Questions you should be able to answer after reading this chapter:

1. What is the difference in the meaning of the terms phonetics and phonology?
2. What is a phoneme? What are allophones?
3. Why are phonemes and allophones considered mental constructs rather than being defined in terms of their specific physical properties?
4. How are a language's phonemes determined?
5. What is a distinctive feature? How does distinctive feature analysis help us understand the systematic aspects of language?
6. What are the two major classes of phonological processes, and how do they differ from each other?
7. What is meant by the statement "Speech includes redundant features"?
8. What does the term markedness refer to?

One lesson gained from phonetics is that humans can produce a considerable variety of speech sounds. Yet each language limits the number of speech sounds that it uses. The sounds are organized into sound systems. Although the sound system of each language differs, some interesting general patterns are found in languages throughout the world. These sound system universals will be discussed later in this chapter.

Phonetics, the subject of Chapter 2, deals with the nature of speech sounds. Phonology is concerned with factors that are rooted in language as a system; that is, with the intrinsic systems used to organize speech sounds. We will begin this chapter with a look at the concept of the phoneme.
The Phoneme and the Concept of Significant Differences in Sounds

Any sound used in speech can be called a phone or phonetic unit or segment. A phone is a unit of sound that can be mentally distinguished from other sounds in what is actually the continuous flow of sound that makes up speech. A phone can be described on the basis of its articulatory, auditory, and acoustic characteristics. \([p^h]\) is a phone that can be said to be a bilabial, a stop, and a consonant, and it is oral and aspirated. A somewhat different type of unit, called a phome, is the major unit of phonology.

The phoneme is a more abstract unit than the phone. The phoneme is a mental construct rather than a physical unit. For instance, we have seen that the \(p\) sound can be unaspirated \([p]\) or aspirated \([p^h]\). The \([p]\) and \([p^h]\) are physically two different sounds (phones) that are produced in different ways. We can tell this because a thin piece of paper held in front of the lips moves when the aspirated \(p\) sound is made as in \([p^h]\)it, but does not move for the unaspirated \(p\) as in \([spit]\). Yet even if we aspirated the \(p\) in \(spit\) or did not aspirate the \(p\) in \(pit\), we would still recognize the same words. The words might sound a little different than expected, but the meaning of each word would not change. In English, there is a grammatical rule that subconsciously directs a native speaker to aspirate the \(p\) sound when it is the first sound in a word, and not to aspirate when it is not the first sound. In other words, which \(p\) sound a native speaker of English uses is predictable because there is a rule governing its use. \([p]\) and \([p^h]\) are two different phones, but their difference is not significant in English. In linguistics, a significant difference between sounds means that by substituting one sound for the other, the meaning of the words will change. If we substitute the \(b\) sound for the \(p\) sound in \(pit\), we get the word \(bit\). Because \(pit\) and \(bit\) have different meanings, they are said to contrast. Therefore, \(p\) and \(b\) sounds are perceptually significant. In English, in most environments, /\(p/\) and /\(b/\) when substituted for each other change the meaning of a word. We therefore say that /\(p/\) and /\(b/\) are different phonemes, whereas /\(p\) and /\(p^h\) are two different forms, called allophones (allo = other), of the phoneme /\(p/\). Notice that allophones are placed inside brackets, but phonemes are placed between slashes.

A phoneme can be defined as a perceived unit of language that functions to signal a difference in meaning when contrasted to another phoneme. In reality, in spoken language, a phoneme is a class of sounds or phones that speakers and listeners perceive as being one sound. The phonemes /\(b/\) and /\(p/\) have no meaning in themselves. Yet words that are the same except for a difference of one phoneme (in the same position in each word) contrast. That is, they have different meanings (\(bit\) and \(pit\), for example). The word perceived is used earlier in this paragraph because, as mentioned previously, a phoneme is a mental construct that tells a listener that two or more sounds function as the same sound or different sounds, regardless of the acoustic properties of the sound. \([p]\) and \([p^h]\) are acoustically (physically) somewhat different sounds, yet native English speakers (who have not taken a linguistics class) perceive them as being the same sound. Therefore, native speakers would call them both the \(p\) sound.

The word phoneme comes from the Greek root meaning sound. Yet phonemes are not sounds. A phoneme is a mental construct. No one has ever heard a phoneme. In the case of /\(p/\), the listener hears either /\(p\) or /\(p^h\) or various other allophones of /\(p/\) that we have not discussed. The unit /\(p/\) exists in the mind of the speaker and listener. The /\(p/\) and all other phonemes are organizational and functional units with no physical properties of their own. Not only is a phoneme
The Phonological Component: Phonology

not a sound, it does not have to refer to sound. Phonemes exist in soundless languages such as American Sign Language (ASL). We will discuss the phonemes of ASL in Chapter 9.

Sounds such as [p] and [ph], which are allophones of the same phoneme /p/ in English, might be different (separate) phonemes in another language. For example, in Hindi the aspirated [ph] sound and the unaspirated [p] sound are different phonemes. In Hindi, [kapi] means copy, whereas [kaphi] means ample. This difference in meaning between words that are identical except for aspiration is consistent in Hindi. Aspiration differences between otherwise identical sounds are never significant in English; that is, aspiration by itself never changes meaning. So the mental construct of an English speaker classes the two p sounds together, whereas in Hindi the two p sounds are seen to be as different as /b/ and /p/ are in English. In Hindi /p/ and /ph/ are different phonemes (see Box 3-1).

Phonetics and Phonemics

Armed with a phonetic alphabet to help organize information on sound, linguists attempt to describe all the speech sounds of a previously unstudied language. Because linguists do not yet know which sounds are significant or distinctive (systematically used to make distinctions in words), they attempt to record every slight detail. Linguists at this point are doing a phonetic analysis. A phonetic analysis of a heretofore unstudied language is an “outside” view, sometimes called an etic view or approach. In a sense, the linguist is sitting on a hill, looking down at a speech community, and describing a language without reference to the speakers’ own subconscious concepts of what is significant or distinctive. A phonetic approach is a first step.

One goal of the linguist is to determine what categories of sound are significant to native speakers. Once the raw data are collected, the linguist can begin the phonemic study. The researcher attempts to discover the shared understanding of phonology that native speakers possess. The linguist is now taking an “inside” or emic approach, and attempting to derive the speaker’s linguistic competence. The reason one cannot proceed directly to the phonemic level of analysis is that the native speaker’s competence is mostly subconscious. Therefore, the investigator
cannot just ask a speaker to report on what categories are significant, and what the rules to combine categories are. These principles must be discovered. One way to do this is to have knowledge of all the possible categories, and then to discover regularities in the data. Questioning native speakers can check the validity and significance of these regularities (see Box 3-2).

For instance, at the phonetic level, a non-English-speaking linguist, with no previous knowledge of English, might discover two p phones: [p] and [ph]. The linguist would have been compiling written texts of the native speakers’ utterances (stretches of speech between two periods of silence or potential silence). This yet-to-be-organized collection of data gathered in the field is called a corpus.

