounds of these phonemes are those that occur at the beginning and end of lull and roar. To form the /l/, a speaker places the tip of the tongue against the alveolar ridge and lowers one side of the tongue.
to let the air pass through on that side. Since the air passes on one side, the /l/ is
referred to as a lateral. It is possible to tell which side of the tongue a person
lowers by making the kind of clicking sound used to signal a horse. Most speakers
can make that click best on one side, and that is the side the speaker also lowers
to produce an /l/.

We mentioned earlier that /r/ affects following vowels. The American En­
glish /r/ is produced by curling the tongue tip back slightly. The tongue does not
touch another part of the mouth, but raising and curling the tongue changes the
shape of the oral cavity. As the tongue uncurls, a vowel sound is produced, but
the action of the tongue colors that vowel. Many other languages make the r
sound by flapping the tongue against the back of the front teeth. Spanish also
has a trilled or rolled r, but neither of the Spanish r sounds is the same as the
English /r/.

Glides

The final two consonant phonemes, the glides, are sometimes called semivowels
because they are produced with very little constriction of the air passage, more
like a vowel. These two phonemes are the /y/ sound at the beginning of yes and
the /w/ that occurs at the start of wet. The sounds of words like day and saw have
glides that are part of vowel diphthongs, but these are considered vowels, not con­
sonant phonemes. The glides that are consonants occur only at the beginning of
a syllable in English or as part of a blend, like the sw in swing. They are produced
by moving the tongue up toward the alveopalatal or velar region. In the case of
/w/, the lips are also rounded.

In all, American English has twenty-four consonant phonemes: six stops,
ine fricatives, two affricates, three nasals, two liquids, and two glides. The
consonant phonemes are relatively easy to learn to transcribe. Only seven

<table>
<thead>
<tr>
<th>Fluids</th>
<th>voiced</th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Interdental</th>
<th>Alveolar</th>
<th>Alveopalatal</th>
<th>Velar</th>
<th>Glottal</th>
</tr>
</thead>
</table>

Figure 3-12. Glides
consonant sounds are represented by special marks. The rest use letters from the alphabet. For example, the /p/ phoneme represents most words that begin with p in written English (except for words like ptarmigan in which the p is silent). The seven special marks are represented in spelling by digraphs. Digraphs are two letters used to indicate one sound. Since there is only one sound in each case, linguists represent the sound with a single character. The phonemes that correspond most often to two-letter spellings (digraphs) are /th/ and /ð/, which represent the voiceless and voiced “th” sound; /ʃ/ and /ʒ/, which represent the “sh” and “zh” sounds; /ʃ/ and /ʒ/, which represent “ch” and “dg,” and /ŋ/ for the sound of “ng” in ring. The /j/ is also spelled with a single j at the beginning of a word.

Digraphs are two-letter spellings for one phoneme. They differ from blends, such as bl and st. In blends, two letters are used to represent two different phonemes. When pronounced, each of these phonemes maintains its sound. For example, a word like blend is transcribed as /blend/. The two consonant phonemes at the beginning and at the end are both pronounced. In contrast, a word like thing contains digraphs, not blends. It is transcribed as /θŋ/ because the th represents the first phoneme, and the ng is the last phoneme. Digraphs are also used to spell long vowel sounds (diphthongs). For example, the phoneme /iy/ is represented by the digraph ee in see. The term diphthong refers to a sound, and digraph refers to a spelling.

The twenty-four consonant phonemes, together with the fifteen vowels, make thirty-nine phonemes in the system we are describing. Speakers of English acquire the ability to produce and understand these sounds early in life. Some of the phonemes, the bilabials and the low, back vowel, are acquired early, and others, such as the /θ/, come later. However, by the time they reach school, most children have good control over the complex phonological system of English. Teachers of young children sometimes worry that their students don’t yet “have their sounds,” but this concern usually reflects an inability of students to identify or produce certain sounds as part of a classroom exercise. Often, young children simply don’t understand what they are being asked to do. On the other hand, observation of children in natural communicative situations generally reveals that they do “have their sounds.”

