Introduction to Communication Disorders

A Lifespan Evidence-Based Perspective

FIFTH EDITION

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A LIFESPAN EVIDENCE-BASED PERSPECTIVE

GLOBAL EDITION

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Introducing a new edition is always exciting and exhausting. In preparing a new edition, especially an introductory text, there is always the question of balance. Did we provide enough detail? Too much? Did we get the perspective correct? We hope that those of you who are familiar with the previous editions will agree with us that this edition is a worthy introduction to the field of speech pathology and audiology and one that contributes meaningfully to the education of speech-language pathologists and audiologists.

Within each chapter, we have attempted to describe a specific type of disorder and related assessment and intervention methods. In addition, we have included lifespan issues and evidence-based practice to provide the reader with added insights. Each type of disorder is illustrated by personal stories of individuals with that disorder. Further knowledge can be gained through the suggested readings provided at the conclusion of each chapter.

NEW TO THIS EDITION

This fifth edition of *Introduction to Communication Disorders* has many new features that strengthen the existing material in the previous edition. These include the following:

- Chapters have been reorganized and rewritten to help conceptualize the information differently so as to conform more to current clinical and educational categories. Several chapters have been reworked entirely.

- The reorganization of the entire book has resulted in fewer chapters—in part to respond to instructors' concerns about covering the material in a semester. We do listen!

- Of course, the material in each chapter has been updated to reflect the current state of clinical research. Special attention has been paid to the growing body of evidence-based research and literature. A quick perusal of the references will verify the addition of hundreds of new professional articles.

- As in the past, we have worked to improve readability throughout the book and to provide the right mix of information for those getting their first taste of this field. Several professors and students have commented favorably on our attempt in previous editions to speak directly to the reader, and we have continued and expanded this practice.

- We have continued to provide evidence-based practices in concise, easy-to-read boxes within each chapter. This demonstrates our commitment to this practice begun in the previous edition. As with all the rest of the text, these boxes have been updated to reflect our best knowledge to date.

- Background information has been simplified and shortened, in response to input from professors who felt we had provided too much and that

this information would be covered in other introductory course in anatomy and physiology, language development, and phonetics. This change increases readability and decreases the burden on faculty who felt compelled to teach it all.

ACKNOWLEDGMENTS

Robert Owens

I would like to thank the faculty of the Department of Communication Sciences and Disorders and the entire faculty and administration at the College of St. Rose in Albany, New York. What a wonderful place to work and to call home. The college places a premium on scholarship, student education, professionalism, and a friendly and supportive workplace environment and recognizes the importance of our field. I am indebted to all for making my new academic home welcoming and comfortable. I am especially thankful to President Margaret "Maggie" Kirwin, Interim School of Education Dean Margaret McLane, my chair Jim Feeney, and my colleagues in my department, fellow faculty members Dave DeBonis, Colleen Karow, Megan Overby, Jack Pickering, Anne Rowley, Jessica Kisenwether, and Julia Unger, and fellow clinical faculty members Kim Lamparelli, Elizabeth Baird, Marisa Bryant, Wyndi Capeci, Sarah Coons, Elaine Galbraith, Julie Hart, Barbara Hoffman, Jackie Klein, Kate Lansing, Jessica Laurenzo, Melissa Spring, and Lynn Stephens. You have all made me feel welcomed and valued.

It is with some sadness that I remember my colleagues at my former institution, State University of New York at Geneseo and the demise of the Department of Communicative Disorders and Sciences due to a shortsighted college administration decision. These great folks include Rachel Beck, Irene Belyakov, Linda Deats, Brenda Fredereksen, Beverly Henke-Lofquist, Thomas House, Carol Ivsan, Cheryl Mackenzie, Doug MacKenzie, Dale Metz, Diane Scott, Gail Serventi, and Bob Whitehead. All of us are indebted to the chair Linda House, who helped us keep our dignity and our promise to students in the face of a terrible and demoralizing situation. Best to you all always.

I would be remiss if I did not acknowledge the continuing love and support I receive from Addie Haas. She was with us in the first and second editions and continues to be a source of inspiration.

Finally, my most personal thanks and love goes to my spouse and partner, who supported and encouraged me and truly makes my life fulfilling and happy. I'm looking forward to our life together.

Kimberly Farinella

I wish to sincerely thank Bob Owens, Dale Metz, and Steve Dragin for again including me on this new and exciting edition of the textbook. I remain perpetually in awe of the fact that I work with such brilliant people, and I'm truly grateful for the opportunity.

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I want to thank my family, especially my parents, for their continued support of my career, and I want to express my gratitude to my significant other and future spouse, Tom Parker. I look forward to a long and happy life with you with plenty of skiing in the beautiful mountains of Flagstaff, Arizona!

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BRIEF CONTENTS

CONTENTS

Introduction to Communication Disorders

1

Communicative Disorders and Clinical Service

CHAPTER LEARNING GOALS

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

- Describe communication impairment
- Describe the roles of audiologists, speech-language pathologists, and speech, language, and hearing scientists
- Outline the history of changing attitudes toward individuals with disabilities over the centuries and legislation over the past several decades
- Describe how evidence-based practice (EBP) influences clinical decisions

C an you imagine life without communication? No talking, no listening, no interacting with others? Communication is part of what makes us human. Even minor or temporary problems with communication, such as laryngitis, are often frustrating. Many of us have experienced a problem in speaking or listening at some time in our lives.

We hope through this text to explore the nature of **communication disorders**. In this first chapter, we'll introduce the professionals who work with individuals who have communication disorders. These are audiologists, speech-language pathologists, or speech/language scientists. We'll also explore the roles of other professional team members, where speech-language pathologists and audiologists work, and what they do, plus we'll explain the nature of EBP. This first chapter also provides a historical perspective and outlines the laws that mandate appropriate care for those in need. Along the way, we'll explore why people choose these careers.

HELPING OTHERS TO HELP THEMSELVES

Why does someone decide to become a speech-language pathologist (SLP) or audiologist? It is mostly because of the satisfaction they receive from helping others to live a fuller life. Many—maybe even you—first became interested through a personal or family encounter with a communication disorder or through a work or volunteer experience with individuals with communication disorders. SLPs and audiologists may also have chosen their careers because they want to be useful to society, to contribute to the general good.

COMMUNICATION DISORDERS

We've mentioned communication disorders, but we haven't been very specific. It's always good to agree on our topic in any type of communication, so let's begin here.

A **communication disorder** impairs the ability to both receive and send, and also process and comprehend concepts or verbal, nonverbal and graphic information. A communication disorder may affect hearing, language, and/or speech processes; may range from mild to profound severity; and may be developmental or acquired. One or a combination of communication disorders may be presented by an individual and may result in a primary disability or may be secondary to other disabilities.

That's a lot. In short, a communication disorder may affect any and all aspects of communication, even gesturing. A communication disorder may affect hearing, language (the code we use to communicate), and/or speech (our primary mode or manner of communication). This is reflected in American Speech Language Hearing Association's (ASHA) name. (The Appendix describes ASHA's role in more detail.) But communication impairments can affect much more as you are about to explore through this book and the course you're taking. For example, SLPs are also involved in feeding and swallowing assessment and intervention.

A **speech disorder** may be evident in the atypical production of speech sounds, interruption in the flow of speaking, or abnormal production and/or

absences of voice quality, including pitch, loudness, resonance, and/or duration. A **language disorder**, in contrast, is an impairment in comprehension and/or use of spoken, written, and/or other symbol systems. Finally, a **hearing disorder** is a result of impaired sensitivity of the auditory or hearing system. No doubt you've heard individuals referred to as deaf or hard of hearing. In addition, auditory impairment may include **central auditory processing disorders**, or deficits in the processing of information from audible signals.

It's appropriate to note here that communication disorders do not include communication difference, such as dialectal differences or multilingualism. If you've been to a country where you don't speak the language well, you know that this can impede communication. While these differences may lead to communication difficulties, they are not disorders.

Another communication variation is **augmentative/alternative communication** systems. Far from being communication impairments, these systems, whether signing or the use of digital methods, are attempts often taught by SLPs to compensate and facilitate, on a temporary or permanent basis, for impaired or disabled communication disorders.

As you can see, communication disorders cover a wide range of problems with varying severities and are related to several other disorders. Our purpose in preparing this text is to help you understand and appreciate the many different disorders included in communication impairment. Maybe you began a few pages ago with some vague recollection of an SLP in your elementary school who mostly worked with children correcting their production of difficult speech sounds. That's part of disordered communication, but it's only a small part, as you are about to find out.

THE PROFESSIONALS

Today, professionals who serve individuals with communication disorders come from several disciplines. They often refer clients to one another or work together in teams to provide optimal care. Specialists in communication disorders are employed in early intervention programs, preschools, schools, colleges and universities, hospitals, independent clinics, nursing care facilities, research laboratories, and home-based programs. Many are in private practice. SLPs and audiologists receive similar basic training, but in their advanced study, they concentrate on one profession or the other.

Opportunities for SLPs and audiologists include serving individuals of all ages from infancy through the aged with varied disorders, from mild to profound, in a wide assortment of settings.

