Chapter 2

Articulatory Phonetics: Speech Sound Form

LEARNING OBJECTIVES

When you have finished this chapter, you should be able to:

- Define and classify phonetics and the branches of phonetics.
- Briefly review the anatomical-physiological foundations of speech production.
- List the differences in production and function of vowels versus consonants.
- Identify the descriptive parameters used for vowels of General American English and categorize the vowels accordingly.
- Identify the descriptive parameters used for the consonants of General American English and classify the consonants accordingly.
- Define coarticulation and assimilation, and list the different types of assimilatory processes.
- Identify the various types of syllable structures, including phonotactic restraints that might be noted in children.

CHAPTER OVERVIEW

This chapter first presented a definition of phonetics and the three subdivisions of phonetics: articulatory, acoustic, and auditory phonetics. Second, this chapter reviewed the anatomical and physiological prerequisites for speech production. The structures involved in producing speech are cumulatively labeled the speech mechanism. The speech mechanism is further divided into the respiratory, phonatory, resonatory, and articulatory systems. These systems were briefly discussed.

Next within articulatory phonetics an overview of vowels and consonants was given and the form and function of vowels and consonants of General American English were discussed. Both vowels and consonants were classified according to their articulatory production features and their linguistic functions. Phonetic descriptors were given to provide the clinician with a detailed account of articulatory action during norm production of vowels and consonants. These features can later be contrasted to those noted in the impaired sound realizations of children and adults with articulatory-phonological impairments.

In the last portion of this chapter, coarticulation, assimilation processes, and syllable structure were defined and examined. Coarticulation and resulting assimilatory processes were described as possible normal articulatory consequences that regularly occur in the speech of individuals. Assimilatory processes were defined according to the type and degree of sound modification. Examples were given of assimilatory processes in children as well as of the possible impact these processes could have on standardized speech assessment results. The section on syllable structure defined the parts of the syllable. It was suggested that an analysis of syllable structures could provide the clinician with additional knowledge when evaluating individuals with speech sound disorders.

PRESENTATION OUTLINES

1. Define phonetics and three subdivisions of phonetics: Articulatory phonetics, acoustic phonetics, and auditory phonetics.
2. Review the anatomical-physiological foundations of speech production relative to the respiratory, phonatory, resonatory, and articulatory systems.
3. Review basic vowel and consonant definitions. Both production aspects and linguistic function are highlighted.
4. Classify the vowels of General American English according to phonetic production parameters. These include the portion of the tongue involved in the vowel articulation (front versus back), the position of the tongue relative to the palate (high versus low), and the degree of lip rounding or unrounding.
5. Classify the consonants of General American English according to phonetic production parameters. These include the place of articulation, the type of constriction established between the articulators (manner), and the presence or absence of vocal fold vibration (voiced versus voiceless)
6. Describe coarticulation and identify various types of resulting assimilation processes and the implications for the assessment of children with speech sound disorders
7. Categorize the various parts of a syllable noting the impact syllable structure has on the articulation possibilities of children.

KEYWORD DEFINITIONS

Phonetics is the study of speech emphasizing the description and classification of speech sounds according to their production, transmission and perceptual features (p. 18).

Articulatory phonetics deals with the production features of speech sounds, their categorization and classification according to specific parameters of their production. Central aspects include how speech sounds are actually articulated, their objective similarities, and their differences (p. 18). The motor processes which result in speech sounds are categorized according to several different parameters. For example, categories may include those speech motor processes which are coupled with vocal fold vibration (voiced sounds) versus those which are not (voiceless sounds), or those speech motor movements which result in a partial or total hindrance within the vocal tract (consonants) versus those which demonstrate a relatively open vocal tract, a vocal tract without significant obstructions (vowels).

Acoustic phonetics is the area of study related to speech sound transmission. The frequency, intensity, and duration of speech sounds, for example, are described and categorized (p. 18). The transmission of speech sounds can be exemplified by a display of the acoustic constituents of a particular speech sound. For example, the frequency of a voiced sound, i.e., the number of complete repetitions (cycles) of variations in air pressure occurring within a second's time, directly related to the opening and closing of the glottis, is a portion of acoustic phonetics. Another aspect of acoustics would be the intensity of a sound mirrored by the amplitude of these variations in air pressure.

Auditory phonetics pertains to speech sound perception (p. 18). For example, pitch and loudness are terms which are used to describe the perceptual categorization of frequency and intensity, which were noted parameters in acoustic phonetics. Although pitch and loudness are related to frequency and intensity, equal steps of increasing frequency or intensity do not produce the perceptual effect of equal steps of pitch and loudness. These discrepancies between acoustic facts and their perceptual impressions are typical for studies within auditory phonetics.

Speech mechanism refers to those anatomical-physiological structures involved in producing speech (p. 19). The speech mechanism is functionally divided into respiratory, phonatory,

resonatory, and articulatory systems.

Pleural linkage refers to the manner in which the lungs increase their volume during inspiration and decrease their volume during expiration (p. 21). A strong negative pressure exists between two pleurae (one covering the outer surface of the lungs and one covering the inner surface of the thorax and the top portion of the diaphragm) which are airtight and fused together. This negative pressure links the membranes so closely that any movement of the thoracic cavity results in movement of the lungs.

Alveolar pressure consists of the pressure within the lungs (p. 22). During rest the alveolar pressure is equal to the outside air pressure, however, as inspiration begins and the resulting expansion of the thoracic cavity, a negative alveolar pressure occurs. Air rushes in and inspiratory muscles cease their activity and air is forced out as the upward movement of the diaphragm and the decrease in the thoracic cavity occur. At this point, alveolar pressure again equals the outside air pressure.

Subglottal air pressure is that air pressure below the vocal folds (p. 22). The glottis is the space between the vocal folds, sub- indicating below.