**Minimal Pairs and Sets**

The linguist can use the corpus to discover regularities in the language. One way of doing this is by finding **minimal pairs** and **minimal sets**. A minimal pair is made up of two forms (such as words, phrases, sentences) that contain the same number of sound segments, display only one phonetic difference that occurs at the same place in the form, and differ in meaning. If more than two forms are being compared, then we speak of sets instead of pairs.

/kaːt/ cat and /pæt/ pat

is a minimal pair. These words both have three sound segments, differ only in the initial consonant, and mean different things.

/kaːt/, /pæt/, /ræt/, /baːt/, /fæt/

and so on, represent a minimal set. Linguists studying English for the first time would not know that this sequence was a minimal set until they had definitions for each phonetic sequence in the corpus.

Now let’s return to the original question involving [p] and [ph]. The linguist might search the corpus in an attempt to find minimal pairs for these phones. The researcher would find that these phones do not occur in the same locations.
Complementary distribution means that each of a series of sounds occurs in different phonetic contexts and these sounds never contrast with each other. Phones that are in complementary distribution with each other are allophones of the same phoneme.

Overlapping distribution is characteristic of different phones that appear in most of the same phonetic environments. Unlike complementary distribution, phones in overlapping distribution are different phonemes (not allophones), and therefore substituting one for the other changes the meaning of an utterance.

A substitution frame is a form that has a “slot” that can be filled in with different items, and is used to identify different phonemes.

within words. That is, the phones might be in complementary distribution. Complementary distribution means that each of the sounds occurs in a different phonetic context. These sounds never contrast; changing [p] for [pʰ] (and vice versa) will never change meaning. Minimal pairs cannot be found for the two p sounds. The position and/or the surrounding sounds will determine which of the p sounds will be used. For this reason, the p sound chosen by a native English speaker will be predictable. The choice of which p sound to use is not optional, but obligatory. The speaker will choose [pʰ] only for words with the p sound in the initial position followed by a stressed vowel, and will choose the [p] for most other contexts. (There are other allophones of the phoneme /p/.

See this chapter’s section on free variation.) Because the linguist would not find minimal pairs involving the p sounds, these sounds are not distinctive or significant in English. They do not signal differences in meaning. Therefore, the two p sounds are not two different phonemes, but allophones (varieties) of the same phoneme /p/. A phoneme such as /p/ is a group or class of sounds that are perceived by a native speaker as the same sound. The actual sounds that make up the class ([p] and [pʰ] in this case) are the allophones.

On the other hand, /p/ and /k/, as well as the other initial consonants that occur before /æt/ in the minimal set above, are all different phonemes. The /p/ and /k/ phonemes are not in complementary distribution, but show an overlapping distribution. Phones are characterized by an overlapping distribution if they can occur in all or most of the same phonetic environments.

A form that has a “slot” that can be filled in with different items, such as /_æt/, is called a substitution frame. Can you determine all of the English sounds that can be placed in this substitution frame that will yield meaningful units? Table 3-1 lists the results that you should get. Each sound that can be substituted for the blank and that changes the meaning of an utterance. Notice that we cannot predict what sound will go into the slot in the substitution frame. Unlike allophones of the same phoneme, the environment does not tell us what phoneme to choose.

The non-English-speaking linguist now has established that the two p sounds in English are phonetically distinct, but they are not phonemically distinct. (They sound different, but they are not different phonemes.) Researchers also have discovered that /p/ is phonemically distinct from some sounds not listed in Table 3-1, when they apply other substitution frames to the corpus. For instance, /ŋ/ cannot be found to substitute for /p/ in the initial position.

| bat /bæt/ | mat /mæt/ | tat /tæt/ 1 |
| fat /fæt/ | Nat /næt/ | that /ðæt/ |
| hat /hæt/ | pat /pæt/ | vat /væt/ |
| cat /kæt/ | rat /ræt/ | dat /dæt/ 2 |
| sat /sæt/ | gat /gæt/ 2 |

1 Tat has several meanings, including to crochet, to entangle, to confuse, and it is a type of cloth.
2 Dat and gat are not words in English, in that they have no meaning. However, they do conform to all the phonological rules of English. They could be English words if they had meaning. Such linguistic forms are referred to as accidental gaps. When new words are created, these accidental gaps may be used. In fact, dat is used by audiophiles as an acronym for digital audiotape. The word Bic /bIk/, referring to a pen, was an accidental gap in the substitution frame /_Ik/, until it was used as a brand name.
This does not mean that the ŋ sound is an allophone of /p/. /p/ will form minimal pairs with the ŋ sound in other positions. For example, both the p and ŋ sounds fit into the substitution frame: /siʃ/. The p forms the word sip /sip/, and the ŋ forms the word sing /sin/. The /ŋ/ sound is never in the initial position in an English word.

We have shown how minimal pairs and sets are used as one tool to discover the contrastive sound units of a language (phonemes). Yet this method is not always sufficient to establish all of the phonemes of a language. Actually, some languages have few minimal pairs. In these cases, phonemes are established on the basis of other criteria, some of which are discussed later in this chapter. In any case, when linguists begin to discover phonemic features of a language, they are exploring the native speakers' competence and are therefore involved in an emic or “inside” study.

**Free Variation**

In addition to [p] and [pʰ], our non-English-speaking linguist may have found a third variation of /p/. [p̚] is used in some dialects of English. [p̚] is an unreleased sound. This occurs when the phone is released without sound; that is, closure occurs and outward pressure ceases. In English, the [p̚] or the [p] can occur in a word’s final position; however, the difference in pronunciation does not change the meaning of the word. Minimal pairs do not occur between [p̚] and [p]. The sounds are not in complementary distribution, but in free variation. Free variation is a condition in which phonetically different sounds may occur in the same environment without changing meaning. [p̚] is an allophone of /p/. But unlike the complementary relationship of [pʰ] and [p], [p̚] may be in overlapping distribution with [p].

/t/ and /k/ also have the allophones [t], [tʰ], [t̚] and [k], [kʰ], and [k̚].

Sometimes two phonemes may alternate, more or less freely, with each other without changing the meaning of a word. In fact, there is a song that illustrates this point, saying that some people pronounce the word potato as /poteto/ and some as /potato/. For these varieties of English, the word tomato is /tometo/ and /tomato/, respectively.

But a tomato is a tomato. That is, no matter which way you pronounce this word, the meaning remains the same. Does this mean that /e/ and /a/ are not distinct, that they are not two different phonemes? /poteto/-/potato/ and /tometo/-/tomato/ are not minimal pairs. Each pair has the same number of segments, and each item of each pair differs from the other item of its pair by only one sound, but the items of each pair do not differ in meaning. Yet, /e/ and /a/ can be shown to form minimal pairs for other groups of words, such as:

\[
\text{/het/ / hate and /hat/ / hot} \\
\text{/kep/ / cape and /kap/ / cop}
\]

When one meaning (like potato or tomato) is represented by more than one phonemic form, the different pronunciations are free variations of the word in question. Another example of this type of free variation is that the word pretty might be pronounced as [priti] or as [priDɪ] ([D] is a voiced retroflex flap produced by a single strike of the tongue against the alveolar ridge as the tongue returns to its resting position). In any case of free variation, the different pronunciations do not signal a difference in meaning. The pronunciation chosen is optional, not obligatory as with complementary distribution.