Audiologists

Audiologists are specialists who measure hearing ability and identify, assess, manage, and prevent disorders of hearing and balance. They use a variety of technologies to measure and appraise hearing in people from infancy through old age. Although they work in educational settings to improve communication and programming for people with hearing disabilities, audiologists also contribute to the prevention of hearing loss by recommending and fitting protective devices and by consulting with government and industry on the effects and management of environmental noise. In addition, audiologists evaluate and assist individuals with **auditory processing disorders (APD)**, sometimes

called central auditory processing disorders, and select, fit, and dispense hearing aids and other amplification devices and provide guidance in their care and use (DeBonis & Moncrieff, 2008). Licensed audiologists are independent professionals who practice without a prescription from any other health care provider (ASHA, 2001b). Box 1.1 contains an audiologist's comments on some of the challenges and rewards of the profession. As you will note, being a good detective, or problem solver, is one of the skills that is needed. Websites of interest are found at the end of the chapter.

Credentials for Audiologists

At the present time, the educational requirement for an audiologist is 3 to 5 years of professional education beyond the bachelor's degree. An audiologist's studies will culminate in a doctoral degree that may be an audiology doctorate (AuD) or a doctor of philosophy degree (PhD) or doctor of education degree (EdD) in audiology.

After a person has earned a doctorate, obtained the required preprofessional as well as paid clinical experience, and passed a national examination, she or he is eligible for the Certificate of Clinical Competence in Audiology (CCC-A) awarded by ASHA. ASHA CCC-A (sometimes referred to as ASHA "Cs") is the generally accepted standard for most employment opportunities for audiologists in the United States. In addition, states require audiologists to obtain a state license. The requirements for state licensure tend to be the same as or similar to the ASHA standards (ASHA, 2001b, 2001c).

You can further explore a career in audiology at three websites. The Acoustical Society of America (http://asa.aip.org) has material of special interest to hearing scientists and audiologists. The American Academy of Audiology (www.audiology.org) provides consumer and professional information regarding hearing and balance disorders as well as audiological services. Finally, ASHA (www.asha.org) provides information for professionals, students, and others who are interested in careers in audiology or hearing science. Simply click on "Careers" in the upper-left corner.

BOX 1.1 | **An Audiologist Reflects**

I chose to become an audiologist because I enjoyed the challenge. Most clients come in and are frightened or apprehensive. I try to set them at ease while I explain each test I will perform. At each step, I try to bring the client along and make sure that he or she understands what I will be doing and why. Children are often the biggest challenge and sometimes refuse to cooperate. This is when I have to be at my best. If I confirm the presence of a hearing loss, then my task becomes one of counseling and referral. It takes time to walk a client through the results and the possibilities. Older clients are often not willing initially to accept a diagnosis of hearing loss. Counseling is very important, especially for family members. It is all too easy for family members to adopt an "I told you so" attitude, but we must be sensitive to the needs of the client with the loss who will need time to adjust to his or her now-diagnosed disorder. It is this detective work and the counseling that give me satisfaction and motivate me to come to work every day.

Speech-Language Pathologists

Speech-language pathologists (SLPs) are professionals who provide an assortment of services related to communicative disorders. The distinguishing role of an SLP is to identify, assess, treat, and prevent communication disorders in all modalities (including spoken, written, pictorial, and manual), both receptively and expressively. This includes attention to physiological, cognitive, and social aspects of communication. SLPs also provide services for disorders of swallowing and may work with individuals who choose to modify a regional or foreign dialect. Like audiologists, licensed SLPs are independent professionals who practice without a prescription from any other health care provider (ASHA, 2000a, 2000b, 2000c). Box 1.2 contains reflections by two SLPs; the first one has been in private practice as a clinician for about 25 years. Although sometimes frustrated by the lack of support in his work setting, he believes in setting his imagination free and not giving up in the challenge to help others.

Credentials for Speech-Language Pathologists

With technology, the task of an SLP is changing. Technologies for digital speech recording and analysis are now readily available, as are new and exciting assistive technologies for those with great difficulty communicating via speech (Ingram et al., 2004). SLPs have a master's or doctoral degree and have studied typical communication and swallowing development; anatomy and physiology of the speech, swallowing, and hearing mechanisms; phonetics; speech and hearing science; and disorders of speech, language, and swallowing.

Three types of credentials are available for SLPs:

1. Public school certification normally stipulates basic and advanced coursework, clinical practice within a school setting, and a satisfactory score on a state or national examination. At the least, prospective school SLPs need a bachelor's degree, although in most states, a master's degree either is the entry-level requirement or is mandated after a certain number of years of

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BOX 1.2 | **A Speech-Language Pathologist Reflects**

For me, the exciting part of my job is the problem solving and the satisfaction of helping others. Similar to a fictional detective who collects all the clues, synthesizes the information, and deduces the guilty party, I evaluate each client and determine the best course of intervention. The more severe the impairment, the greater the challenge, and I love a challenge. How can I help a young man who attempted suicide and is now brain injured to access the language within him? How can a young child with autism begin the road through communication to language? How can I help parents communicate with their infant who has deafness, blindness, and cerebral palsy? When is the best time to introduce signing with a nonspeaking client? These are all challenges for me and the children and adults I serve. We work together as I try to solve each communication puzzle and propose and implement possible intervention strategies. Sometimes I'm very successful and sometimes I have to reevaluate my methods, but as I said, I love a challenge.

employment. The exact requirements to become a school SLP vary from state to state. ASHA encourages the same standards for SLPs in all employment settings, as described in the following paragraph.

2. ASHA issues a Certificate of Clinical Competence in Speech-Language Pathology (CCC-SLP) to an individual who has obtained a master's degree or doctorate in the field. Ongoing professional development must be demonstrated through a variety of continuing education options. Since 2004, the United States, United Kingdom, Australia, and Canada have allowed mutual recognition of certification in speech-language pathology (Boswell, 2004).

3. Individual states have licensure laws for SLPs that are usually independent of the state's department of education school certification requirements. A license is needed if you plan to engage in private practice or work in a hospital, clinic, or other setting apart from a public school. Most states accept a person with ASHA CCC-SLP as having met licensure requirements, although you will need to check with your state licensing board on the specifics.

Table 1.1 shows the credentials that are needed in the professions of audiology and speech-language pathology. These are also found on the ASHA website.

Thought Question

If you want to further explore a career in speech-language pathology, check out the ASHA website (www.asha.org). You'll find a wealth of information, as well as discussion of various disorders that affect children and adults who may benefit from the help of a SLP. Type in the disorder you wish to explore in the search box in the upper right. If you wish to read about a career as a SLP, click on "Careers" at the top left.

Speech, Language, and Hearing Scientists

Click here to check your understanding of the concepts in this section.

Individuals who are employed as speech, language, or hearing scientists typically have earned a doctorate degree, either a PhD or an EdD. They are employed by universities, government agencies, industry, and research centers to extend our knowledge of human communication processes and disorders. Some may also serve as clinical SLPs or audiologists.

TABLE 1.1

Credentials for speech-language pathologists and audiologists

Credentialing Organization	Speech-Language Pathologist	Audiologist
American Speech-Language-Hearing Association	Certificate of Clinical Competence in Speech-Language Pathology (CCC-SLP)	Certificate of Clinical Competence in Audiology (CCC-A)
State department of education	Certification as teacher of students with speech and language disabilities*	—
State professional licensing board	License as speech-language pathologist	License as audiologist

*The title for the school-based speech-language pathologist varies from state to state.

What Speech, Language, and Hearing Scientists Do

Speech scientists may be involved in basic research exploring the anatomy, physiology, and physics of speech-sound production. Using various technologies, these researchers strive to learn more about typical and pathological communication. Their findings help clinicians improve service to clients with speech disorders. Recent advances in knowledge of human genetics provide fertile soil for continuing investigation into the causes, prevention, and treatment of various speech impairments. Some speech scientists are involved in the development of computer-generated speech that may be used in telephone answering systems, substitute voices for individuals who are unable to speak, and many new purposes. Box 1.3 contains some observations by a speech-language scientist who enjoys the interdisciplinary nature of his work.

Language scientists may investigate the ways in which children learn their native tongue. They may study the differences and similarities of different languages. Over the past half a century or so, the United States has become increasingly linguistically and culturally diverse; this provides an excellent opportunity for cross-cultural study of language and communication. Some language scientists explore the variations of modern-day English (dialects) and how the language is changing. Others are concerned with language disabilities and study the nature of language disorders in children and adults. An in-depth knowledge of typical language is critical to understanding language problems.

Hearing scientists investigate the nature of sound, noise, and hearing. They may work with other scientists in the development of equipment to be used in the assessment of hearing. They are also involved in the development of techniques for testing the hard-to-test, such as infants and those with severe physical or psychological impairments. Hearing scientists develop and improve assistive listening devices such as hearing aids and telephone amplifiers to help people who have limited hearing. In addition, hearing scientists are concerned with conservation of hearing and are engaged in research to measure and limit the impact of environmental noise.

It's never too early to think about graduate school. Whether you eventually choose to become an audiologist, an SLP, or a speech, language, or hearing scientist, you will need advanced training. Consider cost, location, faculty, and practicum opportunities. Two websites can be helpful. The ASHA site (www.asha.org)

> The professions of speech-language pathology and audiology require lifelong learning. Clinicians need to be able to intelligently use relevant research findings in their practice.