Extrinsic muscles of the larynx are those having at least one attachment outside the larynx (pp. 22-23). These muscles are primarily responsible for supporting and anchoring the larynx.

Intrinsic muscles of the larynx are those having both attachments within the larynx (p. 23). These muscles are necessary for control during voice production such as opening and closing the vocal folds.

Adduct refers to closing the vocal folds (p. 23). The muscles responsible for adduction of the vocal folds are the lateral cricoarytenoid and the interarytenoid muscles (pp. 23-24).

Abduct refers to the opening of the vocal folds (p. 23). There is one muscle responsible for abduction of the vocal folds, the posterior cricoarytenoid (pp. 23-24).

Fundamental frequency is the average number of glottal openings per second (p. 23). The average fundamental frequency for males is between 120 and 145 cycles per second while for females it is approximately 200 to 260 cycles per second.

Timbre refers to the tonal quality which distinguishes two sounds of the same pitch, loudness and duration from one another, for example, between two different speakers (p. 24).

Vocal tract consists of all speech-related systems above the vocal folds (p. 24).

Pharyngeal cavity, a muscular and membranous tube-like structure extends from the epiglottis to the soft palate (p. 24).

Oral cavity, or mouth area, extends from the lips to the soft palate (p. 24).

Nasal cavities, or nose area, consist of two narrow chambers that begin at the soft palate and end at the exterior portion of the nostrils (pp. 24-25).

Resonance is the selective reinforcement and absorption of sound energy at specific frequencies. Certain frequencies are amplified or intensified (reinforced) while others are suppressed or damped out (absorbed) (p. 25).

Velopharyngeal mechanism consists of the structures and muscles of the velum, or soft palate, and those of the pharyngeal walls (p. 25).

Velopharyngeal port is the passage that connects the oropharynx and the nasopharynx. It can be closed by elevation and posterior movements of the velum and some forward and

medial movements of the posterior and lateral pharyngeal walls. These combined movements resemble the action of a sphincter (p. 25).

Dorsum is the body of the tongue (p. 26).

Alveolar ridge is a prominent ridge-like structure located behind the front teeth (p. 26). The protuberance is formed by the alveolar process, which is a thickened portion of the maxilla (upper jaw) housing the upper teeth.

Vowels are speech sounds produced without a significant constriction of the oral (and pharyngeal) cavities (p. 27). The airflow from the vocal folds to the oral opening remains relatively unimpeded. Because of this production feature, vowels are often labeled open sounds.

Consonants are speech sounds produced with a significant constriction within the oral (and pharyngeal) cavities, foremost along the sagittal midline of the oral cavity (p. 27). The sagittal midline is the median plane dividing, in this case, the vocal tract into right and left halves. Sagittal midline constriction can be noted when articulating [s], or [l], for example. With [s], the air stream is directed over the tongue tip, while actual contact between the tongue tip and the alveolar ridge can be noted for [l] productions. Due to these production features consonants are often labeled constricted sounds.

Sagittal midline of the vocal tract refers to the median plane that divides the vocal tract into right and left halves (p. 27).

Sonority, when referring to speech sounds, is the loudness of a particular speech sound relative to others of equal length, stress, and pitch (p. 27). "There is roughly a 700-to-1 range of intensities between the weakest and strongest speech sounds made while speaking at a normal conversational level. The vowels are the strongest sounds but, even among these, there is a three-to-one range. The strongest vowel is the "aw" (as in "talk"), which is usually pronounced at three times the intensity of the weakest vowel, "ee" (as in "see"). The strongest of the consonants, the "r" sound, has about the same intensity as the "ee" vowel, but is two and a half times more intense than "sh" (as in "shout"); six times more intense than "n" (as in "no"); and 200 times greater than the weakest consonant, "θ" (as in "thin") " (Denes and Pinson, 1973, p. 150-151).

Sonorants are another name for vowels and diphthongs due to their greater sonority in relationship to consonants (p. 27).

Sonorant consonants are a group of consonants which have a relatively open expiratory passageway; they are produced with less obstruction of the air stream (p. 27). Sonorant consonants include the nasals, liquids, and the glides

Obstruent consonants are a group of consonants which are characterized by a complete or narrow constriction between the articulators hindering the expiratory air stream (p. 27). The obstruents include the stops, fricatives, and the affricates.

Syllabics are a small group of consonants which can function as the nucleus of the syllable (p. 28). Certain sonorant consonants can be syllabics. For example, [l, m, n]. For example, if the second syllable of “button” is reduced and pronounced without the vowel, as in [bʌtn], [n] now becomes the nucleus of the syllable and is termed a syllabic. This also occurs with the second syllable of “bottle” when said as [bɑtl], [l] is a syllabic in this case. Syllabics are indicated by a small line placed under the symbol in question.

Vowels of General American English can be described according to the following parameters (pp. 29-31):

1) **the portion of the tongue that is involved in the articulation** which is correlated to the phonetic descriptors of front, central, and back vowels;

2) **the tongue’s position relative to the palate** translates phonetically into the labels high,

mid, and low vowels. These descriptions can be directly related to the vowel quadrilateral (p. 29) with front vowels being at the far left of the quadrilateral, central vowels in the center, and back vowels on the right axis. The high vowels are at the top of the quadrilateral, the mid vowels further down when moving vertically, while the low vowels are at the bottom of the quadrilateral. The last parameter which is used to describe the articulation of vowels is

3) **the degree of lip rounding or unrounding** (p. 29). The high-back vowels, such as [u] and [ʊ] have a relatively high degree of lip rounding. As you move down the vowel quadrilateral with the back vowels the lip rounding decreases until [ɑ], which is considered an unrounded vowel. The front vowels are considered to be unrounded vowels or those produced with lip spreading. The high-front vowels [i] and [ɪ] have a high degree of lip spreading while the low-front vowels have less.