In summary, the fact that two sounds form minimal pairs is sufficient proof that the two sounds are two different phonemes. The converse is not true. Two
sounds that do not form a minimal pair in a particular context may still be separate phonemes. The corpus must be studied carefully to discover if the sounds under investigation (such as the /e/ and /a/ of our example) are found in minimal pairs anywhere in the language. Even if this search fails, it does not necessarily mean that the sounds are not different phonemes.

**Naming the Phoneme**

Why is the p sound phoneme called /p/ and not /ph/ or /p¬/? The criterion for naming the phoneme is which allophone is the most common. Of the three p sounds listed in the preceding sentence, /p/ is most frequent. It occurs more often than either /ph/ or /p¬/. So we would notate this relationship in the following way: /p/ → [p], [ph], and [p¬].

It might be relatively easy for an English speaker to understand the relationship between [p], [ph], and [p¬] because they are all based on a sound notated with the same symbol, p. But allophones of the same phoneme can be based on sounds that in English and the phonetic alphabet are written with different letters. For instance, in the Native American language Mohawk, /t/ → [t] and [d]. The [t] occurs at the end of the word [salá:dat] pick it up! and before another consonant as in [ohyótsa/] chin. The [d] only occurs preceding a vowel as in [odáhsa/] tail. The phoneme in this Mohawk example is called /t/, not /d/, because [t] is more frequent than [d]. The physical feature that differentiates [p] from [ph] is aspiration; the difference between [t] and [d] is voicing. In English, the voicing distinction leads to different phonemes: /t/ and /d/ are different phonemes in English. In Mohawk, voicing distinctions can lead to different allophones of the same phoneme: [t] and [d] are in complementary distribution and are therefore allophones of the same phoneme in Mohawk.

**Broad and Narrow Transcriptions**

In the first stage of a linguistic study done in the field, the linguist writes down each utterance in as much phonetic detail as can be perceived. At this stage, as many symbols (such as diacritics and special letters) will be used as needed to transcribe the linguist’s perceptions of the language. Such a recording system is called a narrow transcription or a phonetic transcription. The narrow transcription will show both distinctive and nondistinctive features. A broad transcription or a phonemic transcription does not include nondistinctive features. Many details of pronunciation are left out of a broad transcription. For instance, the word pit would be written as /pit/ in broad transcription and [pʰit] in the narrow transcription. The narrow transcription of pit indicates the nondistinctive feature (in English) of aspiration. The broad transcription is restricted to sound distinctions that are meaningful to native speakers. The linguist cannot write a broad transcription until the phonemes of the language have been discovered.

**EXERCISE 1  Phonemes, Allophones, Complementary Distribution, and Free Variation**

1. Below is a list of words that contain aspirated and unaspirated velar oral stops. Are the aspirated and unaspirated stops different phonemes or allophones of the same phoneme? If they are allophones, state the nature of their complementary distribution.
Hint: First see if there are minimal pairs.

a. skill [skɪl]  
g. school [skʊl]
b. ask [æsk]  
h. skull [skɔl]
c. kill [kɪl]  
i. cool [kʊl]
d. Cass [kæs]  
j. key [kɪ] 
e. king [kɪŋ]  
k. cull [kʰəl]
f. ski [ski]  
l. ink [ɪŋk]

2. In English, the lateral sound /l/ is articulated in either the alveolar position [l] or the velar position [l̪]. (The [~] through the center of the /l/ is a diacritic that indicates it is pronounced with the tongue in the velar position.) After examining the list below, answer the following questions:

a. Are the two /l/ sounds different phonemes or allophones of the same phoneme?
b. What data do you have to back up your conclusion?

<table>
<thead>
<tr>
<th>lit [lɪt]</th>
<th>lull [lʌl]</th>
<th>leak [lɪk]</th>
</tr>
</thead>
<tbody>
<tr>
<td>lame [lem]</td>
<td>lea [li]</td>
<td>lap [læp]</td>
</tr>
<tr>
<td>all [ɔl]</td>
<td>low [ləʊ]</td>
<td>lop [ləp]</td>
</tr>
<tr>
<td>late [let]</td>
<td>lay [le]</td>
<td>law [lɔ]</td>
</tr>
<tr>
<td>lick [lɪk]</td>
<td>feel [fiːl]</td>
<td></td>
</tr>
</tbody>
</table>

3. Write the broad transcription for the following words. (The diacritical mark [:] means that the vowel is long.)

a. [tʰɑp] 
b. [pʰæm] 
c. [kʰɒd]

4. Some people pronounce difficult as /dɪfɪkəlt/, while others say /dɪfəkəlt/. /ɪ/ and /ə/ are distinctive elsewhere. (They can be seen to form minimal
pairs.) What is the phenomenon illustrated by the multiple pronunciations of difficult? Give three other examples of this phonological phenomenon.

A Comparative Example: Russian and English

We can further refine our understanding of the distinction between the phonetic and phonemic aspects of language with a comparative example. We will compare how various t sounds function in two languages.

Say the word brat, pronouncing the /t/ with the tip of the tongue against the upper teeth. Now say the same word with the /t/ formed by touching the tip of the tongue to the alveolar ridge. Follow this by saying brat with the /t/ formed even further back in the mouth, at the palate. In this last position, some people use more than the tip of the tongue, placing a greater surface of the tongue against the palate (see Figure 3-1). You should notice the difference in pronunciation of these three variants of the t sound. However, you will perceive that you have said the same word. The variations in these sounds are clearly insignificant in English; they do not contrast. We can phonetically represent the three t sounds as [t], [t], and [t]. The [t] without a diacritic is produced at the alveolar location. The diacritics [ ] and [ ] stand for dental and palatal, respectively. In English, these three sounds are allophones of the phoneme /t/. Let’s look at two of these variants as they function in Russian.

In Russian, there is a significant difference between [t] and [t]. The Russian word /mat/ (floor mat) differs in meaning from the word /mat/ (mother). These words form a minimal pair in Russian; they contrast. The difference between the two types of t sound is as significant to the Russian speaker as is the

![FIGURE 3-1 Three t Sounds](image-url)
difference between the initial sounds in *cat* and *pat* to the English speaker. In Russian, therefore, /t/ and /tj/ are not allophones of a single phoneme, as they are in English, but are two different phonemes (see Figure 3-2).

Each language embodies different perceptions of speech sounds, which means that speakers of different languages mentally cut up (segment) the range of possible sounds in various ways. For each language, only a small number of possible sounds are used. Even when there is an overlap in the sounds used in different languages, the functional significance of these sounds might differ. A series of sounds might be allophonic in one language (the *t*’s of English in our example) and phonemic in another (the *t*’s of Russian). (See Box 3-3.)