Thought Question

BOX 1.3 | **A Speech-Language Scientist Reflects**

I work as a speech scientist and college professor specializing in voice science. In this profession I'm able to combine my love of communication with my interest in biology. As a student I hadn't realized the possibilities that would be open to me in this profession. I instruct students in the structure and functioning of the speech mechanism and in voice disorders. In the clinic, I use instrumentation to measure different parameters of voice. This enables me to objectify my diagnosis and provide accurate measurement of speech changes that may result from any number of disorders as varied as laryngeal cancer and neuromuscular dysfunction. I also work with transgender clients, helping them adopt a new voice. I love my work because it combines science and technology with speech-language pathology.

lists graduate program. Click on "Careers" to explore further. The Peterson's Guide site (www.petersons.com) can assist you with helpful advice about graduate school and a student planner. Type "speech-language pathology," "audiology," or "speech, language or hearing science" in the *Find the School That's Right for You* box at the upper right.

Professional Aides

Paraprofessionals usually have an associate's or bachelor's degree; they work closely with and are supervised by professionals with more training and experience.

Professional aides, sometimes referred to as paraprofessionals or speech-language pathology or audiology assistants, are individuals who work closely with SLPs or audiologists. In states in which professional aides are permitted, the title, educational requirements, and responsibilities of these individuals vary.

Speech-language pathology assistants (SLPAs) typically participate in routine therapy tasks, under the direction of an SLP. They may engage in clerical tasks and assist an SLP in the preparation of assessment and treatment materials. SLPAs may work alongside SLPs in many of the settings in which a fully credentialed SLP is found. Audiology assistants may conduct screenings, participate in calibration of audiological instrumentation, and engage in a variety of clerical tasks under the direction of an audiologist.

Support personnel may work only with supervision and are not permitted to perform such tasks as interpretation of test results, service plan development, family/client counseling, or determination of when to discharge a client from treatment (ASHA, 1995; Paul-Brown & Goldberg, 2001).

Related Professions: A Team Approach

Specialists in communication disorders do not operate in a vacuum. They work closely with family members, regular and special educators, psychologists, social workers, doctors and other medical personnel, and occupational, physical, and music therapists. They may collaborate with physicists and engineers. Box 1.4 contains a SLP's schedule, showing a tremendous amount of teamwork.

SERVICE THROUGH THE LIFESPAN

Individuals with communication and swallowing disorders may be of any age, and professionals address their needs from birth through old age. According to U.S. Census Bureau reports, 1 in 5 people has a disability. In general, the likelihood of having a disability increases as we age. Unfortunately, the total number of individuals in the United States who have speech, voice, and swallowing and/or language disorders is difficult to determine (ASHA, 2008).

Infants may be screened for hearing loss and a host of other disabilities soon after birth. The U.S. Census Bureau reports that about 2% of all children born in the United States have some existing disabling condition and that hearing loss occurs more often than any other physical problem (Brault, 2005). Babies and toddlers may exhibit developmental delay and have physical problems including those involving movement, hearing, and vision that may impact their communication and feeding abilities. All infants in the United States must be screened

BOX 1.4 | A Team Approach

Alicia is the senior speech-language pathologist in a community-based rehabilitation center in New York State. During the mornings, Alicia works with infants, preschoolers, and school-age children at the center. In the afternoons, she directs the Augmentative/Alternative Communication Program and assists severely impaired individuals of all ages to improve their communication abilities. The schedule outlined below has a bit more collaboration than is normally found in any one day, but it suggests the kinds of activities that are typical within a workweek.

8:30 A.M.	Education staff meeting for preschool children: classroom teacher, psychologist, social worker, occupational therapist, physical therapist.
9:00	Preschool class activity: eight children ages 3–4, one classroom teacher, two aides.
10:00	Individual half-hour therapy sessions with children in the preschool and school programs.
11:30	Combined physical and speech therapy for Jeramy, age 4, diagnosed with spastic cerebral palsy; work with physical therapist.
noon	Lunch
12:30 P.M.	Prepare for the afternoon.
1:00	Consult with engineer on wheelchair switch for Lucretia, age 7, who is multiply disabled.
1:30	Outpatient, David, aged 24, had been in a motorcycle accident and experiences some speech and language difficulties.
3:00	Conference with Sally Brown, Bettina's foster mother, and Barbara Sloane, the social worker for the family.
3:30	Communication Disorders Department meeting. Malcolm, an audiologist, reports on a 3-hour course he took on Saturday on cochlear implants.
4:30	The workday is officially over, but Alicia stays until 5:00 to read the professional journal *Language, Speech, and Hearing Services in the Schools,* which arrived today. Alicia is especially interested in the article about using children's books in working with preschoolers and photocopies it to share with other staff members.

for hearing loss. An interdisciplinary approach is necessary in the assessment and treatment of young children, and an Individualized Family Service Plan (IFSP), developed for each child treated, must be directed at the entire family, with sensitivity to that family's language and culture. Early intervention has been demonstrated to be highly valuable in facilitating optimum results and potentially preventing later difficulties.

Preschoolers with communication difficulties must also be identified and helped. For some, services begun earlier may now be handled by different agencies. The youngster may be placed in a special preschool, and professionals may continue to assist the family in addressing the child's needs.

Almost half of all SLPs are employed by school systems. They work with youngsters in all grades, addressing a full range of communication and swallowing problems. These are described in the chapters that follow. School-age children with communication difficulties often experience academic and social

difficulties, which add additional urgency to the work of communication experts. Some young adults, such as those who were identified earlier as being developmentally delayed or with physical disabilities, may continue to receive certain services until they are 21 years old.

Other individuals may find themselves in need of communication services for the first time later in life. For example, between 1.5 and 2 million Americans sustain traumatic brain injury each year in the United States (see Chapters 5 and 7) stemming from bicycle, motorcycle, or car accidents; falls; or firearms. As a result, they may have cognitive and/or motor problems that interfere with their ability to communicate and/or eat. The SLP plays an important role in rehabilitative efforts.

Thought Question

Among those over age 65, stroke, neurological disorders, and dementia may interfere with effective communication and swallowing. Hearing loss may affect at least one-quarter of people in this age group, creating a need for assessment and treatment. SLPs and audiologists work directly with such individuals. They often also work with spouses and children, as well as staff members of nursing homes and other adult facilities in providing counseling and guidance directed toward improving quality of life in these later years (Lubinski & Masters, 2001).

Evidence-Based Practice

As in other professions, SLPs and audiologists use evidence-based practice to provide the best services possible.

Throughout this text, we'll try to report the best information we can, based on the research evidence available. As an SLP or audiologist, if that is your career choice, it will be your responsibility to provide the best, most well-grounded intervention that is humanly possible. In other words, you should do what works and is most effective.

Deciding on the most efficacious intervention is a portion of something called evidence-based practice (EBP). EBP is an essential part of effective and ethical intervention. The primary benefit is the delivery of optimally effective care to each client (Brackenbury et al., 2008). Using EBP, clinical decision making becomes a combination of scientific evidence, clinical experience, and client needs. In other words, research, specifically the small portion of research directly relevant to decisions about practice, is combined with reason when making decisions about treatment approaches (Dollaghan, 2004).

EBP is based on two assumptions (Bernstein Ratner, 2006):

- Clinical skills grow not just from experience but from the currently available data.
- An expert SLP or audiologist continually seeks new therapeutic information to improve efficacy.

Professional journals, called peer-reviewed journals, in which each manuscript is critiqued by other experts in the field and accepted or rejected on the basis of the quality of the research, are the best source of clinical evidence.

The philosophy and methods of EBP originated in medicine but have now been adopted in many other health care professions and related services. In the fields of audiology and speech-language pathology, EBP is a work in progress. Although ASHA has established the National Center for Evidence-Based Practice in Communication Disorders, it will take years to establish comprehensive

assessment and intervention guidelines. Evidence on some key issues may still be weak or unavailable. In addition, new information may come to light through research that changes previous assumptions about that evidence. None of this relieves SLPs and audiologists of the responsibility to provide the best, most efficacious assessment and intervention possible. See the ASHA online resource at the end of the chapter.

In this discussion, we've used two terms: *efficacy* and *effectiveness*. These are sometimes difficult to discern, given the heterogeneous nature of the existing research studies, so it's important that you understand the generally accepted meanings of these terms from a clinical and research perspective. Technically, **efficacy** as it relates to clinical outcomes is the probability of benefit from an intervention method under ideal conditions (Office of Technology Assessment, 1978). There are three key elements to this definition:

- It refers to an identified population, such as adults with global aphasia, not to individuals.
- The treatment protocol should be focused, and the population should be clearly identified.
- The research should be conducted under optimal intervention conditions (Robey & Schultz, 1998). Of course, results in real-life clinical situations may differ somewhat.

Of interest is the therapeutic effect or the positive benefits resulting from treatment. The ideal treatment, then, would seem to be the one that results in largest changes to meaningful client outcomes, with only limited variability across clients (Johnson, 2006).