Monophthongs are vowels with a relatively constant quality throughout their production (p. 29). Monophthongs are also known as pure vowels. The vowel [i] is typically produced as a pure vowel.

Diphthongs, on the other hand, are vowels in which the quality changes during their production (p. 29). The term diphthong, meaning having two sounds, is used to refer to those vowels which vary in quality during the length of their production but are seen as representing one phoneme.

Onglide is the initial portion of a diphthong (p. 29).

Offglide is the second or end portion of the diphthong (p. 29). Thus, the diphthong that is typically heard in the word *pie,* [paɪ], has [a] as the onglide and [ɪ] as the offglide.

Rising diphthongs are those that the tongue moves from a lower positioned onglide portion to an offglide which has a higher tongue position. Thus, relative to the palate, the tongue moves in a rising motion (p. 31).

Centering diphthongs are a special class of diphthongs in which the offglide or less prominent element of the diphthong is a central vowel (p. 31). Depending upon the dialect of the speaker this may be a schwa vowel or a central vowel with r-coloring. Thus “farm” could be pronounced as [fɑəm] or [fɑɚm].

Rhotic diphthongs are centering diphthongs with [ɚ] as their offglide (p. 31).

Rhotics refers to the r-coloring noted in specific vowels or consonants of American English (p. 31). The rhotics in American English are [ɹ, ɝ, ɚ]

Nonphonemic diphthongs are those that do not demonstrate phonemic value, i.e., the meaning of the word does not change, if the diphthong is reduced to a monophthong with only its onglide portion (p.32). For example, whether one pronounces “cake”, [keɪk] or [kek], the same word meaning will be perceived. The diphthongization of these vowels does not have phonemic value.

Phonemic diphthongs are those that do demonstrate phonemic value; the meaning of the word does change, if the diphthong is reduced to a monophthong with only its onglide portion (p. 32). For example, [ɔɪ] is a phonemic diphthong in that if it is produced as a monophthong, the phonemic value changes. The two words [sɔɪ], “soy”, and [sɔ], “saw” exemplify this, when the diphthong is produced without the offglide, a word with a different meaning results.

Consonants can be categorized according to their

voicing features,
place of articulation, and
manner of articulation (p. 33).

Voicing is the term used to denote the presence or absence of simultaneous vocal fold vibration resulting in voiced or voiceless consonants (p. 33).

Cognates are pairs of sounds, such as [p] and [b] which differ only in their voicing features (p. 33).

Place of articulation describes where the constriction or narrowing occurs for the various consonant productions. The lip, teeth, portions of the palate and velum are the main places of articulation in the production of General American English consonants (p. 34).

Manner of articulation refers to the type of constriction the articulators generate (p. 34). This constriction may consist of a complete closure or a relatively wide opening between the articulators (p. 34).

In General American English, the manners of articulation consist of the **plosives** (sometimes referred to as **stops**), **fricatives, nasals, affricates, approximants (glides** and **laterals), and rhotics** (pp.34-35).

Plosives ([p, b, t, d, k, g]) are signaled by a complete occlusion between the articulators (p. 25). This complete closure results in the build-up of air pressure (stop phase) followed by a release phase in which the separation of the articulators allows for a burst of air (plosive phase) (pp. 34-35).

Fricatives ([f, v, s, z, ʃ, ʒ, θ, ð]) are the result of a very close approximation between the articulators, so close in fact that an audible friction-noise results (p. 35).

Sibilants [s, z, ʃ, ʒ] (literally hissing sounds) are one subcategory of fricatives which have a sharper sound than others due to the presence of high frequency acoustic components (p. 35).

Nasals ([m, n, ŋ]) are produced with the velum lowered so that the air passes freely through the nasal cavity giving them their characteristic quality (p. 25). The nasals are the only consonants in American English that are produced with the velum lowered, for all other consonants the velum is raised, closing off the passageway between the oral and nasal cavities (p. 35).

Affricates ([ʧ, ʤ]) are a group of consonants that contain two phases: 1) a stop portion with a build-up of air pressure which is slowly released followed by 2) a friction portion of the speech sound (p. 35). The stop phase releases into a fricative portion which is produced at the same place of articulation. Although they are transcribed with two separate symbols, they are not consonant clusters but rather have one phoneme value.

Approximants are a manner of articulation in which the articulators come close to each other but the constriction is far less than for the fricatives, i.e., the articulators approximate one another (p. 35). The liquids and glides are approximants.

Glides ([w. j]) are produced with a constriction that is wider than that necessary for fricative consonants. In addition, there is a gliding movement of the articulators to a more open position (p. 35). According to the International Phonetic Alphabet the glides are labeled as approximants. This term refers to those consonants which are produced with a wider passage of air resulting in a smooth, as opposed to a turbulent airflow.

Laterals are characterized by a midline closure with simultaneous lateral airflow. Thus, the air stream passes around one or both sides of the tongue (p. 35). There is one lateral consonant in American English, [l]. According to the International Phonetic Alphabet [l] is labelled a lateral approximant.

Liquids are collectively the lateral [l] and the rhotic [ɹ] which are grouped together under this heading (p. 35).

Rhotic consonants are produced with the articulators approximating one another and creating an r-quality sound. These sounds are variable in their production; there are three different productions 1) where the tongue tip is raised towards the alveolar ridge, 2) a retroflexed and 3) a bunched production (p. 35). According to the classification used within the International Phonetic Alphabet, the rhotics are considered central approximants (p. 35).

Coarticulation refers to the constant positioning of the articulators as they move over a stretch of speech (p. 38). Ladefoged and Johnson (2014) describe coarticulation as the overlapping of adjacent articulations while Shriberg, Kent, McAllister, and Preston (2019) use the term to refer to speech modifications in which the production of a sound is influenced by other sounds around it, that is, by its phonetic context. The effects of coarticulation are clinically significant in that the surrounding phonetic context may assert a positive or negative articulatory influence on a specific sound.