Phonotactics

People who acquire English not only acquire the ability to comprehend and produce English phonemes but also acquire knowledge of the distribution of the sounds. The linguistic term for possible phoneme combinations is phonotactics. For example, in English, /ŋ/ appears only at the end of a syllable, never at the beginning. English speakers know that English words don’t start with /ŋ/. An English
speaker who tries to pronounce the common Vietnamese name Nguyen typically experiences difficulty. Even though English speakers have no trouble pronouncing words that end in /ŋ/, they find it difficult to pronounce words starting with /ŋ/. This helps confirm that phonemes are perceptual, not physical units, since English speakers have no trouble with the physical production of the sound /ŋ/ unless it begins a word.

This knowledge of sound distribution, or phonotactics, allows an English speaker to decide that /glark/ is a possible English word, but /tlark/ or /dlark/ is not. Every language puts constraints on how the phonemes can be combined. In English a number of different consonant blends are possible at the beginnings of words, but some combinations never occur. For example, if the first consonant phoneme in an English word is a stop, the second can be a liquid. This is true for all the possible combinations except /tl/ and /dl/. Figure 3–13 shows how this pattern works.

English allows up to three consonant phonemes at the beginning of syllables. However, there are constraints on the kinds of phonemes that can be combined. Figure 3–14 lists the possibilities. What is interesting, from a linguistic perspective,
is that the kinds of phonemes that can be combined fall into certain classes. The first phoneme must be /s/. The second phoneme must be a voiceless stop, and the third phoneme must be a liquid or a glide, the two kinds of consonants that are most like vowels.

English spelling doesn't reflect these consonant combinations, but each of the example words would be transcribed using the phonemes that are listed. Not all the possible combinations occur, but the only words in English that start with three consonant phonemes start with one of the combinations listed in Figure 3–14.

There are also constraints on vowels. For example, while any kind of vowel can go at the beginning or middle of a syllable, only long vowels and reduced vowels can end a syllable. Many words, such as free and stay, end with a long vowel sound. English words like idea end with the schwa sound. Long and reduced vowels are sometimes referred to as free vowels because they occur freely in any position in English words. Short vowels, also known as checked vowels, cannot end a word. No word or syllable in English ends in /a/, for example. These constraints on vowels constitute part of a speaker's knowledge of English phonotactics.

Young children who grow up in an English-speaking environment acquire knowledge of English phonotactics. This is subconscious knowledge. They use this information as they speak, but they can't explain how they know that certain combinations are possible and others are not. Part of acquiring a language is acquiring the phonemes, but people also acquire the knowledge of how to combine the phonemes into words.

**Tongue Twisters**

People have fun trying to pronounce tongue twisters. In his book *A Twister of Twists, a Tangler of Tongues*, Alvin Schwartz (1972) has collected tongue twisters
from many different regions of the United States as well as from different languages. He begins the book by presenting a very difficult example: “One of the hardest tongue twisters in the English language is ‘Peggy Babcock.’ Try to say it five times as fast as you can. If you are like most people I know, your tongue won’t cooperate” (p. 9).

Most people can’t even say this name twice in a row. Just what makes tongue twisters like this one so difficult? Part of the difficulty comes from the physical movement of the tongue, but part also comes from the mixed patterns the brain has to deal with. A phonological analysis of Peggy Babcock reveals both difficulties.

The name would be transcribed as /pegiy babkak/. To produce these sounds, the tongue must move rapidly from front to back. Both /p/ and /b/ are bilabials, produced as far forward in the mouth as possible. The other two consonant phonemes, /g/ and /k/, are produced at the back of the mouth. The sequence of consonant phonemes is /p/, /g/, /b/, /b/, /k/, /k/. In other words, the tongue goes front, back, front, front, back, back. The brain is sending messages to the tongue, lips, and other parts of the mouth to control these movements.

At the same time, the brain is sending messages to the vocal cords. They vibrate to produce the voiced consonants, /b/ and /g/, and they are held apart to make the voiceless phonemes, /p/ and /k/. Here is the pattern of voicing: voiceless, voiced, voiced, voiced, voiceless, voiceless. Now consider where most people run into trouble. For many speakers it is the second time through, when the first name comes out as “Pebby” instead of “Peggy.” Why might this occur?

Two different patterns (at least) are at work here, the front-back movement of the tongue and the on-off pattern of the voicing. Figure 3–15 shows the relationship between these two patterns.