Unfortunately, in the fields of speech-language pathology and audiology, only a small percentage of the articles concern intervention efficacy. Making clinical decisions, therefore, is not particularly easy, especially given potentially competing claims, varying clinical expertise, and client values. Still, SLPs especially are tasked with determining which treatment approach is best for each client. It is also important for SLPs to recognize that efficacy is never an all-or-nothing proposition (Law et al., 2004; Rescorla, 2005).

Effectiveness is the probability of benefit from an intervention method under average conditions (Office of Technology Assessment, 1978). The effectiveness of treatment is the outcome of the real-world application of the treatment for individual clients or subgroups. In short, effectiveness is "what works." Valid clinical studies must be realistically evaluated for the feasibility of applying them to intervention with specific populations and individuals (Guyatt & Rennie, 2002).

One way of determining potential effectiveness, but not the only one, may be a clinical approach's reported **efficiency** (Kamhi, 2006a). Efficiency results from application of the quickest method involving the least effort and the greatest positive benefit, including unintended effects. For example, an unintended benefit of working to correct difficult speech sounds is that it improves the production of untreated easier sounds, although the reverse is not true (Miccio & Ingrisano, 2000). Targeting more difficult sounds would seem to be more efficient.

Other factors in decision making include the clinician's expertise and experience, client values, and service delivery variables. In addition to clinical experience and expertise, individual SLP factors such as attitude and motivation

are important. Clients vary widely and respond differently to intervention based on each client's unique characteristics, such as family history and support, age, hearing ability, speech and language reception and production, cognitive abilities, and psychosocial traits, such as motivation. Finally, service delivery factors include the targets and methods selected, the treatment setting, participants, and the schedule of intervention.

An SLP or audiologist must carefully discuss possible intervention options with a client and/or family, including an explanation of the research evidence. The goal is to provide sufficient information to enable the client and/or family to make an informed choice or to collaboratively plan and refine the options to suit the client and/or family preferences.

Making good clinical decisions is not always easy. High-quality evidence-based research must be evaluated critically by each SLP and applied to specific clients with specific communication disorders. EBP requires the judicious integration of scientific evidence into clinical decision making (Johnson, 2006). Although EBP can improve and validate clinical services, we must acknowledge that it can be difficult to incorporate into everyday clinical settings because of the time required for SLPs to comb through relevant research. In addition, evidence may be limited, contradictory, or nonexistent (Brackenbury et al., 2008). In the last analysis, however, the necessity of providing the best intervention services possible must be the foremost professional concern.

Thought Question

You can explore EBP further at two websites. The ASHA site (www.asha .org) describes EBP and offers guidance for clinical practice. Click on "Practice Management" to find the "Evidence Map" for the disorder you wish to explore. The National Institute on Deafness and Other Communication Disorders (NIDCD) site (www.nidcd.nih.gov) contains relevant health and research information.

COMMUNICATION DISORDERS IN HISTORICAL PERSPECTIVE

It is believed that many early human groups shunned less able individuals. They sometimes abandoned children who were malformed or who had obvious physical disabilities. Groups also often abandoned, deprived of food, or even killed aged people who could no longer contribute. There is also archaeological data to suggest that is some early cultures, those with physical disabilities were sometimes considered to have special powers.

Over the centuries, attitudes have changed somewhat. By the late 1700s in some parts of the world, societal efforts were being made to help those who were unable to care for themselves. Individuals began to be classified and grouped according to their disorder. Special residences for individuals with deafness, blindness, mental illness, and intellectual limitations were established, although most were little more than warehouses providing no services other than what was necessary to keep the residents alive (Karagiannis et al., 1996).

The first U.S. "speech correctionists" were educators and others in the helping or medical professions who took an interest in speech problems (Duchan, 2002). These were accompanied by a few "quacks" who promised curing therapies or drugs. The more legitimate therapists came from already established professions. Among them were Alexander Melville Bell and his father, Alexander Graham Bell,

of telephone fame. Other Americans trained with famous "speech doctors" in Germany and Austria or became interested in speech correction because of their own difficulties, often with stuttering. The first professional journal, *The Voice,* which appeared in 1879, focused primarily on stuttering research and intervention.

Early interest groups were formed primarily among teachers within the National Education Association and among physicians and academics belonging to the National Association of Teachers of Speech. The latter group formed the American Academy of Speech Correction in 1925, a precursor to ASHA, and attempted to promote scientific inquiry and to set standards for training and practice. ASHA has had varying names over the years; it finally settled on American Speech-Language-Hearing Association in 1978.

The profession of audiology originated in the 1920s, when *audiometers* were first designed for measuring hearing. Interest surged in the 1940s when returning World War II veterans exhibited noise-induced hearing loss due to gunfire or prolonged and unprotected exposure to noise. Others had psychogenic hearing loss as a result of trauma. The Veterans Administration provided hearing testing and rehabilitation.

Gradually, ASHA was able to establish professional and educational standards and to advocate for the rights of individuals with disabilities. During the 1960s in the United States and elsewhere, intense energy was directed toward the advancement of civil rights for all people. Just as the rights of women, ethnic minorities, gays, and lesbians have been and are being recast, the status of individuals with disabilities has been reevaluated, and bold reforms have been initiated. The American Coalition of Citizens with Disabilities was created in 1974; legislative action on behalf of all Americans with disabling conditions began in earnest around the same time. In many cases, people with disabilities occupied leadership roles in the push for change. As a result of this work, providing opportunities for individuals with disabilities to develop to their full potential was no longer simply an ethical position. It became federally mandated through a series of laws.

> A series of laws passed by the U.S. Congress over the past 50 years mandate appropriate treatment for individuals with disabilities.

Congress enacted the Education for All Handicapped Children Act (EAHCA) as Public Law 94–142 in 1975. It mandated that a free and appropriate public education must be provided for all children with disabilities between the ages of 5 and 21. Several years later, Public Law 99–457 extended the age of those served to cover youngsters between the ages of birth and 5 years. In 1990, Congress reauthorized the original law and renamed it the Individuals with Disabilities Education Act (IDEA). IDEA addressed the multicultural nature of U.S. society. The needs of English language learners (ELLs) and those from racial and ethnic minorities were targeted for special consideration. Reauthorized in 2004, IDEA established birth-to-6 programs as well as new early intervention services. ASHA has been a vital advocacy agency throughout this long legislative process.

> ✔ Click here to check your understanding of the concepts in this section.

SUMMARY

Speech-language pathologists, audiologists, and other specialists work together to assist those with communicative impairments. They work in a variety of settings and with people of all ages. They are rewarded by contributing to the well-being of others. Professionals who are engaged in clinical service for those with

communication disorders must have a master's or doctoral degree and supervised clinical experience. They have earned the American Speech-Language-Hearing Association Certificate of Clinical Competence (ASHA-CCC) in their area of specialization.

Services are provided to individuals from birth through advanced age. The American Speech-Language-Hearing Association (ASHA) is the largest organization of professionals working with communication disorders. ASHA's missions include the scientific study of human communication, provision of clinical service in speech-language pathology and audiology, maintenance of ethical standards, and advocacy for individuals with communication disabilities. As a result, federal legislation currently mandates services for people with disabilities.

SUGGESTED READINGS

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2

Communication: Means, Impairments, Intervention

CHAPTER LEARNING GOALS

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

- Explain the role of culture and environment in communication

- Describe what is involved in human communication

- Demonstrate how communication disorders may be classified

- Name some types of communication disorders

- Discuss and estimate the frequency of occurrence of communication disorders

- Describe in general the assessment and intervention process

HUMAN COMMUNICATION

The Social Animal

Possibly the worst punishment for a prisoner is to be sentenced to isolation. Discipline for a teenager might include limitations on texting or e-mail use. These restrictions are punitive because we humans are social beings. We have powerful drives to be with and to communicate with others.

What is **communication**? In general, we can say that communication is an exchange of ideas between sender(s) and receiver(s). It involves message transmission and response or feedback. We communicate to make contact or to reach out to others, and to satisfy our needs, to reveal feelings, to share information, and to accomplish a host of purposes. Communication is interactive; it is a give-and-take. The importance of effective communication is highlighted when it fails or is hindered in some way. Think about how frustrated you get by a temporary lapse in Internet or cellphone service. Now imagine that as a permanent or semipermanent state.

Several variables affect communication and its success or failure. These include cultural identity, setting, and participants to name a few. The study of these influences on communication is called **sociolinguistics.**

It is axiomatic to say "We cannot *not* communicate" (Watzlawick et al., 1967, p. 48). Even a lack of response to someone sends a message to "leave me alone."

Cultural Identity

Each of us is a member of a language community. The more you understand about your own culture and that of the people with whom you communicate, the more effective your interaction will be. If this text were written in perfectly good Mandarin Chinese and you could not read that language, it would communicate nothing meaningful to you. Speakers and listeners must share competence in a common language if they are to communicate fully.

Perhaps you have traveled to a country in which a language that you did not know was spoken. You might have been able to communicate by gesture and pantomime; however, you would have to agree that while you could exchange some meaning, it fell far short of optimal communication. Even when two people come from the same language background, "perfect" communication is rare. This is because successful communication depends not just on language and speech but on related factors, such as age, socioeconomic status, geographical background, ethnicity, gender, and ability.