Assimilation refers to adaptive articulatory changes in which one sound becomes similar to (or identical to) a neighboring sound (p. 38). Many assimilatory changes are natural consequences of articulatory adjustments which make speech easier and faster.

Assimilation processes (also known as **harmony processes**) are categorized according to the type and degree of assimilatory changes (pp. 38-39).

Contact (or **contiguous**) assimilation denotes changes impacting directly adjacent sounds while **remote** (or **noncontiguous**) assimilation occurs when the assimilatory changes affect sounds separated by at least one other sound segment (p. 39).

Progressive (or **perseverative**) assimilations refer to a sound impacting a following sound while **regressive** (or **anticipatory**) assimilations designate an assimilatory change of a sound influencing a preceding sound (p. 39).

Total (or **complete**) assimilation occurs when two segments become identical while **partial** assimilation refers to changes in one or more phonetic features of the sound in question (p. 39).

Peak is a term used to denote the most prominent, the most acoustically intense part of the syllable, in other words the syllable nucleus (p. 40).

Onset of a syllable consists of all segments prior to the peak (p. 40). Those segments *are* also termed **syllable releasing sounds.**

Coda refers to those segments following the peak (p. 40). These are also labeled **syllable arresting sounds.**

Rime consists of the peak and coda of a syllable (p. 41).

Open or **unchecked syllables** are those that do not contain codas (p. 41).

Closed or **checked syllables** do have codas (p. 41).

Syllable production is affected by four factors (1) the number of syllables an utterance contains (fewer syllables are easier to produce), (2) the type of syllable relative to open versus closed syllables (open syllables are easier to produce), (3) the degree of syllable stress (stressed syllables are easier to produce than unstressed ones) (4) the number of consonants that are grouped together (singletons are easier to produce than consonant clusters) (p. 42).

LEARNING MATERIALS

ANSWERS TO QUESTIONS FROM TEXTBOOK CASE STUDY

(PAGE 43)

The following sample is from Tina, age 3;8.

dig	[dɪg]	⇨	[dɛg]	vowel change: high-front vowel [ɪ] changed to a mid-front vowel [ɛ]
house	[haʊs]	⇨	[haʊθ]	consonant change: a voiceless alveolar fricative [s] changed to a voiceless interdental fricative [θ]
knife	[naɪf]	⇨	[naf]	vowel change: diphthong vowel [aɪ] changed to a monophthong [a]
duck	[dʌk]	⇨	[dʊt]	vowel change: a central vowel [ʌ] changed to a high-back vowel [ʊ] consonant change: a voiceless velar plosive [k] changed to a voiceless alveolar plosive [t]
fan	[fæn]	⇨	[vɛn]	vowel change: a low-front vowel [æ] changed to a mid-front vowel [ɛ] consonant change: a voiceless labio-dental fricative [f] changed to a voiced labio-dental fricative [v]
yes	[jɛs]	⇨	[wɛt]	consonant change: a voiced palatal glide (or approximant) [j] changed to a voiced labio-velar glide (or approximant) [w] consonant change: a voiceless alveolar fricative [s] changed to a voiceless alveolar plosive [t]
boat	[boʊt]	⇨	[bot]	no errors
cup	[kʌp]	⇨	[tʊp]	vowel change: a central vowel [ʌ] changed to a high-back vowel [ʊ] consonant change: a voiceless velar plosive [k] changed to a voiceless alveolar plosive [t]
lamp	[læmp]	⇨	[wæmp]	consonant change: voiced alveolar liquid (lateral approximant) [l] changed to a voiced labio-velar glide (approximant) [w]
goat	[goʊt]	⇨	[doʊt]	consonant change: a voiced velar plosive [g] changed to a voiced

alveolar plosive [d]

cat	[kæt]	⇨	[tæt]	consonant change: a voiceless velar plosive [k] changed to a voiceless alveolar plosive [t]
bath	[bæθ]	⇨	[bæt]	consonant change: a voiceless interdental fricative [θ] changed to a voiceless alveolar plosive [t]
red	[ɹɛd]	⇨	[lɛd]	consonant change: a voiced palatal rhotic (or liquid, central approximant) [ɹ] changed to a voiced alveolar lateral approximant (liquid) [l]
ship	[ʃɪp]	⇨	[sɪp]	consonant change: a voiceless prepalatal (or postalveolar) fricative with lip rounding [ʃ] changed to a voiceless alveolar fricative [s]
ring	[ɹɪŋ]	⇨	[wɪŋ]	consonant change: a voiced palatal rhotic (or liquid, central approximant) [ɹ] changed to a voiced labio-velar glide (approximant) [w]
thumb	[θʌm]	⇨	[dʌm]	consonant change: a voiceless interdental fricative [θ] changed to a voiced alveolar plosive [d]
that	[ð æt]	⇨	[zæt]	consonant change: a voiced interdental fricative [ð] changed to a voiced alveolar fricative [z]
zip	[zɪp]	⇨	[wɪp]	consonant change: a voiced alveolar fricative [z] changed to a voiced labio-velar glide (or approximant) [w]
key	[ki]	⇨	[di]	consonant change: a voiceless velar plosive [k] changed to a voiced alveolar plosive [d]
win	[wɪn]	⇨	[jɪn]	consonant change: a voiced labio-velar glide (or approximant) [w] changed to a voiced palatal glide (or approximant) [j]

THINKING CRITICALLY (PAGE 44): ANSWERS

1. The [θ] and [ð] sounds are produced with a more anterior constriction than [s] and [z]. Thus the th-sounds can be produced as interdental or as apico-dental fricatives. For the interdental production the tongue tip is located between the teeth, the air flow is between the bottom edge of the incisors and the tip of the tongue. For the apico-dental production the tip of the tongue is located slightly more posterior than for the interdental production. Here the tongue tip is located slightly behind the cutting edge of the incisors; the air flow is again between the teeth and the apex of the tongue.