**Distinctive Feature Analysis**

The phoneme can be thought of as a “bundle” or set of distinctive features. A **distinctive feature** is any trait that distinguishes one phoneme from another. For instance, in English, /p/ can be phonemically distinguished from /b/ by the single feature called voicing: /b/ is voiced and /p/ is not. In English, changing a /p/ for a /b/ in a minimal pair is distinctive; it changes meaning. The child learning English learns subconsciously to distinguish between /b/ and /p/ on the basis of voicing. However, /p/ can also be thought of as resulting from a whole series of traits, not just the fact that it is voiceless. The child subconsciously learns to contrast all phonemes in a number of ways. /p/ is a consonant as opposed to a vowel; it is oral, not nasal; it is a stop, not a fricative; and so on. Therefore, /p/ is the sum of all its features. Note that aspiration is not a distinctive feature in English. It is an acoustic feature, but is not distinctive because a contrast in aspiration, between [p] and [ph] for example, does not change meaning. Aspiration is a distinctive feature in other languages, such as Hindi. Distinctive features distinguish between different phonemes, not allophones of the same phoneme.

**Distinctive Features**

Voice (voicing) is just one of many distinctive features. Different linguists use somewhat different lists of features. The most commonly used lists are based on articulatory features of sound, but some distinctive feature lists use acoustic
The Phonological Component: Phonology

Each distinctive feature in the list of features used in this book is established on the basis of articulatory criteria. For instance, the feature [voice] is an articulatory feature because it involves movement (or the lack of it) of the vocal cords in the production of a sound. You are already familiar with some distinctive features because they were used to construct the consonant and vowel tables in Chapter 2 (see Table 2-1 and Figure 2-3). In fact, the names of

and/or auditory features as well. New insights into how the mind perceives distinctions between sounds could lead to the discovery of new distinctive features.

BOX 3-3 Why Foreign Speakers Have Trouble with English

People who are learning a second language have the easiest time with sounds and sound combinations that are the same or similar to their native language. A native speaker of Japanese would have little trouble pronouncing the English word *banana* because it contains sounds pronounced in a similar manner in Japanese, and the arrangement of the sounds conforms to the Japanese phonological pattern. In Japanese, a syllable must be a vowel or end with a vowel, with one exception: words can end with an /n/ as in *Pokemon* [pokiman]. When Japanese speakers first try to pronounce a word that does not conform to the Japanese pattern, they will force that pattern on the word. For instance, the English word *drink* /driŋk/ will be pronounced as *dorinku* /dortŋku/. Notice that a vowel is placed between most consonants, such as /d/ and /r/.

Another problem that a Japanese speaker might have is with the *r* and *l* sounds in English. In English /r/ and /l/ are separate phonemes. In Japanese, there is an /r/ phoneme, but no /l/ phoneme. The Japanese /r/ does have allophones that sound similar to the *l* and *d* sounds in English, but Japanese speakers tend to substitute the *r* sound for the *l* sound in English words. So the English word *lucky* will be pronounced as /raki/.

Some examples of difficulties foreign speakers other than Japanese might have learning English as a second language are as follows:

- Sounds /z/ and /s/ are distinct phonemes in English, but allophones of the same phoneme in Spanish.
- /ʒ/ and /ʃ/ are distinct phonemes in English, but allophones in Italian ([ лишь] and [ʃi]).
- /l/ and /n/ are distinct phonemes in English, but allophones in Cantonese ([li] and [ni]).
- In Finnish, the first syllable of a multisyllabic word is always stressed. So English multisyllabic words that do not carry stress on the first syllable are often mispronounced.
- The English /θ/ and /ð/ are pronounced as /t/ and /d/ by Serbo-Croatian speakers.
- Hebrew has only five vowels and, except for borrowed words, does not have diphthongs. Therefore, English words containing diphthongs are often mispronounced.
- The French do not aspirate voiceless stops in the initial position, but English speakers do.
- The Hawaiian language lacks the /t/ phoneme.
- The Mohawk language lacks the /p/ phoneme.

These are just a few examples of phonetic and phonological differences between English and other languages. There are also suprasegmental differences in pitch, stress, and duration that create problems for adults learning a new language. All of these sound differences make it hard for a nonnative speaker of English to pronounce English like a native speaker would. Of course, the reverse is also true; English speakers have a difficult time pronouncing sounds or reproducing sound patterns not used in English. When we say a person has a foreign accent, that accent is partially due to the interference of the phonological rules of the native language while speaking English.

For additional examples of why foreign speakers have trouble with English, see [http://www.fact-index.com/n/no/non_native_pronunciations_of_english.html](http://www.fact-index.com/n/no/non_native_pronunciations_of_english.html).
two distinctive features are [consonantal] (most consonants) and [syllabic] (vowels and syllabic consonants).

- Another distinctive feature is [sonorant] (frictionless continuants, including vowels, glides, liquids, and nasals).
- Some distinctive features are based on the manner of articulation. The ones we already have discussed in Chapter 2 are [nasal], [lateral], and [continuant].
- Some distinctive features are based on place of articulation. Again, we have discussed some of these such as [tense] (versus lax) and [reduced] (exceptionally brief duration).
- Other place-of-articulation features are based on what the lips are doing. The feature called [round] refers to when the lips are made to protrude.
- Other sounds are dependent on what part of the tongue is involved. Sounds in which the tongue tip or blade is raised in the front part of the mouth are called [coronal]. If the body of the tongue is above the central location in the mouth, they are called [high]. Sounds produced with the tongue body lower than the central position in the mouth are called [low]. Speech sounds produced with the tongue body behind the hard palate are called [back] sounds.
- The feature [strident] refers to sounds (only fricatives and affricates) that are produced with constriction that forces the air stream to hit two surfaces, which results in high-intensity noise. This discussion includes only distinctive features that will be used in examples and exercises in this book. There are additional features not discussed here.

The Feature Matrix

The distinctive features mentioned in the preceding section are voice, consonantal, syllabic, sonorant, nasal, lateral, continuant, tense, reduced, round, anterior, high, low, back, and strident. Voiced sounds contrast with voiceless sounds, nasal sounds with nonnasal (oral) sounds, and so on. Linguists might indicate each distinctive feature with a + or a −. This is a binary system of classification. The feature is either present or absent. If a sound is voiced, it will be denoted as [+voice]. A voiceless sound is shown as [−voice]. From our discussion of phonetics, it is clear that a binary phonetic system of classification is simplified and highly idealized. That is, from acoustic studies we know that some sounds are voiced more than others; some sounds are more nasalized than others; and so on. An all-or-none feature analysis ignores these possible variations. Table 3-2 is a feature matrix. A feature matrix lists sound segments along the horizontal axis, and features on the vertical axis.

If the feature is present at all, it is marked with a +. From an analytical point of view, this is not necessarily a weakness of the system. More information may be unnecessary and actually obscure the analysis. Consider the following analogy. If you were putting an object together from instructions (a piece of furniture, for instance), you would not expect the instructions to tell you exactly how to hold a screwdriver, how many times to turn it, and how to remove it from the notch in the screw. The instructions might simply say, “Put screw B into hole B and tighten.” In most cases, this should be sufficient. In describing sounds, it may be sufficient to know that /n/ is nasalized and /p/ is not. We do not necessarily have to know the degree to which /n/ is nasalized. However, if a linguist finds that a + or − designation is not sufficient for the specific research problem being tackled, a feature can always be ranked. For instance, in the word pant ([pænt]),
TABLE 3-2  Feature Matrix for Some English Phonemes

Vowels
Except for situations in which the phonetic environment might alter the usual way in which a vowel is produced, all vowels are [+voice], [+syllabic], [−consonantal], [+continuant], and [+sonorant].