The location and the participants also influence the nature of communication. Where you interact affects how and what you'll say. You communicate differently at home, in school, in a noisy restaurant, and at a ballgame. Similarly, you might speak quite differently to your best friend, your mother, your father, your boss, your grandmother, and large audiences.

Thought Question

Means of Communication

As noted in Chapter 1, communication takes many forms and can involve one or a combination of our senses, including sight, hearing, smell, and touch. It can include both verbal and nonverbal means, such as the spoken or written word, naturalistic gesture, or sign. The primary vehicle of human communication is language, and speech is the primary means of language expression for most individuals.

Language

Language is a socially shared code that is used to represent concepts. This code uses arbitrary symbols that are combined in rule-governed ways (Owens, 2012). Some characteristics of language are that it is:

- A socially shared tool
- A rule-governed system
- An arbitrary code
- A generative process
- A dynamic scheme

Language is a social tool for relating to others and for accomplishing a variety of objectives. As pointed out earlier, others must share the language code if communication is to occur. When an infant utters "ga da da ka," we cannot call this language because this "code" is not shared.

Many people are so accustomed to their own language that they fail to recognize its arbitrary nature. Is there anything in the sound combination or the written letters of the word *water* that resembles the wet stuff? Is the French word *l'eau* or the Italian *l'acqua* any more or less moist? A comparison of different languages rapidly confirms this very arbitrary nature. The equivalent of the English word *butterfly* is *farfalla* in Italian, *mariposa* in Spanish, and *Schmetterling* in German—four very different renditions of that graceful creature. Some words have no equivalent in other languages. For example, the Spanish word *salsa* has no one-word English equivalent.

Each language, in addition to being composed of arbitrary but agreed upon words, consists of rules that dictate how these words are arranged in sentences. In English, an adjective precedes a noun; for example, we say, "brown cow." In French, as in many other languages, this sequence is reversed, and they say, "le vache brun" ("the cow brown"). The rules of a language make up its **grammar**. Interestingly, you do not have to be able to explain the rules to recognize when they have been broken. Take, for example the sentence "The leaves of the maple green tree in the breeze swayed." You know that the sentence is wrong and that it doesn't sound right. This recognition of "wrong" and "right" grammar is called **linguistic intuition**, and native speakers of a language possess this intuition.

Language is **generative**; this means that each utterance is freshly created. As a speaker, you don't just quote or repeat what you heard before. Instead, you present your own ideas in an individual way. Imagine a conversation if all you could do was imitate your conversation partner.

Languages are also **dynamic**; they change over time. The famous Academie Française has tried to keep French "pure" and true to its origins. The Academie still attempts to keep "foreign" words from infiltrating French. For example, it has tried to ban the English words "jet" and "drugstore." But "le jet" is apparently easier to use than the French "l'avion à réaction," and so it stays. No academy, no school, no law, and no army can keep languages from being modified. American English adds five or six new words each day, many from other languages. Pronunciation, grammar, and ways of communicating also change.

Parents often assume that their infant's earliest "ma ma" or "da da" are uttered in reference to themselves. These sound combinations are not considered true words unless there is evidence that they are used meaningfully.

Figure 2.1 Components of language.
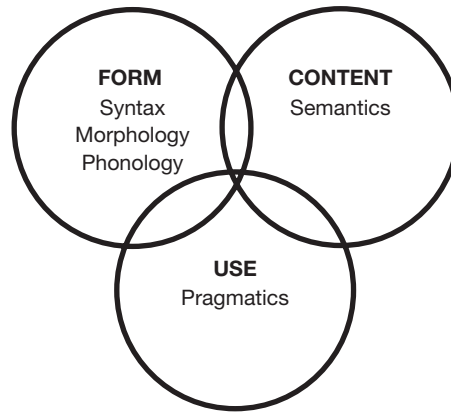
All human languages consist of similar basic ingredients. The primary components have been labeled form, content, and use. See Figure 2.1.

Form   Form consists of phonology, morphology, and syntax. **Phonology**, or the sound system of English, consists of about 43 phonemes (unique speech sounds). Although different languages use many of the same phonemes, variations exist. Spanish and German, to name only two, do not use the English "th." As a consequence, because this sound is not learned as a child, it is difficult for some nonnative English speakers to produce.

Speech sounds are not combined arbitrarily. **Phonotactic** rules specify how sounds may be arranged in words. Like rules of grammar, phonotactic rules are not universal. For example "k" and "n" cannot be blended in spoken English, although this combination is acceptable in German. For this reason the "k" in "knife" and "Knoxville" is silent for native English speakers but might be pronounced by Germans speaking English as a second language.

Morphology, the second aspect of form, involves the structure of words. A **morpheme** is the smallest grammatical unit within a language. Words contain both **free morphemes** and **bound morphemes**. A free morpheme may stand alone as a word. For example, *cat, go, spite, like,* and *magnificent* are all free morphemes. If you attempt to break them into smaller units, you lose the meaning of the word. In contrast, *cats, going, spiteful, dislike,* and *magnificently* each contain one free morpheme and one bound morpheme. The bound morphemes *-s, -ing, -ful, dis-,* and *-ly* change the meanings of the original words by adding their own meanings but cannot be used alone and must be attached to free morphemes.

Syntax pertains to how words are arranged in a sentence and to the ways in which one word may affect another. In an English declarative sentence, the subject comes before the verb: "John is going to the opera." When we reverse the order of the subject and the auxiliary or helping verb, we change the meaning of the sentence and end up with a question: "Is John going to the opera?" One word can also change another. We say "I walk" but "She walks." The *s* on the verb occurs because of the pronoun *she*. This also occurs with *he, it,* and singular nouns, such as *puppy*.

Content   Because language is used to communicate, it must be about something, and that is its content, meaning, or **semantics**. **Semantic features** are the pieces of meaning that come together to define a particular word. For example, *girl* and *woman* share the semantic features of *feminine* and *human,* but *child* is generally considered a feature in *girl* and not in *woman*. You'll notice that we said "generally" because, although most of us think of a girl as being young, it is common among some groups of people to refer to any woman as a "girl." Each word has multiple meanings, as you can quickly verify by looking in the dictionary. It is the other aspects of language, such as use and form, that determine which of these definitions is appropriate in context.

Use   If you are beginning to think that this is complicated, you're right. As we said earlier, social and cultural factors influence the way language is used. Use, or **pragmatics**, is the driving force behind all aspects of language. We speak for a reason. It is the purpose of our utterance that primarily determines its form and content. For example, if you are with a friend and are hungry, you might say, "Let's get something to eat." If the purpose were a simple biological drive, then "eat" grunted out might suffice. But who and where you are, whom you are with, and the time of day also influence what you say. If you are at your home, and you have invited a friend to dinner, you might say, "Dinner is ready." If you are working with someone as noon approaches, you might suggest, "Let's break for lunch."

> While all are important, it is the use or purpose of communication that dictates form and content.

Pragmatic rules vary with culture. For example, in the United States, business meetings tend to be very task oriented. Very little time is spent on social exchanges; the work to be done has center stage. In Saudi Arabia, however, when two people meet for the first time for business purposes, they might spend the entire session talking about family and friends and not get to the meat of the business until the second meeting. The rules for business conversations in each of these societies are different. A few general rules for speakers of American English are presented in Figure 2.2.

Speech

Speech is the process of producing the acoustic representations of language. Features such as articulation, fluency, and voice interact to influence speech production. The final product reflects the rapid coordination of movements associated with each of these features.

Figure 2.2 A sampling of pragmatic rules for speakers of American English.

1. Only one person speaks at a time. Each person should contribute to the conversation.
2. Speakers should not be interrupted.
3. Each utterance should be relevant.
4. Each speech act should provide new information.
5. Politeness forms reflect the relationship of the speakers.
6. Topics of conversation must be established, maintained, and terminated.
7. The speaker should be sensitive to successfully communicating the message, avoiding vagueness and ambiguity.
8. The listener should provide feedback that reflects comprehension of the message.

Articulation   Articulation refers to the way in which speech sounds are formed. How do we move our tongue, teeth, and lips to produce the specific phonemes of a language? How do we combine these individual sounds to form words? After all, we don't speak in a series of isolated sounds such as "h-e-ll-o," or we'd sound like robots. Chapter 8 explains the nature of speech sound production and describes the problems that may occur.

Fluency   **Fluency** is the smooth, forward flow of communication. It is influenced by the rhythm and rate of speech. Every language has its own rhythmic pattern, or timing. Do we pause after each word that we speak? Do we pause after each sentence? If we do, how long do the pauses last? What is our phrasing? You'll note that timing is not an isolated feature of speech. A word or syllable that is held tends to be emphasized and said more loudly. A skilled storyteller uses pauses and rhythmic variations for dramatic effect.

The speed at which we talk is our **rate**. Overall rate can reveal things about us. It may provide clues about where we come from. For example, people from New York usually speak more rapidly than those from Georgia. However, if you habitually speak very quickly, it may suggest that you are in a hurry, are impatient, or have a great deal to say. By contrast, slow speech may connote a relaxed or casual personality.

The component of speech that includes rate and rhythm is referred to as *prosody*. Prosodic features are known as suprasegmentals. *Supra-* means "above" or "beyond," so suprasegmental features go beyond individual speech sounds (or segmental units) and are applied to whole phrases or sentences. Stress and intonation are also suprasegmental features of speech production that are discussed later in this chapter.