To achieve an apico-alveolar [s] or [z], the child should be instructed to move the tongue back. The child could start by gliding the tongue tip back and forth from the front to the back of the palate and then from the [θ] or [ð] productions back to a perceptually normal s-sound.

2. news [nuz] however newspaper [nuspeɪpɚ]

The change that occurs is from a voiced [z] to a voiceless [s] in "newspaper". This is contact assimilation, it is regressive in that the voiceless [p] is influencing the previous voiced [z] sound, it becomes voiceless.

panty [pænti] ⇨ [pæni]

The change that occurs is that the [t] in "panty" is completely gone (total assimilation). It is contact, progressive assimilation as the [n] (an alveolar nasal) has completely assimilated the [t] (an alveolar plosive).

did you [dɪd ju] ⇨ [dɪdʒu]

This is progressive, contact assimilation as the [d] has influenced the [j] in "you". The resulting affricate with its homorganic fricative portion is productionally very similar to the [d].

incubate [ɪnkjubeɪt] ⇨ [ɪŋkjubeɪt]

This is regressive, contact assimilation as the placement of the [k] (velar) has changed the preceding nasal from an alveolar to a velar nasal [ŋ].

misuse [mɪsjus] ⇨ [mɪʃus]

This is a contact, regressive assimilation as the more posterior placement of the [j] (palatal) has influenced the placement of the [s]. The [s] is an alveolar fricative which has now become a postalveolar [ʃ].

3. Identify the following syllable structures:

telephone ⇨ [tɛ.lə.foʊn]

1st syllable onset-peak, open syllable
2nd syllable onset-peak, open

			syllable 3rd syllable onset-peak-coda, closed syllable
wagon	⇨	[wæ.gən]	1st syllable onset-peak, open syllable 2nd syllable onset-peak-coda, closed syllable
shovel	⇨	[ʃʌ.vʌl]	1st syllable onset-peak, open syllable 2nd syllable onset-peak-coda, closed syllable
banana	⇨	[bə.næ.nə]	1st syllable onset-peak, open syllable 2nd syllable onset-peak, open syllable 3rd syllable onset-peak, open syllable
pajamas	⇨	[pə.ʤæ.məs]	1st syllable onset-peak, open syllable 2nd syllable onset-peak, open syllable 3rd syllable, onset-peak-coda, closed syllable

4. Two syllable words with [k] in comparable syllable and stressing situation in initial-, medial- and final-word positions.

Initial:	cow – boys	co - llies
Medial:	ta – cos	ro -cket
Final:	sea – hawk	sea - sick

ADDITIONAL LEARNING MATERIALS

DISCUSSION TOPICS AND CLINICAL APPLICATIONS

1. Difficulties with vowel productions may occur in children with phonological disorders. The following examples of vowel substitutions have been slightly modified from those presented

in the article by Pollock and Keiser (1990). Students should compare the typical vowel production to the noted changes according to the parameters 1) the portion of the tongue which is involved in the articulation, i.e., front, central, back vowels; and 2) the tongue"s position relative to the palate, i.e., high, mid, low vowels.

Example	Word	Target	Child's Production
1.	pillow	[pɪloʊ]	[bɑloʊ]
2.	eight	[eɪt]	[aɪt]
3.	red	[ɹɛd]	[wɑd]
4.	cat	[kæt]	[kaɪt]
5.	wagon	[wægən]	[wɪgən]
6.	foot	[fʊt]	[fɔt]
7.	duck	[dʌk]	[dɑk]
8.	cow	[kɑʊ]	[kɑ]
9.	toy	[tɔɪ]	[dʌ]
10.	rock	[ɹɑk]	[wɪk]

See Test Bank for more detailed answers.

Example 1: a high-front vowel changes to a low-back vowel
Example 2: a diphthong with a mid-front onglide changes to a diphthong with a low-front onglide
Example 3: a mid-front vowel changes to a low-back vowel
Example 4: a low-front vowel changes to a diphthong with a low front onglide and a high-front offglide.
Example 5: a low-front vowel changes to a high-front vowel
Example 6: a high-back vowel changes to a mid-back vowel
Example 7: a central vowel changes to a low-back vowel
Example 8: a diphthong changes to a monophthong with only the onglide
Example 9: a diphthong with a mid-back onglide and a high-front offglide changes to a central monophthong vowel
Example 10: a low-back vowel changes to a high-front vowel

2. Students should compare the typical consonant productions to the noted misarticulations according to the voicing, place of articulation and manner changes.

Example	Word	Target	Child's Production
1.	swing	[swɪŋ]	[θwɪŋ]
2.	shovel	[ʃʌvəl]	[ʃʌbəl]
3.	frog	[fɹɑg]	[fwɑg]
4.	thumb	[θʌm]	[fʌm]
5.	knot	[nɑt]	[dɑt]
6.	coat	[koʊt]	[toʊt]
7.	fishing	[fɪʃɪŋ]	[fɪtɪŋ]
8.	lamp	[læmp]	[wæmp]
9.	zoo	[zu]	[du]
10.	three	[θɹi]	[tɹi]

See Test Bank for more detailed answers

Example 1: a voiceless alveolar fricative has been replaced by a voiceless dental fricative
Example 2: a voiced labiodental fricative has been replaced by a voiced bilabial plosive
Example 3: a voiced alveolar approximant has been replaced by a voiced labio-velar approximant
Example 4: a voiceless dental fricative has been replaced by a voiceless labiodental fricative
Example 5: a voiced alveolar nasal has been replaced by a voiced alveolar plosive
Example 6: a voiceless velar plosive has been replaced by a voiceless alveolar plosive
Example 7: a voiceless postalveolar fricative has been replaced by a voiceless alveolar plosive
Example 8: a voiced alveolar lateral approximant has been replaced by a voiced labio-velar approximant
Example 9: a voiced alveolar fricative has been replaced by a voiced alveolar stop
Example 10: a voiceless dental fricative has been replaced by a voiceless alveolar plosive

3. Based on the results from question #2, discuss which production parameters have been altered for each of the misarticulations. For example, are all four articulatory parameters different, that is, are there changes in the place of articulation, the manner, and voicing between the target realization and the actual production? Also, discuss in general terms what these changes mean. For example, has the place of articulation moved forward, backward, or has the manner of articulation changed from a complete closure to a wider opening?