<table>
<thead>
<tr>
<th>Phoneme</th>
<th>p</th>
<th>g</th>
<th>b</th>
<th>b</th>
<th>k</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>front</td>
<td>back</td>
<td>front</td>
<td>front</td>
<td>back</td>
<td>back</td>
</tr>
<tr>
<td>Voicing</td>
<td>voiceless</td>
<td>voiced</td>
<td>voiced</td>
<td>voiced</td>
<td>voiceless</td>
<td>voiceless</td>
</tr>
<tr>
<td>Front = −</td>
<td>−</td>
<td>+</td>
<td>−</td>
<td>−</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Back = +</td>
<td>−</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td>Voiceless = −</td>
<td>−</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td>Voiced = +</td>
<td>−</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>−</td>
<td>−</td>
</tr>
</tbody>
</table>

Figure 3–15. Peggy Babcock
As shown by the last two rows, in which front or back and voiceless or voiced are represented by a plus or a minus, the two patterns start out the same, but then change with the first /b/. The brain is very good at picking up patterns. People can repeat rhymes rapidly. But here the two patterns seem to conflict and speech is short-circuited. Speakers who say “Pebby” the second time through produce the right voicing but in the wrong position. Other tongue twisters, like “Rubber baby buggy bumpers,” also play on these same alterations between front and back, voiceless and voiced.

Some tongue twisters, such as “She says she shall sew a sheet,” require rapid movement between two points in the mouth that are close together, /s/ and /ʃ/. Several tongue twisters use this contrast. Again, this alteration seems to cause problems primarily because the pattern is complex. Speakers do not have trouble shifting between /s/ and /ʃ/ as long as the two sounds alternate following a regular pattern. However, here the pattern is irregular. In addition, says contains a voiced phoneme, /z/, that is produced at the same place as /s/. The result, for most people, is a twist of the tongue.

Several Internet websites that deal with linguistics feature tongue twisters. One site that is a good resource for a discussion of tongue twisters from different languages is www.geocities.com/Athens/8136/tonguetwisters.html.

Native speakers of a language can produce phonemes at rapid rates. The brain sends a series of messages to the muscles that control speech, and the desired sounds are produced almost effortlessly. Tongue twisters suggest the upper limits on human capacity, but they are interesting primarily because they occur so seldom in natural communicative situations.

Conclusion

Despite the complexity of phonology, speakers of a language can produce sounds that convey meanings to listeners, and listeners can interpret these sounds. They do this while focusing their attention on what they are saying, not on how they are saying it. Linguists argue that speech production and comprehension are so complex that they must be acquired, not learned. Most young children have mastered the phonology of one or more languages by the time they enter school, and they have done this without receiving any instruction.

Humans are born with a drive to communicate. They acquire the ability to comprehend and produce language to receive and express ideas. Hearing individuals rely on sound to communicate because communicating with sounds offers practical advantages. However, deaf people communicate with signs. The modality is not important. What is important is the capacity to make and share
meanings. Oral language and sign language are simply two systems humans can use to comprehend and express meanings.

Linguists study different aspects of language. Phonology is the study of speech sounds. Linguists have examined both the acoustic and articulatory aspects of speech. The meaningful sounds of a language are called *phonemes*. One way to test for phonemes is to find minimal pairs, two words that differ by just one sound. English has about thirty-nine phonemes.

Phonemes can be described by their place and manner of articulation. Vowel phonemes are made by moving the tongue and lips into different positions as the air passes through the vocal tract. Consonant phonemes are made by constricting the air in different ways as it passes from the lungs and out past the lips. Words in any language consist of combinations of vowel and consonant phonemes. As people acquire the phonology of a language, they also acquire knowledge of phonotactics, the possible combinations of phonemes in that language.

Language production is a complex process, but most speakers are not aware of the complicated series of messages the brain sends to the various muscles that control speech. The process seems to occur automatically as people produce and comprehend ideas. Tongue twisters help show the upper limits on this capacity to produce language so easily. Most tongue twisters require the brain to send out different patterns to the muscles at the same time, and this may overload the capacity to produce meaningful language.

Insights from linguistics in the area of phonology can be helpful for educators evaluating methods of teaching reading or methods of teaching a second language. In the following chapter, we apply the concepts presented here to written and second language development.

**Applications**

1. Look back at Figure 3–1, the simple model of communication. Make a list of different facts about communication that this model fails to capture. Sketch out a model that would include some of these missing features.

2. Try saying "It's Friday" in different ways using different intonation and emphasis to convey different meanings. How many different meanings can you convey?

3. Read one or more of Parish's Amelia Bedelia books and list the expressions she fails to understand. Make a table like the following one that lists the expression, Amelia's interpretation, and the conventional interpretation.
4. Describe in detail how the following phonemes are produced: /d/, /m/, /l/, /w/, /ey/, and /u/.