Although most of the time we attempt to use a clear, sufficiently loud voice, sometimes our meaning may be more effectively communicated by a whisper, a whine, or a throaty rasp. When you are upset, your voice might sound angry to the point where someone says, "Don't use that tone of voice with me." Clearly, tone communicates information.

Voice

Voice can reveal things about the speaker as well as about the message. A woman with a hoarse voice might (correctly or not) communicate to others that she smokes. A person with a soft, high-pitched voice might be communicating youth or immaturity. A deep, throaty voice might connote masculinity or authority.

Both the overall level of loudness and the loudness pattern within sentences and words are important. A generally loud voice may communicate strength; a soft one may suggest timidity. By stressing different words within a sentence, you are also conveying different meanings. Say the following sentence in each of the ways listed here, with the emphasis or increased loudness on the underlined word. Notice how the meaning changes:

I got an "A" on my Physics final.

I got an "A" on my Physics final.

I got an "A" on my Physics final.

I got an "A" on my Physics final.

Placing the stress on different syllables within certain words also changes the meaning. Stressed syllables often have long vowels, as in the first word in each of the following pairs:

record/re<u>cord</u>

recess/re<u>cess</u>

present/pre<u>sent</u>

You might have noticed that as you vary the stress, the pitch, duration, and pronunciation of different speech sounds may also change. The pitch tends to go up as the loudness is increased. Similarly, you are likely to prolong the syllable that receives stress.

Pitch is a listener's perception of how high or low a sound is; it can be physically measured as frequency or cycles per second, called hertz. **Habitual pitch** is the basic tone that an individual uses most of the time. Women usually have higher-pitched voices than men, and children have higher voices than adults of both sexes. So our habitual pitch tells something about who we are.

Pitch movement within an utterance is called **intonation**. A rising intonation turns a statement into a question. First say the following sentence by bringing your pitch down for the last word and then say it by raising your pitch at the end:

She wants to do the dishes.

You'll notice that intonation influences meaning. You should also observe that as you alter intonation, your rhythm and loudness patterns also change.

Nonverbal Communication

Although most humans rely heavily on spoken communication, some researchers report that about two thirds of human exchanges of meaning take place nonverbally. The term *nonverbal* encompasses both the suprasegmental aspects of speech that we described in the previous section and the **nonvocal** (without voice) and nonlinguistic (nonlanguage) aspects of communication.

Artifacts   The way you look and the way you have decorated your personal environment communicate something about you. Even the car you drive can deliver a message. One young man we know impressed a woman on their first date by correctly selecting her car out of 30 in a parking lot. He did this by evaluating the make and year as well as the items on the seat and dashboard. If you walk into the best hotel in your area dressed in a business suit and ask for the rest room, you will be treated better than if you are wearing shabby jeans and look unkempt. People make assumptions about our personalities and trustworthiness on the basis of our possessions, clothing, and general appearance.

Music, art, architecture, and furniture are also artifacts that communicate. They communicate messages from the artists who designed and produced them and also from the people who purchase, patronize, or in some way support them.

Kinesics   **Kinesics** refers to the way we move our bodies, or *body language*. This includes overall body movement and position as well as gestures and facial expression. Although there is some overlap with signing, gesturing typically lacks **explicit** (clearly defined) movements. In signing, the meanings of particular

The symbols /ɛ/, /ə/, and /l/ represent phonemes, or speech sounds to be described in more detail in Chapter 9.

Punctuation and font type and size may contribute to the meaning of an e-mail. A century ago, perfumed letter paper modified the written word.

movements are well specified. For example, in American Sign Language (ASL), a thumb stroke down the cheek means "girl." Kinesics tend to be more general, subtle, or **implicit**. Gestures such as a "brush-off" have explicit meanings, and they support and contribute to the larger speech system. By contrast, signing is a primary means of communication used by many people who have deafness. ASL is described in greater detail in Chapter 12 and Chapter 13.

Speech-language pathologists recognize the heterogeneous nature of the U.S. population and strive to be sensitive to both verbal and nonverbal variations.

Space and Time   The study of the physical distance between people as it affects communication is called **proxemics**. Proxemics not only reflects the relationship between people but is also influenced by age and culture. Infants, children, people from Middle Eastern and Latin cultures, and those with strong emotional attachments, such as lovers, tend to interact in intimate or close proximity, very near one another. One young U.S. student we know reported feeling "backed into a corner" by a female exchange student from Spain whom he had just met at a social gathering. It is possible that the Spanish woman felt that the American was "too distant."

Tactiles are touching behaviors. Who touches whom and how and where on the body the touch occurs can reveal a great deal. For example, some friends hug and kiss, others shake hands, and still others simply greet with a smile and a nod. A touch may convey "I understand," "I'm sorry," or "Good luck." Children in our society learn that touching others is usually not appropriate and are told early on to "keep your hands to yourself." In contrast, infants' earliest interactions normally include considerable parental and caretaker touch.

Chronemics is the effect of time on communication. Again, cultural and age factors influence this nonvocal aspect of communication. People from German and Scandinavian backgrounds tend to be exactly prompt, while those from Latin and African cultures may permit greater time flexibility. When two individuals come from cultures with different time rules, conflicts can easily arise. Status and context also affect chronemics. You might be kept waiting at the doctor's office, but your doctor does not expect to have to wait for you. Promptness is part of the U.S. work ethic. If you are routinely late to class or to a job, you've violated a chronemic norm and might have to pay a price in terms of a lowered grade or lost employment.

Age, sex, education, and cultural background influence every aspect of communication. These variations in communication are not impairments. Differences reflect regional, social, cultural, or ethnic identity and are not a disorder of speech or language. Table 2.1 offers a sampling of typical communication features at different life stages. We describe communication impairments in the next section.

COMMUNICATION THROUGH THE LIFESPAN

The most complex and challenging task newborns face is learning the abstract code called language that those around them use to communicate. To do this, infants must first learn the rudiments of communication and begin to master the primary means of language transmission, called speech. The early establishment of communication between children and their caregivers fosters the development of speech and language, which in turn influences the quality of communication. This intricate pattern is further complicated by physical, cognitive, and social

TABLE 2.1

A lifespan view of typical communication

Age Range	Receptive Communication	Expressive Communication								
		Language			Speech		Voice	Artifacts	Nonverbal Communication	
		Form	Content	Use	Articulation	Fluency			Kinesics	Space/Time
Infancy	Quiets/turns to human voice; Distinguishes speech sounds	Prelinguistic sound-making	No "true" speech; vocalizations, body movement focus on here and now	Obtain assistance; imitate, respond to others	Gurgles, coos, babbles	Rhythm and rate begin to resemble that of surrounding language toward end of year	Varies volume, rate, pitch	Toys, materials given to child, may "give" objects to others	Gestures precede meaningful spoken language	Close proximity/immediacy
Toddler	Responds to some verbal commands	Vocabulary growth from 4 to 300 words; moves from single word to short utterances	Familiar names, actions	Imitate, greet, protest, question	Simplified phonology		High (childish) pitch, more variability than adults	Toys, begins to construct things, start of imaginary play	Gestures slowly take second place to spoken language	Proximity decreases, begins to comprehend "now" and "later"
Preschool	Comprehension far exceeds expression; enjoys stories, books; follows increasingly complex commands; comprehends simple humor	Vocabulary grows from 1,000 to more than 2,000 words; uses complete sentences	Immediate to imaginary; includes past, present, and future	Greet, request, protest, inform, pretend, entertain	Almost all speech sounds correctly produced by the end of this period	Part-word, whole word, and phrase repetition not uncommon	Adjusts to listener; often used effectively to enhance verbal communication	Tremendous variability, reflects social/cultural background	Gestures used to enhance verbal communication	Begins to understand personal space

TABLE 2.1
(Continued)

Age Range	Receptive Communication				Expressive Communication					
		Language			**Speech**				**Nonverbal Communication**	
		Form	**Content**	**Use**	**Articulation**	**Fluency**	**Voice**	**Artifacts**	**Kinesics**	**Space/Time**
School-age	Reading skills improve; receptive language grows to 50,000 words by sixth grade, 80,000 words end of high school; comprehension becomes adult-like	Vocabulary grows to 25,000 to 30,000 words; slang important; written language more complex than spoken language	Very broad, includes distant as well as near and abstract concepts	Many enjoy talking, sharing thoughts, raising and answering personal as well as abstract questions; narrative skills expand	Speech sounds correctly produced	Rate may be rapid, fluency is good	Pitch drops to adult levels with puberty, voice used to supplement verbal message	Clear indication of what is wanted, reflect peer group, gender	Gestures used in wide array of means to supplement speech	Becomes territorial, mature understanding of space and time
Early and middle adulthood	Comprehension increases	Education and occupation may be reflected in vocabulary	Full range of topics; written language continues in importance and sophistication	Instructing, directing others may be added if not there earlier	Mature articulation	Use of rhythm and rate to enhance message	Mature pitch, full-bodied vocal quality	Tremendous variety dependent on sociocultural and individual variables	Body movement and gesture continue to supplement verbal communication	Space may reflect relative "importance" in environment as well as cultural factors
Advanced age	Comprehension may decrease	Vocabulary may reflect "older" generation	May focus more on past than future	May have limited communication partners, speech may be major way to achieve companionship	Normally not impaired	Rate may slow	Pitch may increase, vocal quality may become "thinner"	Old/familiar items may become increasingly treasured	Body movement may be less forceful	May crave touch, as significant others become less available

Sources: Information from Owens (2012) and Shadden & Toner (1997).