See Test Bank for more detailed answers.

Example 1: a voiceless alveolar fricative has been replaced by a voiceless dental fricative
Place of articulation has been moved forward from from alveolar to dental,
Example 2: a voiced labiodental fricative has been replaced by a voiced bilabial plosive
Place of articulation has moved somewhat forward to a bilabial and the manner has changed from a fricative to a plosive
Example 3: a voiced alveolar approximant has been replaced by a voiced labio-velar approximant
Place of articulation has changed from a forward alveolar position to one with lip rounding and a high back tongue placement
Example 4: a voiceless dental fricative has been replaced by a voiceless labiodental fricative
Place of articulation has changed from the tongue approximating the teeth to one with involvement of the bottom lip
Example 5: a voiced alveolar nasal has been replaced by a voiced alveolar plosive
Manner of articulation has changed from a nasal to a plosive
Example 6: a voiceless velar plosive has been replaced by a voiceless alveolar plosive
Place of articulation has changed from a back velar to a more fronted alveolar plosive
Example 7: a voiceless postalveolar fricative has been replaced by a voiceless alveolar plosive
Place of articulation has changed minimally (a bit more forward), manner of articulation has changed from a fricative to a plosive
Example 8: a voiced alveolar lateral approximant has been replaced by a voiced labio-velar approximant
Place of articulation has changed from alveolar to one with lip rounding and a high back tongue position
Example 9: a voiced alveolar fricative has been replaced by a voiced alveolar plosive
Manner of articulation has changed from a fricative to a plosive
Example 10: a voiceless dental fricative has been replaced by a voiceless alveolar plosive
Place of articulation has been moved back and the manner of articulation has changed from a fricative to a plosive

Voicing always remains the same. Fricatives are replaced by plosives. Place of articulation changes the most.

4. Ingram (1974) and Smith (1973) offer case studies of children with assimilation processes. A few examples are offered here for discussion. What types of assimilation processes (progressive, regressive, contact, remote) are being seen in these examples?

Example	Word	Target	Child's Production
1.	talk	[tɑk]	[kɑk]
2.	doggie	[dɑgi]	[gɑgi]
3.	blankie	[blæŋki]	[bæmbi]
4.	stop	[stɑp]	[bɑp]
5.	snake	[sneɪk]	[ŋeɪk]

Assimilation Processes

1. Regressive (anticipatory), remote (noncontiguous) assimilation. This is called back assimilation in Ingram (1974) and velar harmony in Smith (1973).
2. Regressive (anticipatory), remote (noncontiguous) assimilation. This is similar to the first example.
3. Progressive (perseverative), remote (noncontiguous) assimilation. Note: The reduction of [bl] to [b] would be a normal production for a young child.
4. Regressive (anticipatory), remote (noncontiguous) assimilation. The changes in voicing from two voiceless sounds [st] to a voiced sound [b] could be discussed. This might be a case of prevocalic voicing (in addition to the assimilation process) which is often seen in young children.
5. Regressive (anticipatory), remote (noncontiguous) assimilation.

5. Analyze an articulation test noting the number of syllables which are used to test the [s] and [z] sounds and how the syllable structures vary when analyzing the sounds tested in the *medial* position.

MULTIPLE CHOICE QUESTIONS

1. Which group of speech sounds is produced with a significant constriction within the vocal tract?
   a) consonants
   b) onsets
   c) vowels
   d) syllable nuclei

2. Within the group of consonants, which specific speech sounds are produced with a relatively more open expiratory passageway?
   a) fricatives
   b) obstruents
   c) sonorants
   d) affricates

3. Which one of the following sounds is not considered a sonorant?
   a) [ɹ]
   b) [m]
   c) [w]
   d) [s]

4. A consonant that functions as a syllable nucleus is referred to as a
   a) releasing sound
   b) syllabic
   c) obstruent
   d) coda

5. Which of the following is not a parameter used to describe vowel productions?
   a) the part of the tongue that is raised
   b) the extent to which the tongue is raised
   c) the manner of articulation
   d) the kind of opening made at the level of the lips

6. Vowels which are labeled front vowels are
   a) acoustically more intense
   b) occur more often at the beginning of words
   c) are produced with the front articulators such as the teeth and lips
   d) are produced by articulatory adjustments made by more anterior portions of the tongue

7. The terms rounded and unrounded refer to
   a) the degree of muscular activity involved in the articulation
   b) the relative closeness of the tongue to the roof of the mouth
   c) the positioning of the lips during vowel articulations
   d) the position of the vowel within the syllable

8. Which one of the following is a diphthong?
   a) the vowel usually produced in "beet"
   b) the vowel usually produced in "in"
   c) the vowel usually produced in "pie"
   d) the vowel usually produced in "moon"

9. Which one of the following diphthongs is considered to be a nonphonemic diphthong?
   a) [eɪ]
   b) [aɪ]
   c) [ɔɪ]
   d) [ɑʊ]

10. Which one of the following diphthongs has a back vowel offglide?
   a) [eɪ]
   b) [aʊ]

c) [ɔɪ]
d) [aɪ]