5. Find a minimal pair of words for each phoneme. The consonant phonemes are listed on p. 61 and the vowel phonemes on p. 59. Minimal pairs differ by just one phoneme. Transcribe your answers. Add boxes to complete the chart here.

<table>
<thead>
<tr>
<th>Expression</th>
<th>Literal Meaning</th>
<th>Nonliteral Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>dust the furniture</td>
<td>put dust on the furniture</td>
<td>remove dust from the furniture</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/p/</th>
<th>pat</th>
<th>kat</th>
<th>/iy/</th>
<th>biyt</th>
<th>bayt</th>
</tr>
</thead>
<tbody>
<tr>
<td>/b/</td>
<td>tuwb</td>
<td>tuwn</td>
<td>/u/</td>
<td>put</td>
<td>pat</td>
</tr>
</tbody>
</table>

6. Try analyzing your favorite tongue twisters to see why they are difficult to say. Use the procedure explained in this chapter for your analysis.

7. Transcribe the following words:

play  chance  dread

<table>
<thead>
<tr>
<th>Expression</th>
<th>Literal Meaning</th>
<th>Nonliteral Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>play</td>
<td>chance</td>
<td>dread</td>
</tr>
<tr>
<td>crazy</td>
<td>shout</td>
<td>bath</td>
</tr>
<tr>
<td>just</td>
<td>yes</td>
<td>ring</td>
</tr>
<tr>
<td>bridge</td>
<td>five</td>
<td>toy</td>
</tr>
<tr>
<td>mast</td>
<td>then</td>
<td>taste</td>
</tr>
</tbody>
</table>

8. What are the possible combinations of consonant phonemes that can begin English words? This is one feature of English phonotactics. Complete the following chart by putting an X in each cell that represents a possible English word. Write a word for each X. Then try to make some generalizations about classes of words (voiceless stops, nasals, etc.) that can be combined. The first row is done. Possible words are play, pray, and pew (/pyew/). It would be possible to mark /pw/ if you include borrowed words like pueblo. However, it would be best to mark combinations that exist only in words that are not borrowed. Even though some words are spelled with ps-, no words begin with the sounds /ps/. Remember to mark possible sound combinations, not possible spellings. Only mark boxes for initial consonant combinations.
| p | t | k | b | d | g | m | n | ŋ | f | v | θ | ð | s | z | ź | h | ĕ | j | l | r | y | w |
| p | t | k | b | d | g | m | n | ŋ | f | v | θ | ð | s | z | ź | h | ĕ | j | l | r | y | w |

### English Phonology

#### Figure 3-6. English consonants

<table>
<thead>
<tr>
<th>Category</th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Interdental</th>
<th>Alveolar</th>
<th>Alveopalatal</th>
<th>Velar</th>
<th>Glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stops</strong></td>
<td>voiceless</td>
<td>p</td>
<td>t</td>
<td>k</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>voiced</td>
<td>b</td>
<td>d</td>
<td>g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fricatives</strong></td>
<td>voiceless</td>
<td>f</td>
<td>θ</td>
<td>s</td>
<td>z</td>
<td>h</td>
<td></td>
</tr>
<tr>
<td></td>
<td>voiced</td>
<td>v</td>
<td>δ</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Affricates</strong></td>
<td>voiceless</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>voiced</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nasals</strong></td>
<td>voiced</td>
<td>m</td>
<td>n</td>
<td>η</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Liquids</strong></td>
<td>voiced</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Glides</strong></td>
<td>voiced</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Figure 3-5. Vowel phonemes of English

<table>
<thead>
<tr>
<th>Category</th>
<th>Front</th>
<th>Central</th>
<th>Back</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td>i (beet)</td>
<td>(i) (jumping)</td>
<td>u (boot)</td>
</tr>
<tr>
<td></td>
<td>i (pit)</td>
<td></td>
<td>u (put)</td>
</tr>
<tr>
<td><strong>Mid</strong></td>
<td>e (bait)</td>
<td>(a) about</td>
<td>e (boat)</td>
</tr>
<tr>
<td></td>
<td>e (pet)</td>
<td>η (putt)</td>
<td>oj boy</td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>æ (pat)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>a (pot)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>aj (bite)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>aw (bout)</td>
</tr>
</tbody>
</table>