Note: This is a sampling of communication behaviors. Variability within each age group is the norm.

development as children mature. We can go even further and suggest studies in several languages which reveal that language proficiency is critical to development of higher cognitive skills, even nonverbal ones (Oller et al., 2001).

The key to becoming a communicator is being treated as one. Although both speech and language depend on physical and cognitive maturation, neither is sufficient to account for the rapid developments in children's communication. Most linguists would also agree that language has strong biological underpinnings, although this too is an insufficient explanation in itself of the language learning process.

The process of learning speech and language is a social one that occurs through interactions of children and the people in their environment. Speech and language are learned within routines and familiar activities that shape children's days and within conversations about food, toys, and pets and later about school, social life, and the like. As listeners, we use a variety of lexical, syntactic, and stress-pattern cues flexibly to break continuous speech into more readily interpretable chunks (Sanders & Neville, 2000).

In different cultures, the type of child–caregiver interaction, the model of language presented to the child, and the expectations for the child differ, but each is sufficient for the learning of language. Learning to become an effective communicator is a dynamic and active process in which children in our culture become involved in the give-and-take of conversations. Even the more formal educational processes of learning to read and write are initially social and occur within book-reading activities in the home involving children and caregivers.

Every person's speech and language continue to change until the end of life. Communication reflects the changes occurring in us and around us. Even the means of communication can change. Your great-grandparents might have begun life without a telephone and had to learn this new means of communication. Your grandparents probably began life without television. We, the authors, had to learn to use computers to communicate when we were well into our adult lives. You, in contrast, grew up with the Internet and cellphones. Many preschoolers now have tablets and Kindles.

> Communication is established very early between child and caregiver.

Languages change, too. New words and phrases have entered American English within your lifetime, such as *Internet, Blu-ray disc, iPod, smartphone, texting, hip-hop,* and *hybrid vehicle.* Other cultures and languages have contributed *mullah, sushi, bodega,* and *tsunami*. A competent communicator continues to adapt to changes in the language and in the communication process.

> Children become communicators because we treat them as if they already are.

COMMUNICATION IMPAIRMENTS

> ✔ Click here to check your understanding of the concepts in this section.

Now that you have an idea of the complexity and varied nature of communication, it should be easy to see that much can go wrong. Let's expand on what we discussed in Chapter 1. We can further define communication disorders as consisting of disorders of speech (articulation, voice, resonance, fluency), oral neuromotor patterns of control and movement, language impairment, feeding and swallowing disorders, cognitive and social communication deficits, and hearing and processing difficulties. Notice that this definition does not confine itself to speech and hearing but also includes reading and writing, as well as manual (or sign and gestures) and other communication systems, in addition to processes such as swallowing and balance that share anatomy and physiology

with parts of the communication mechanism. That's a lot! Communication disorders may be categorized on the basis of whether reception, processing, and/or expression is affected. Is the problem primarily one of hearing, comprehending and manipulating language, or speaking? In fact, the three dimensions may be intertwined, reflecting the integration of the processes of speech, language, and hearing. Figure 2.3 presents various systems for categorizing communication disorders. The American Speech-Language-Hearing Association (ASHA) website (www.asha.org) discusses various disorders that affect children and adults who may benefit from the help of a speech-language pathologist (SLP). Type in the disorder you wish to explore in the search box in the upper right.

Etiology, the cause or origin of a problem, may be used to classify a communication problem. Disorders may be due to faulty learning, neurological impairments, anatomical or physiological abnormalities, cognitive deficits, hearing impairment, or damage to any part of the speech system.

Sometimes a dichotomy is made between **congenital** and **acquired** problems. Congenital disorders are present at birth; acquired ones result from illness, accident, or environmental circumstances anytime later in life. Finally, disorders may range from borderline or mild to profoundly severe.

As mentioned in Chapter 1, variations in communication are not impairments. Communication **dialects** are differences that reflect a particular regional, social, cultural, or ethnic identity and are not disorders of speech or language. Likewise, differences found in the speech and language of English language learners (ELLs) are not disorders.

In this text, we provide a **holistic** approach to diagnosis and treatment of people with communicative impairments. We have separate chapters that discuss speech characteristics such as voice, fluency, and phonology, and we also provide chapters that are organized on the basis of etiology such as neurogenic and craniofacial disorders. Within each chapter, we examine the interconnectedness of age, time of onset, social and cultural factors, and cause of the presenting disorder, and we describe evidence-based assessment and treatment practices. We observe that it is common for an individual who demonstrates difficulties with

Speech-language pathologists are concerned with both verbal and nonverbal disorders of communication.

Figure 2.3 Possible classification of speech communication disorders.

Reception	Expression	Etiology	Time of Onset	Severity
Hearing Acuity:	*Speech:*	Neuromotor	Congenital	Borderline
Conductive	Articulation	abnormalities	Acquired	Mild
Sensorineural	Fluency	Hearing impairment		Moderate
Mixed	Voice	Environmental/learning		Severe
Auditory Processing:	*Language:*	factors		Profound
Decoding	Form	Cognitive deficits		
Integration	Phonology	Anatomical or		
Organization	Morphology	physiological		
Understanding speech	Syntax	impairments		
under adverse	Content			
conditions	Vocabulary			
Short-term memory	Use			
Multiple categories	Pragmatics			

one aspect of communication to be affected in other areas as well. We demonstrate that differences and dialects do not constitute disorders, and we examine the sometimes perplexing contrast between "typical" and "impaired."

Language Disorders

Disorders of Form

As explained earlier, language form includes phonology, morphology, and syntax. We speak in sounds (phonemes) that are combined into words (morphemes), which in turn are combined into phrases and sentences (based on syntactical rules). Errors in sound use, such as not producing the ends of words ("hi shi i too sma" for "his shirt is too small"), constitutes a disorder of phonology. Incorrect use of past tense or plural markers ("the girl wented home" for "the girls went home") is an example of a disorder of morphology. Syntactical errors include incorrect word order and run-on sentences (for example, "I want to go mall and go skate and buy peanuts and you come with me 'cause I want you to but not Jimmy 'cause he's not big enough to go skate"). These errors in school-age children may affect academic achievement and social well-being.

Disorders of form may be due to many factors, including sensory limitations such as hearing problems or perceptual difficulties such as learning disabilities. Limited exposure to correct models may also hinder a child's language development. For many children who are delayed in their production of mature language forms, the cause is not apparent. Patterns that seem like errors at first are sometimes a reflection of a particular speech dialect. An SLP must distinguish between dialectal variations, which do not signify impairment, and disorders.

Disorders of Content

Children and adults with limited vocabularies, those who misuse words, and those with word-finding difficulties may have disorders of content or semantics. Similarly, limited ability to understand and use abstract language, as in metaphors, proverbs, sarcasm, and some humor, suggests semantic difficulties. A persistent pattern of avoiding naming objects and referring instead to "the thing" is another indication of a disorder of content. Although limited experience or a concrete learning style may contribute to this problem in youngsters, among older people, cerebrovascular accidents (strokes), head trauma due to accidents, and certain illnesses may result in word-retrieval problems and other content-related difficulties.

Disorders of Use

Pragmatic language problems may stem from limited or unacceptable conversational, social, and narrative skills; deficits in spoken vocabulary; and/or immature or disordered phonology, morphology, and syntax. Examples of impaired pragmatic language skills might include difficulty staying on topic, providing inappropriate or incongruent responses to questions, and constantly interrupting the conversational partner. Culture, group affiliations, setting, and participants described earlier in this chapter play a major role in judgments regarding pragmatic competence.

It is not uncommon for an individual to have an impairment in more than one aspect of communication.

Speech Disorders

Disorders of speech may involve articulation (the production of speech sounds), fluency (rhythm and rate), or **voice** (pitch, loudness, and quality). They may affect people of all ages, be congenital or acquired, be due to numerous causes, and reflect any degree of severity.

Disorders of Articulation

Production of speech requires perception and conceptualization of the speech sounds in a language as well as motor movements to form these sounds in isolation and in context. You must have both a mental/auditory image of the sound you are going to say and the neuromuscular skills to produce the sound. The cognitive and theoretical concepts of the nature, production, and rules for producing and combining speech sounds in language is known as *phonology*. The actual production of these sounds is called **articulation**.

It is not always easy to determine whether an individual's speech-sound errors indicate an impairment of phonology, which is a language problem, or articulation, which is a speech disorder. To sort this out, SLPs identify the phonemes that are incorrectly produced and look for error patterns that may point to phonological disturbances. The sound system of a language is usually fully in place by age 7 or 8. Children with multiple speech-sound errors past age 4 may have *phonological* difficulties. The causes are often not known but may result from faulty learning due to illness, such as ear infections, hearing or perceptual impairments, or other problems in the early years.