11. Which one of the following vowels is a high-back vowel?
    a) [u]
    b) [ɔ]
    c) [ʌ]
    d) [o]

12. Diphthongs which are produced with a central vowel as the offglide are referred to as
    a) phonemic diphthongs
    b) falling diphthongs
    c) centering diphthongs
    d) rising diphthongs

13. During consonant production, which one of the following refers to the vocal fold vibration?
    a) coarticulation
    b) place of articulation
    c) manner of articulation
    d) voicing

14. Sibilants are a subcategory of
    a) plosives
    b) fricatives
    c) nasals
    d) affricates

15. According to the International Phonetic Alphabet, what is the label given to consonants in which there is a much wider passage of air resulting in a smooth (as opposed to turbulent) airflow?
    a) laterals
    b) approximants
    c) plosives
    d) fricatives

16. Why are rhotic consonants difficult to describe?
    a) because there is a gliding movement during their production
    b) because they occur infrequently in General American English
    c) because their production is context- and speaker dependent
    d) because there is confusion between the rhotic consonants and the central vowels with r-coloring

17. According to the International Phonetic Alphabet, which one of the following consonants is not considered an approximant?
    a) [j]
    b) [ɹ]
    c) [w]
    d) [n]

18. Which one of the following descriptions describes the consonant [l]?
    a) voiced alveolar lateral approximant
    b) voiced velar lateral
    c) voiceless postalveolar lateral
    d) voiced labiodental lateral

19. Which consonant is described as a voiceless velar plosive?
    a) [t]
    b) [p]
    c) [k]
    d) [f]

20. If the word "unpredictable" is pronounced as [əm.prə.dɪk.tə.bəl], this is an example of a
    a) progressive assimilation
    b) regressive assimilation
    c) noncontiguous assimilation
    d) perseverative assimilation

21. If the phrase "want to" is pronounced [wʌ.nə], this is an example of a
    e) noncontiguous assimilation
    f) contact assimilation
    g) regressive assimilation
    h) remote assimilation

22. Given the typical pronunciation, which one of the following words has two unchecked syllables?
    i) away
    j) captain
    k) balloon
    l) upset

23. What are the syllable arresting sounds of the two syllables in the word "today"?
    a) [t] and [d]
    b) [u] and [eɪ]
    c) [ɪ]
    d) the word "today" has no codas, therefore, it does not have syllable arresting sounds

TRUE/FALSE QUESTIONS

1. Only vowels can function as syllable nuclei.

2. Typically consonants have more acoustic intensity than vowels.

3. The vowel [i] is a high vowel that is unrounded.

4. In the standard pronunciation of General American English, only rising diphthongs are typically produced.

5. There is no difference in the production of diphthongs versus two vowels following one another.

6. The manner of articulation describes what type of constriction the articulators produce for the realization of a particular consonant.

7. Assimilation processes are typically classified as sound errors.

8. A syllable must have a peak and either an onset or a coda.

9. The number of syllables, the type of syllable, and the degree of syllable stress affect syllable production.

10. Standardized speech assessments account for syllable structure when establishing the words that will be used in the testing procedure.

SHORT ANSWER QUESTIONS

1. Give the definition of vowels.

2. Which vowels are considered rounded vowels?

3. Define monophthong.

4. Which four phonetic categories are used to describe consonants?

5. Define phonetics and the three subdivisions of phonetics which were discussed.

6. What are the active articulators for consonants of General American English?

7. What are the passive articulators for consonants of General American English?

8. Define coarticulation.

9. Define assimilation.

10. List the peak, onset, and coda for the word "stretch".

ESSAY QUESTIONS

1. List the production and linguistic function differences between vowels and consonants.

2. The vowel quadrilateral reflects the production features of the various vowels. Discuss how the quadrilateral reflects the oral dimensions of vowel production.

3. Distinguish between nonphonemic and phonemic diphthongs. Give word examples for both phonemic and nonphonemic diphthongs.

4. A child says [s p] for "ship". Explain the difference phonetically between the child's production and the typical pronunciation.

5. How might syllable structure be helpful when structuring word materials for therapy?

Chapter 2

Articulatory Phonetics

Speech Sound Form

DISCUSSION TOPICS AND CLINICAL APPLICATIONS

1. Difficulties with vowel productions may occur in children with phonological disorders. The following examples of vowel substitutions have been slightly modified from those presented in the article by Pollock and Keiser (1990). Students should compare the typical vowel production to the noted changes according to the parameters 1) the portion of the tongue which is involved in the articulation, i.e., front, central, back vowels; and 2) the tongue‟s

position relative to the palate, i.e., high, mid, low vowels.

Vowel Changes

1. High-front vowel is changed to a low-back vowel.
2. Onglide portion of diphthong is changed; mid-front vowel is changed to a low- front vowel.
3. Mid-front vowel is changed to a low-back vowel.
4. Monophthong is changed to a diphthong; low-front monophthong is changed to a diphthong with a low-front onglide and a high-front offglide.
5. Monophthong is changed to a diphthong; low-front monophthong is changed to a diphthong with a mid-back onglide and a high-front offglide.
6. High-back vowel is changed to a mid-back vowel.
7. Central vowel is changed to a low-back vowel.
8. Diphthong is changed to a monophthong; low-front onglide is changed to alow-back vowel.
9. Diphthong is changed to a monophthong; mid-back onglide is changed to a central vowel.
10. Monophthong is changed to a diphthong; low-back monophthong is changed to a diphthong with a low-back onglide and a high-front offglide.

2. Students should compare the typical consonant productions to the noted misarticulations according to voicing, place of articulation, and manner, changes.