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>I</th>
<th>u</th>
<th>ø</th>
<th>e</th>
<th>ø</th>
<th>ä</th>
<th>a</th>
<th>ö</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td>Low</td>
<td>−</td>
<td>−</td>
<td>−</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>
<td>+</td>
<td>−</td>
<td>+</td>
</tr>
<tr>
<td>Tense</td>
<td>+</td>
<td>−</td>
<td>+</td>
<td>−</td>
<td>−</td>
<td>+</td>
<td>−</td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td>Reduced</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>+</td>
</tr>
<tr>
<td>Rounded</td>
<td>−</td>
<td>−</td>
<td>+</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>+</td>
<td>+</td>
<td>−</td>
</tr>
</tbody>
</table>

Consonants
The features low, tense, and reduced are not used for English consonants. All consonants are [−syllabic] except for m, n, ñ, l, and r, which can act as syllabic consonants (marked ±) in some contexts.

| p | b | f | v | t | d | θ | s | ŋ | z | ŋ | š | ž | k | g | m | n | ñ | l | r | y | w | h | ? |
| Consonantal | + | + | + | + | + | + | + | + | + | + | ± | ± | ± | ± | − | − | − | + |
| Sonorant    | − | − | − | − | − | − | − | − | − | − | − | + | + | + | + | + | + | + | + |
| Nasal       | − | − | − | − | − | − | − | − | − | − | − | + | + | − | − | − | − | − | − | − | − | − | − | − |
| Continuant  | − | + | + | − | + | + | + | − | − | − | − | − | − | + | + | + | + | + | + | + | + | + | + | + |
| Lateral     | − | − | − | − | − | − | − | − | − | − | − | − | − | + | + | − | − | − | − | − | − | − | − | − |
| Voice       | − | − | + | − | + | + | + | − | − | − | − | − | − | − | − | − | − | − | − | − | − | − | − | − |
| Anterior    | + | + | + | + | + | + | − | − | − | − | + | + | + | + | − | − | − | − | − | − | − | − | − | − |
| Strident    | − | − | + | − | − | − | + | + | − | − | − | − | − | − | − | − | − | − | − | − | − | − | − | − |
| High        | − | − | − | − | − | − | − | − | − | − | + | + | + | + | − | − | − | − | − | − | − | − | − | − |
| Back        | − | − | − | − | − | − | − | − | − | − | + | − | − | + | − | − | − | − | − | − | − | − | − | − |
the vowel [æ] is nasalized somewhat as a result of the nasal consonant /n/ that follows it. Yet /æ/ is not nasalized to the same degree as /n/. The linguist may wish to show this in a distinctive feature analysis and can do so by using numbers preceding the symbol for the sound in question. [æ] may be designated as [2 nasal] and /n/ as [1 nasal]. The numbers refer to the degree of nasalization, with 1 being first-degree nasalization, and 2 being second-degree nasalization. These numbers represent relative values.

Some linguists use a combination of binary and nonbinary distinctive features. Peter Ladefoged (1925–2006), a phonetician, used a binary classification for the feature labial (+labial/−labial). However, in his distinctive features analysis he included the feature [glottalic], which has to do with the movement of the glottis. This feature has three values: [ejective] when the glottis is moving upward, [pulmonic] when there is no movement of the glottis, and [implosive] when the glottis is moving downward. Still other features are binary for some languages but have multiple values for other languages. For instance, in most languages a binary designation for [voice] as plus or minus is sufficient. However, in the language Beja, spoken in Sudan, Ladefoged saw five values for voicing that he called [glottal stop], [laryngealized], [voice], [murmur], and [voiceless].

**Natural Classes**

If you examine Table 3-2, you will see that some sounds share features. For instance, [p, t, k, b, d, g] all share the following traits:

- +consonantal
- −sonorant
- −continuant
- −strident
- −nasal

The consonants /p, t, k, b, d, g/ form a natural class called oral stops. A **natural class** is a subset of the total set of phonemes. The subset shares a small number of phonetic (distinctive) features which distinguishes the class from other classes. Natural classes play a significant role in phonological regularities (rules).

One significant characteristic of a natural class is that the members of the class will appear in about the same context (phonetic surrounding) within words. Each member of a class will behave in approximately the same manner throughout the language. Because of these regularities, rules need not be written for each sound. Instead, we can postulate the rules for the entire natural class. What applies to one oral stop, for instance, often applies to all oral stops.

**EXERCISE 2**  Distinctive Features and Natural Classes

1. Determine which of the lettered entries below constitute natural classes. In each case that a natural class exists, name the features that define that class.
   a. /k, g, ɳ/

---

b. /n, l, r/

c. /p, r, θ, g/  

d. /p, b, m/  

e. /i, æ, e, ε/  

2. In each of the lettered entries below, one sound does not fit. Circle it. Give the features of the natural class of the remaining sounds.

a. /u, o, o, i/  

b. /r, p, w, y, l/  

c. /g, n, v, p, d, m/  

Combining Phonemes

In the popular word game Scrabble, players make words from seven letters, which they have picked at random. They attach these letters to existing words on the game board. Often when players cannot come up with a word, they try to bluff. That is, players make up words and gamble that they will not be discovered. Hopefully, players would not bluff with a sequence such as *mbgo. They would certainly be challenged, and their competence in the English language would become questionable. However, if they formed either the sequence bloop or gloop, the other players might hesitate to challenge. Either of these sequences could be an English word. The bluffer would have triumphed if the made-up word was bloop; he or she would not have been so lucky with gloop.

In bluffing with either bloop or *gloop the player would have been modeling a potential word on the basis of rules about the combination of sounds in English. These rules are part of every speaker’s competence in his or her native language. The player did not attempt to bluff with *mbgo, because in English words /m/ and /b/ never occur adjacent to each other in the initial position. Another rule, subconsciously known, specifies that only a limited number of three-consonant clusters are permitted in the initial position in English words; mbg is not one of these clusters. However, mbg is a permissible combination in Igbo, one of many languages of Nigeria.

Every native speaker of a language subconsciously knows the rules of sound combination. However, it would be improbable that any of these speakers could

2An asterisk* placed before a linguistic form (word, sentence, etc.) means that the form is ungrammatical or unacceptable.
write down all of the rules of their language. That is, they could not make these rules explicit. The phonologist attempts to make as many rules of the sound system of language as explicit as is possible. The area of phonology that studies what sound combinations are allowed in different languages is called phonotactics.

**Phonological Processes**

Because no one formally teaches us how to speak, it is perhaps less obvious (than with math, for instance) that language is rule-governed. A person untrained in linguistics might not see any rule involved in the formation of words like *stick*, *spoke*, and *skid*. Of course, the nonlinguist would not be looking for such a rule. However, the linguist could specify that on the basis of these and similar words: In English, any fricative at the beginning of a word, followed by a voiceless stop, must be voiceless. Other phonological rules specify the system governing the combination of other sound sequences. They specify whether to add, delete, or change elements in an idealized form to a form that is easier to pronounce or perceive. For instance, we say [hæm] instead of [hæm] because [hæm] is easier to pronounce. Vowels are usually not nasalized in English. However, because the [m] in *ham* is nasalized, the speaker subconsciously begins to lower the velum, opening the nasal cavity, before the [m] is produced. The result is that the preceding vowel [æ] is nasalized in the process. This process of nasalizing a vowel before a nasal consonant is an example of an obligatory phonological process. Obligatory phonological processes are usually done subconsciously and generally involve a single feature of a single phonetic segment. They contrast with optional phonological processes, which usually involve more radical changes from the idealized form.

**Obligatory Phonological Processes**

**Assimilation** is the obligatory phonological process that makes it easier to pronounce combinations of sounds by giving those sounds a shared distinctive feature that, in other environments, one or more of them would not have. The reason it is easier to say [hæm] than to say [hæm] is that it takes fewer articulatory movements. Because the [m] is nasalized, it is easier to move directly to that nasalized configuration of the vocal tract toward the end of the production of the vowel. Such a process is called manner assimilation and involves a change in a single feature, oral/nasal. In the example given, the [æ], which usually is not nasalized, comes to agree in manner of articulation with the nasal [m]. The same process is working in the following pairs:

1. cat [kæt] but can [kæn]
2. cut [kʌt] but come [kʌm]
3. boat [bɔt] but bone [bɔn]

In English, nasalized vowels occur only because of assimilation. In other languages, such as French and Polish, nasalized vowels may occur without an adjacent nasal consonant. Another type of assimilation is called voice assimilation. As the term suggests, sounds often come to agree in the feature voiced/voiceless (voicing). Sounds such as the liquids [l], [r], and the glide [w], which are usually voiced in English, may be devoiced in certain phonetic contexts. Those contexts
occur when the liquid or glide follows a voiceless stop or fricative in the same syllable. A [p] added to lay [le] is pronounced as [p]e [play]. The diacritic [\_] indicates devoicing. The following examples also show this principle:

1. ray [re] but pray [pre]
2. win [wɪn] but twin [twɪn]
3. right [rayt] but fright [frayt]

The opposite of devoicing also can occur. That is, in certain contexts, a speaker may automatically choose a voiced sound to follow another voiced sound and vice versa. The English plural rule shows this. We would automatically pluralize the word cap [kæp] as caps [kæps]. The voiceless consonant [p] is followed by the voiceless consonant [s]. However, we would pluralize cab [kæb] as [kæbz], bomb [bam] as [bamz], and zoo [zu] as [zuz]. In these cases, a voiced sound is followed by a voiced variant of the plural.

Manner and voice assimilation are but two types of assimilation. Consider the following words:

1. impatient /impeʃənt/
2. intangible /ɪntænʤəbl/
3. incomplete /ɪnˈkɒmplɪt/

In these examples, the prefixes im and in translate to not. Yet these two spellings represent three pronunciations: /im/, /in/, and /ŋ/. If we look at the phonetic segment that follows these prefixes in each word above, a pattern emerges.

1. The bilabial /m/ is followed by /p/, which is also a bilabial.
2. The alveolar /n/ is followed by an alveolar /t/.
3. The velar /ŋ/ is followed by the velar /k/.

The speaker, in pronouncing the not prefix in three different ways, is following a rule of place assimilation. In place assimilation, adjacent sounds are made to agree in their place of articulation.

Aspiration, which is discussed in Chapter 2, is another example of an obligatory phonological process in English. In this case, a sound does not come to be more like an adjacent sound as in assimilation. Aspiration involves the addition of a phonetic feature. The rule states that aspiration is added to an unaspirated voiceless stop when that stop occurs at the beginning of a word and before a stressed vowel. Here are some examples that follow this rule:

1. pie [pʰaɪ] but spy [spay]
2. pin [pʰɪn] but spin [spɪn]
3. key [kʰi] but ski [ski]
4. till [tʰɪl] but still [stɪl]

There are more obligatory phonological processes than we have discussed. They generally involve a single phonetic segment and usually must be made so that a sequence of sounds is more easily pronounced. Alternative pronunciations are generally not made.
Optional Phonological Processes

On the other hand, optional phonological processes simply create differences in speech styles. With optional processes, major changes may be made: /səmθŋ/ may become /səmpm/. This contrast involves several differences.

Optional processes may involve changes in syllabicity. In the word something, the last syllable may be pronounced as /θŋ/ or /m/. The choice is optional, with the former usually being used in formal situations and the latter in casual situations. In casual speech, we might also delete sounds, such as the unstressed vowel /ı/ in readily /rεdIli/. The pronunciation becomes /rεdli/. Or we might do the opposite, and insert a sound. A difficult consonant cluster such as the /θl/ in athlete may be made simpler to pronounce by adding a vowel. /æθlIt/ becomes /æθəlIt/.

As with obligatory phonological processes, only a small sample of optional rules has been presented here.

EXERCISE 3 Phonological Processes

1. Consider the following: immoral, inconclusive, indistinct, immodest, imbalance, inconclusive, inconceivable, indestructible, improbable, and insoluble. Why are there three phonetic variations of the prefix meaning “not” in this list? Describe the phonological process involved.

2. Examine the following corpus of data from the Angas language of Nigeria. How many nasal phonemes are there? Determine the allophones for each of the nasal phonemes. What phonological process is represented in this exercise?

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>[mut]</td>
<td>to die</td>
<td>h.</td>
<td>[pampaŋ]</td>
<td>bread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>[ŋgak]</td>
<td>snake</td>
<td>i.</td>
<td>[nta zuŋ]</td>
<td>wasp</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>[ndarn]</td>
<td>bark</td>
<td>j.</td>
<td>[nfwarz]</td>
<td>head cold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>[nuŋ]</td>
<td>to ripen</td>
<td>k.</td>
<td>[mɓiŋ]</td>
<td>to lick</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>[mɓanγa]</td>
<td>drum</td>
<td>l.</td>
<td>[təŋ]</td>
<td>bench</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f.</td>
<td>[dondoŋ]</td>
<td>yesterday</td>
<td>m.</td>
<td>[pɔti]</td>
<td>sky</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g.</td>
<td>[dεŋ]</td>
<td>to drag</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: A raised diacritic [ʷ] means that the consonant is rounded. [ʰ] stands for a voiced implosive bilabial stop.

3. In the data from the Angas language, do you see any phonemes, positions of phonemes, and combinations of phonemes that would not occur in English? List them.

4. Consider the following:

<table>
<thead>
<tr>
<th>word</th>
<th>phoneme</th>
<th>word</th>
<th>phoneme</th>
</tr>
</thead>
<tbody>
<tr>
<td>sign</td>
<td>/saɪn/</td>
<td>but signature</td>
<td>/sɪɡnətʃə/</td>
</tr>
<tr>
<td>paradigm</td>
<td>/pærədæɪm/</td>
<td>but paradigmatic</td>
<td>/pærədɪmætɪk/</td>
</tr>
<tr>
<td>design</td>
<td>/dɪsəɪn/</td>
<td>but designate</td>
<td>/dɪzɪɡnet/</td>
</tr>
<tr>
<td>resign</td>
<td>/rɪzəɪn/</td>
<td>but resignation</td>
<td>/rɪzɪɡneʃən/</td>
</tr>
</tbody>
</table>

Can you figure out what phonological process is occurring in the pairs of words above?