Consonant Changes

1. Voiceless alveolar fricative is changed to a voiceless dental (or interdental) fricative.
2. Voiced labiodental fricative is changed to a voiced bilabial plosive.
3. Voiced alveolar (or retroflexed) rhotic (or liquid or central approximant) is changed to a voiced labio-velar glide (or approximant).
4. Voiceless dental (or interdental) fricative is changed to a voiceless labiodental fricative.
5. Voiced alveolar nasal is changed to a voiced alveolar plosive.
6. Voiceless velar plosive is changed to a voiceless alveolar plosive.
7. Voiceless postalveolar fricative with lip rounding is changed to a voiceless alveolar plosive.
8. Voiced alveolar lateral (liquid or lateral approximant) is changed to a voiced labio-velar glide (or approximant).
9. Voiced alveolar fricative is changed to a voiced alveolar plosive.
10. Voiceless dental (or interdental) fricative is changed to a voiceless alveolar plosive.

3. Based on the results from question #2, discuss which production parameters have been altered for each of the misarticulations.

1. swing [sw] → [θw]

Change in place of articulation: the articulators have moved forward from the alveolar ridge to the upper teeth.

2. shovel [v] → [b]

Change in place of articulation and manner of articulation: the articulatory constriction has moved forward, manner of articulation has changed from a narrow opening (fricative) to a complete closure (plosive)

3. frog [fɹ] → [fw]

Change in place of articulation and manner of articulation: there is lip rounding, the tongue has moved back to include a high-back tongue placement for [w], manner of articulation has changed from a liquid to a glide or from an approximant to a central approximant.

4. thumb [θ] → [f]

Change in place of articulation: articulators have moved from the tip of the tongue to the bottom lip.

5. knot [n] → [d]

Change in manner of articulation: manner has changed from a nasal to a plosive, the velum has moved from an open to a closed position.

6. coat [k] → [t]

Change in place of articulation: articulators have been moved to a more forward position.

7. fishing [ʃ] → [t]

Change in place and manner of articulation: articulator has moved forward, manner of articulation has changed from a narrow opening (fricative) to a complete closure (plosive).

8. lamp [l] → [w]

Change in place of articulation: articulator have moved from the tip of the tongue touching the alveolar ridge to a labial position for [w] (lip rounding), the tongue has moved back to a high-back elevation.

9. zoo [z] → [d]

Change in place and manner of articulation: articulators have moved somewhat back from the tip of the tongue to the edges of the tongue, manner of articulation has changed from a narrow opening (fricative) to a complete closure (plosive).

10. three [θɹ] `→ [tɹ]

Change in place and manner of articulation; the articulators have moved somewhat back from the tip of the tongue to the edges of the tongue and upper teeth to the alveolar ridge, manner of articulation has changed from a narrow opening (fricative) to a complete closure (plosive).

4. Ingram (1974) and Smith (1973) offer case studies of children with assimilation processes. A few examples are offered here for discussion. What types of assimilation processes (progressive, regressive, contact, remote) are being seen in these examples?

Assimilation Processes

1. Regressive (anticipatory), remote (noncontiguous) assimilation. This is called back assimilation in Ingram (1974) and velar harmony in Smith (1973).
2. Regressive (anticipatory), remote (noncontiguous) assimilation. This is similar to the first example.
3. Progressive (perseverative), remote (noncontiguous) assimilation. Note: The reduction of [bl] to [b] would be a normal production for a young child.
4. Regressive (anticipatory), remote (noncontiguous) assimilation. The changes in voicing from two voiceless sounds [st] to a voiced sound [b] could be discussed. This might be a case of prevocalic voicing (in addition to the assimilation process) which is often seen in young children.
5. Regressive (anticipatory), remote (noncontiguous) assimilation.

5. For example, the following words from the Weiss Comprehensive Articulation Test (1980) are used to test [t] and [d].

	Words used to test [t]	Words used to test [d]
Initial position	table	door
Medial position	Santa Claus	ladder
Final position	coat	bed

The number of syllables varies from one to three for testing [t] and [d]. In the medial position [t] is tested as the onset of an unstressed syllable but may frequently be

assimilated to [sænə]. The medial [d] in *ladder* is often produced not as [d] but as a flap (tap, or one-tap trill) (see page 55). Although this is an acceptable allophonic variation of [d], it does not really test [d] per se.

MULTIPLE CHOICE QUESTIONS

1) a	2) c	3) d	4) b	5) c
6) d	7) c	8) c	9) a	10) b
11) a	12) c	13) d	14) b	15) b
16) c	17) d	18) a	19) c	20) b
21) b	22) a	23) d		

TRUE/FALSE QUESTIONS

1) FALSE	2) FALSE	3) TRUE	4) TRUE	5) FALSE
6) TRUE	7) FALSE	8) FALSE	9) TRUE	10) FALSE

SHORT ANSWER QUESTIONS

1. Give the definition of vowels. See page 27 and Table 2.3 page 28.
2. Which vowels are considered rounded vowels? See page 30.
3. Define monophthong. See page 29.
4. Which phonetic categories are used to describe consonants? See page 33.
5. Briefly describe pleural linkage and its impact on respiration. See page 21.
6. What is the difference between extrinsic and intrinsic muscles of the larynx? See pages 22-23.
7. How does resonance modify the signal from the vocal folds? See page 25.
8. Define coarticulation. See page 38.
9. Define assimilation. See page 38.

10. List the peak, onset, and coda for the word "stretch". Refer to page 40.

ESSAY QUESTIONS

1. List the production and linguistic function differences between vowels and consonants. Refer to Table 2.3 (page 28) and the text on pages 27-28.

2. The vowel quadrilateral reflects the production features of the various vowels. Discuss how the quadrilateral reflects the oral dimensions of vowel production. Refer to page 29.

3. Distinguish between nonphonemic and phonemic diphthongs. Give word examples for both phonemic and nonphonemic diphthongs. Refer to page 32.

4. A child says [sɪp] for "ship". Explain the difference phonetically between the child's production and the typical pronunciation. Refer to Table 2.5 on page 36.

5. How might syllable structure be helpful when structuring word materials for therapy? Refer to pages 41 and 42.