5. If English speakers are asked to pluralize the following made-up nouns, they would do so as shown (see Chapter 8, Box 8-1, The Wug Test).

<table>
<thead>
<tr>
<th>noun</th>
<th>plural</th>
<th>noun</th>
<th>plural</th>
</tr>
</thead>
<tbody>
<tr>
<td>boo</td>
<td>/bu/ as /boʊs/ /bʊz/</td>
<td>trut</td>
<td>/trʊt/ as /trʊts/ /trʌts/</td>
</tr>
<tr>
<td>hap</td>
<td>/hæp/ as /hæps/ /hæps/</td>
<td>paʊk</td>
<td>/pɔːk/ as /pɔːks/ /pɔːks/</td>
</tr>
<tr>
<td>nurch</td>
<td>/nɜːtʃ/ as /nɜːtʃɛs/ /nɜːtʃəz/</td>
<td>boʊɡ</td>
<td>/bɔːɡ/ as /bɔːɡs/ /bɔːɡz/</td>
</tr>
<tr>
<td>glab</td>
<td>/ɡlæb/ as /ɡlæbs/ /ɡlæbz/</td>
<td>kʌntʃ</td>
<td>/kʌntʃ/ as /kʌntʃɛs/ /kʌntʃəz/</td>
</tr>
</tbody>
</table>

What phonological process is involved in the distribution of the three variations of the plural?

6. English speakers might say the word warmth as /wɔːrmθ/, hamster as /hæmˈstər/, and the last name of the linguist Noam Chomsky as /ˈkæmpskeɪ/. What optional phonological process is involved and why does it occur in these situations?
The Continuous and Complex Nature of Speech, Revised

In this chapter and Chapter 2, speech sounds have been placed in charts and tables, which might indicate that there is a finite and specific number of speech sounds. However, a specific sound or a series of sounds could be produced in a variety of ways. Because of assimilation, the pronunciation of a sound will differ because of its phonetic environment. Sounds blend into each other in a continuous way. A sound that is voiceless does not abruptly stop, followed by the immediate beginning of the voicing of a voiced sound. The sounds blend into each other. This is true for all distinctive features. Also, an idealized sound is a collective of various distinctive features. Each positive feature ([+consonantal], for example) might blend into its negative element ([−consonantal]) somewhat differently (with different timing, for instance) than might occur with another feature. Early computer speech synthesis sounded very unnatural because each sound was created in its idealized form with no attention to the continuous stream of speech. Today, synthetic speech is sounding more natural because of the attention given to how sounds represented by a specific symbol will sound different, depending on a complex set of phonetic facts.

Distinctiveness Versus Redundancy

If we asked an English speaker to fill in the vacant slot in the substitution frame /_it/, we could not predict the results. The person might say /p_It/, /b_It/, /s_It/, /l_It/, /m_It/, or any one of many other combinations that make up the minimal set for this substitution frame. However, if we asked this person to say bit and pit, we could predict that the initial sound in pit would be aspirated and that the initial sound in bit would not be. That is, if you produce a voiceless stop in the initial position and before a stressed vowel, it will be predictably aspirated. Therefore, aspiration is redundant in this situation; it is completely a result of the phonetic environment. Phonetic (narrow) transcriptions include redundant features (which are also nondistinctive). Phonemic (broad) transcriptions leave redundant features out.

Another example of redundancy in English is that a phonetic segment marked [−consonantal] will almost always be [+voice]. This simply means that all vowels in English are usually voiced. In addition, English vowels in a word’s final position are always [−nasal], because [+nasal] nasalized vowels in English only occur when they come before a nasal consonant. (There are dialectic exceptions to this.) Actually, all obligatory phonological rules are also redundancy rules. That is, they say that if condition A exists, then condition B is predictable (redundant).

Redundancy serves an important function in language communication. By providing more information than is absolutely necessary, a message is much more likely to be understood accurately under difficult situations. For example, the words bill and pill are a minimal pair, which differ phonemically only in that the /p/ is unvoiced and the /b/ is voiced. This single difference might not be enough in a noisy restaurant to clearly distinguish between a person saying either “Please get me the bill” or “Please get me the pill.” Of course, the context of the situation may clarify any confusion. But if the person in question is due to take a pill and is also at the end of a meal, there could be a chance of miscommunication. The fact that /p/ and /b/ also differ in a nondistinctive way may then clarify the situation. That is, /p/ in the word pill is not only voiceless, but also has the redundant characteristic of aspiration, whereas /b/ in bill is unaspirated. So if the voicing difference between /p/ and /b/ was not sufficient to distinguish the two possibilities, the redundant aspiration may have made the message

Redundancy occurs when more information than necessary under ideal conditions is present. For instance, when a vowel is nasalized in English, it indicates that it precedes a nasal consonant. If a person doesn’t hear the nasal consonant clearly, he or she might be able to predict its presence from hearing the nasalization of the vowel.
clear. Redundancy (that is, predictability) differentiates language from many other communication systems. It was probably a highly adaptable trait of human evolution.

**Markedness**

In this chapter, we have discussed how sounds can be distinguished from one another on the phonetic level and on the phonemic level. We have seen that sounds can be defined in terms of bundles of distinctive features; sounds that share features can be grouped together into natural classes. There is another way in which we can distinguish sounds from each other.

Some linguists believe that sounds are best classified in terms of pairs that contrast in markedness. Markedness is a contrast in complexity and rarity of the sounds. One member of each pair would be designated as unmarked while the other is marked. The unmarked member of the pair would be considered more basic or natural than the other member. The marked member of the pair therefore would be thought of as more complicated, less expected to occur, and less plausible. For instance, in the pair composed of the bilabial stops, /b/ and /p/, /p/ may be thought of as more basic than /b/. This is based on the fact that /p/ is unvoiced ([-voice]) and /b/ is voiced ([+voice]). In consonants, voicing is taken as a complication to the more basic nonvoiced configuration. Voicing is the addition of a feature to a consonant, and therefore a complication. That is, /b/ can be considered to be /p/ plus voice. (In a vowel sound, voicing ([+voice]) would be the expected condition and therefore the unmarked condition.) A marked sound might also occur less frequently than the unmarked member of its pair. Of the two alveolar fricatives in English, /s/ and /z/, /s/ would be considered unmarked, because it occurs more frequently than /z/ and is also voiceless.

There are several lines of evidence indicating that some sounds are indeed more basic (unmarked) than others. This evidence comes from the study of language universals, language change, and language acquisition. The concept of markedness will be discussed in the chapters on these topics, as well as in the chapters on syntax (Chapter 5) and on sign language (Chapter 9). Here, we will briefly mention one line of evidence that points to the validity of the marked/unmarked distinction.

The study of the way children acquire language strongly indicates that some sounds are more basic than others. We can predict with great accuracy that the first words that a child regularly makes will not be such things as though /θu/, shoe /ʃu/, or zip /zip/. We can also predict with great confidence that the first vowel sound that a child will make regularly will be /a/, and that this will often be combined with the bilabial nasal /m/. This indicates that the vowel /a/ is unmarked, that it is more natural, in comparison to other vowels, which are then said to be marked in relationship to /a/. It may also indicate that /m/, even though it is [+nasal], may be less marked in relationship to other bilabials. The first sounds that a child forms are often interpreted by the adults as the word for “mother.” The American child says /mama/, the Navajo child says /ma/, and the Ki-Hungan child (from Africa) says /maam/.

**Summary**

Phoneticians attempt to discover as much detail as possible about speech sounds. Phonetic transcriptions (narrow transcriptions) will record as much detail as can be perceived. We can produce the sounds in the following
ways: [t], [tʰ], [t̚], [t̑], [t̂]. These represent narrow transcriptions for the t sound. In English, none of these variations are distinctive because they do not signal a difference in meaning when substituted for each other. In Russian, some of these variants are significant. /t/ and /tʲ/ are different phonemes (each with their own allophones), rather than allophones of the same phoneme as they are in English. A phoneme is a mental construct. Different physical sounds or signs of a sign language may be perceived as the same or different phonemes.

Significant differences (contrasts) in a language can be determined in a number of ways. The one that we have discussed is the use of minimal pairs and sets. Minimal pairs and sets are utterances in which:

1. There are the same number of sound segments,
2. There is only one phonetic difference,
3. This difference occurs at the same place in the forms, and
4. There is a difference in meaning.

In English, minimal pairs or sets cannot be found for the t sounds listed earlier. Therefore, all of these t sounds would phonemically be written the same, as /t/. Here, all nondistinctive features have been eliminated. Such a phonemic transcription is also called a broad transcription.

Phonemes can be seen as the result of simultaneously produced features. The number and nature of these distinctive features is a debated issue. Ultimately, a list may be devised that could be used to describe all phonemes in all languages. Such a list of distinctive features might lead to an understanding of universal phonological principles. The list that we used included seventeen features. With this list, each English phoneme differs from every other phoneme by at least one feature. Phonemes that share a small number of features and can be shown to behave the same in similar phonetic contexts are called a natural class. We can write rules about natural classes of sound.

Language is rule-governed. Phonology is the study of the rules governing the combination of phonemes as well as the investigation of how phonemes function in language. These rules deal with the position of different natural classes of sound within words; which sounds can be strung together in various sequences; and when to add, delete, or change elements of the underlying representation in order to generate the utterance that is actually spoken (surface structure). Some of these rules are rules. That is, they are obligatory phonological processes. Others are not really rules, but optional phonological processes. Obligatory phonological processes usually involve alterations in one phonetic segment, whereas optional processes can be much more complicated.

Linguists use a number of notational conventions to display linguistic rules. These notational systems make it easier to write rules and to see patterns.

Some elements of language are predictable, such as the aspiration of an English voiceless stop before a stressed vowel. Predictable features of language are also called redundant features. Redundancy in most human activities is seen as inefficient. In language, redundancy is not inefficient. It allows a message to be understood, even under conditions of high “static.”

Some sounds appear to be more natural (unmarked) than others. Not all sounds are produced with the same ease. Unmarked sounds tend to appear earlier in a child’s speech and become more frequent than marked sounds do in adult speech.
In this chapter, we have examined some of the basic principles (rules) underlying the combination and function of phonemes. In Chapter 4, we will focus on how words are formed from their component sounds.

**Suggested Reading**


**Suggested Websites**

(Most of these websites contain information on both phonetics, the subject of Chapter 2, and phonology, the subject of this chapter.)

Stirling University’s Online Phonology Course: http://www.ioe.stir.ac.uk/centres/celt/index.php
The UC Berkeley Phonology Laboratory: http://www.linguistics.berkeley.edu/phonlab/

**Review of Terms and Concepts: Phonology**

1. Phonology is concerned with _______.
2. In English, [t] and [ð] are _______.
3. In English, [t] and [b] are _______.
4. [bɔl] and [hɔl] is a _______.
5. The choice of which allophone of the phoneme /p/ to use in a specific phonetic environment is _______.
6. The fact that [k] and [kʰ] do not occur in the same phonetic environment is an example of and indicates that [k] and [kʰ] are _______.
7. The fact that we could say *economics* as [ikənɑmiks] or [ɛkənɑmiks] is an example of _______.
8. What does the diacritic in number 7 indicate? What phonological process is operating on the vowels in this example? Is the process optional or obligatory? _______.
9. If two sounds form minimal pairs, the two sounds are _______.
10. If two sounds cannot be found to form minimal pairs, they are not different phonemes. This statement is _______ (true or false).
11. A distinctive feature is _______.
12. A phoneme can be thought of as _______________.

13. A ______________ lists sound segments along the horizontal axis, and distinctive features are on the vertical axis.

14. Examine Table 3-2. Which sounds would be classified as:
   a. [+cons], [+nasal], [+high], [−ant]
   b. [+high], [+back], [+tense], [+rounded]
   c. [+voiced], [−son], [−nasal], [+cont], [−ant], [+strid]

15. [−continuant, −voice] describes a ______________ of speech sounds called ______________.

16. The concept of natural classes allows us to ______________.

17. Aspiration of voiceless stops at the beginning of a syllable and before a stressed vowel is an example of what type of phonological process? ______________.

18. Processes, such as the one in number 17, usually modify a ______________.

19. The three types of assimilation mentioned in the text are ______________, ______________, and ______________.

20. Changes in syllabicity, deletion, and insertion are examples of ________________________________ ________________________________.

21. Such processes as those mentioned in number 20 differ from the processes in number 17 in that ______________.

22. Sounds that are more frequently used in a language, acquired earlier, and are simpler to articulate are said to be ________________________________.

23. Speech usually provides more information than is necessary to understand the meaning of an utterance. This characteristic is called ________________________________.

**End-of-Chapter Exercises**

1. The data listed below is from Diegueño, a Native American language. Determine the rules for forming plurals in Diegueño. Take into account that the final vowel of a verb is always stressed. Long vowels are indicated by the [:] symbol.

<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. /L[:]ap/</td>
<td>/L[:]a:p/</td>
<td>(burn)</td>
</tr>
<tr>
<td>b. /mul/</td>
<td>/mu:l/</td>
<td>(gather)</td>
</tr>
<tr>
<td>c. /chu:pu:l/</td>
<td>/chu:pu:l/</td>
<td>(boil)</td>
</tr>
</tbody>
</table>
d. /sa:rw/ /saw/ (eat)
e. /ʃu:pit/ /ʃu:pi:t/ (close)
f. /sɪ:/ /siː/ (drink)
g. /ma:/ /maː/ (eat soft things)
h. /tuːna:/ /tunaː/ (pound)
i. /iːma:/ /iːmaː/ (dance)
j. /kwaː/ /kwaː/ (crochet)
k. /mwaːs/ /m waːs/ (be soft)
l. /wiːr/ /wiːr/ (be hard)

2. The diacritic [:] after a vowel means that the vowel is long; that is, it is produced a little longer than other vowels. Describe the process occurring in the following set of English words. State the rule as generally as you can.

[næp] [næːb]
kot [koːd]
/bit/ [biːd]
lut [luːd] / [luː]
/mit/ [miːd]
[sis] [siː]