An SLP is interested in a client's ability to move the structures needed in speech, such as the jaw, lips, and tongue. The causes of articulation disorders include neuromotor problems such as cerebral palsy, physical anomalies such as cleft palate, and faulty learning. When paralysis, weakness, or poor coordination of the muscles for speech result in poor speech articulation, the disorder is called **dysarthria**. Apraxia of speech also results in poor articulation due to neuromotor difficulties; however, the difficulty appears to be in programming the speech mechanism, while muscle strength is normal. Dysarthria and apraxia can affect both children and adults. Assessment and treatment of phonological and articulatory disorders are described in Chapter 10.

Disorders of Fluency

As we described earlier, fluency is the smooth, uninterrupted flow of communication. Certain types of fluency disruptions are fairly common at different ages. For example, many 2-year-olds repeat words: "I want-want-want a cookie." Around age 3, youngsters often make false starts and revise their utterances: "Ben took . . . he broked my crayon." Because these speech patterns are so common, they are sometimes referred to as **developmental disfluency**. Typically fluent adults occasionally use **fillers** ("er," "um," "ya know," and so on), **hesitations** (unexpected pauses), **repetitions** ("g-go-go"), and **prolongations** ("www-well"). However, when these speech behaviors exceed or are qualitatively different from the norm or are accompanied by excessive tension, struggle, and fear, they may be identified as **stuttering**. Appropriate diagnosis and intervention when warranted are the task of an SLP (Yairi et al., 2001).

Fluency disorders are generally first noticed before 6 years of age. If remediation efforts are not made or are unsuccessful, this condition might continue

and even worsen by adulthood. Adult onset of disfluency also occurs. Advancing age, accidents, and disease can all disrupt the normal ease, speed, and rhythm of speech. The causes of nonfluent speech are typically unclear; this is explored further in Chapter 7.

Voice Disorders

As in other areas of speech, voice matures as a child gets older. From uncontrolled cries to carefully modulated whispers, shouts, and variations in pitch, the development of voice follows a predictable pattern. Although occasionally children are born with physiological problems that interfere with normal voice, more common is the pattern of **vocal abuse**. It is characterized by excessive yelling, screaming, or even occasional loud singing that results in **hoarseness** or another voice disorder.

Habits such as physical tension, yelling, coughing, throat clearing, smoking, and alcohol consumption can disrupt normal voice production. These behaviors may result in pathology to the vocal folds such as polyps, nodules, or ulcers. Disease, trauma, allergies, and neuromuscular and endocrine disorders may also affect voice quality. For example, individuals with Parkinson's disease, a progressive neurological disorder, may have a soft voice with limited pitch and loudness variation.

Hearing Disorders

A hearing disorder results from impaired auditory sensitivity in the auditory or hearing system. It may affect the ability to detect sound, to recognize voices or other auditory stimuli, to discriminate between different sounds, such as mistaking the phoneme /s/ for /f/, and to understand speech.

Deafness

When a person's ability to perceive sound is limited to such an extent that the auditory channel is not the primary sensory input for communication, the individual is considered to have deafness. Deafness may be congenital or acquired.

Total communication, including sign, speech, and speechreading, is often considered the most effective intervention for deafness. **Assistive listening devices (ALD)**, **cochlear implants**, and **auditory training** may be helpful. These are explained in Chapter 12.

Hard of Hearing

A person who is hard of hearing, in contrast to one who is deaf, depends primarily on audition for communication. Hearing loss may be temporary due to an illness, such as an ear infection, or permanent, caused by disease, injury, or advancing age. Hearing loss is usually categorized in terms of severity, laterality, and type. The severity of a hearing loss may range from mild to severe. It may be **bilateral**, involving both ears, or **unilateral**, affecting primarily one ear. Finally, the loss may be **conductive**, **sensorineural**, or **mixed**. A conductive loss is caused by damage to the outer or middle ear; people with this type of loss usually report that sounds are generally too soft. A sensorineural loss involves problems with the inner ear and/or auditory nerve; this type of damage is likely to affect a person's ability to discriminate and consequently understand speech sounds, although they may "hear" them. A typical pattern is older people reporting that they hear just fine but wish others would not mumble. Mixed hearing loss, as the

Speech-language pathologists use several indices to differentiate developmental disfluency from early stuttering.

Universal neonatal hearing screening is mandated by law in many states. In this way, congenital deafness can be identified and addressed very early.

name implies, is a combination of both conductive and sensorineural loss (see Chapter 12 for further discussion).

Auditory Processing Disorders

An individual with an auditory processing disorder (APD) may have normal hearing but still have difficulty understanding speech. Individuals with APDs struggle to keep up with conversation, understand speech in less-than-optimal listening conditions (i.e., degraded speech signal, presence of background noise), discriminate and identify speech sounds, and integrate what they hear with non-verbal aspects of communication (DeBonis & Moncrieff, 2008). These difficulties are sometimes traced to tumors, disease, or brain injury, but often the cause is unknown. APD can occur in both children and adults. A special battery of auditory diagnostic tests is used to determine or rule out APD; however, there is currently no "gold standard" to ensure correct identification of the disorder (McFarland & Cacase, 2006). APD may coexist with other disorders, including attention-deficit/hyperactivity disorder (ADHD) and speech-language and learning disabilities (ASHA, 2005c).

Thought Question

How Common Are Communication Disorders?

Before we attempt to estimate the numbers of people who have disorders of communication, we examine the concepts of normalcy and patterns of disability.

What Is "Normal"?

A recent cartoon showed an empty room and a sign reading "Meeting of Members of Functional Families." The implication was that there are no functional, or "normal," families. Likewise, we could ask, "Is anybody normal?" If anything, variability is the norm. We humans are remarkable in our diversity. Just as no two snowflakes are identical, no two individuals, even twins, are exactly alike. Our faces, fingerprints, and manner of communication are unique.

The bell-shaped normal curve graphs measurements that are used to distinguish those who are average from those who perform above and below others of the same population (see Figure 2.4). Many language tests use a scoring system comparable to IQ scores, called *standard scores*. Most people (a little over 68% of those tested) will have scores that cluster around the mean or average score and would be considered "normal" or "average." Higher or lower scores are above or below average. An individual performing in the lowest 5% to 10% would have a score considered to be significantly below average.

Because the word *normal* suggests "without problems," we prefer to use the term *typical* when we mean "like most others of the same age and group." Classifying people on the basis of statistical percentage is little more than a numbers game. A more valid approach requires clear definitions of speech and language disorders.

Communication Disorders as Secondary to Other Disabilities

Most communication disorders are secondary to other disabilities. For example, children with a cleft palate have physical health problems as well as voice and articulation disorders. People with cerebral palsy have motor deficits beyond speech. Children with learning disabilities are especially likely to have language

Figure 2.4 The normal curve, percentile equivalents, and Standard scores.

Normal Curve

Percentage of cases under portions of the normal curve

0.13%   2.14%   13.59%   34.13%   34.13%   13.59%   2.14%   0.13%

Percentile equivalents

1   5   10   20   30 40 50 60 70   80   90   95   99

Standard Scores

15   55   70   85   100   115   130   145
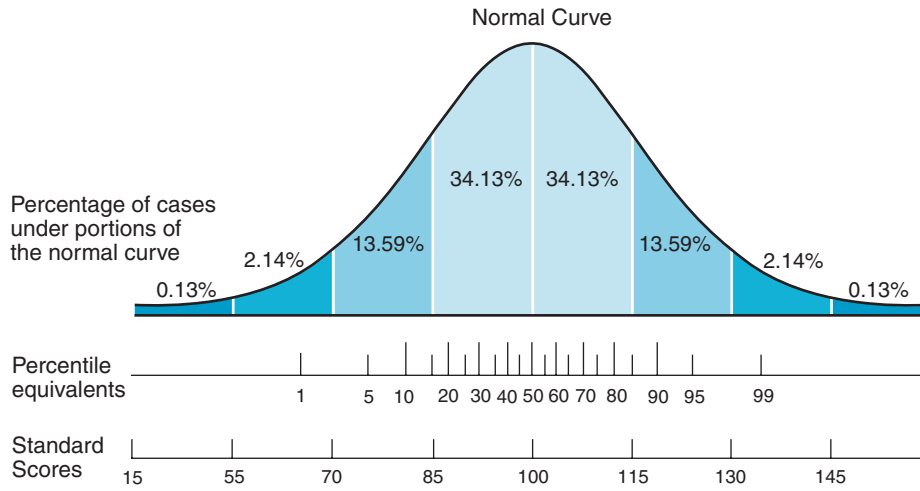
Source: Based on information from *Assessing and Screening Preschoolers,* by E. V. Nuttall, I. Romero, and J. Kalesnik, 1992, Boston: Allyn & Bacon: and *Measurement and Assessment,* by E. H. Wiig and W. A. Secord, 1992, Chicago: Riverside Publishing Co.

difficulties but may also have articulation, voice, fluency, and/or hearing deficits. In addition, they experience academic and social difficulties.

Estimates of Prevalence

Prevalence refers to the number or percentage of people within a specified population who have a particular disorder or condition at a given point in time. If you determined the prevalence of stuttering in the entire U.S. population, among first-grade children, among college seniors, among U.S. males, or among U.S. females, you would get different prevalence figures in each case. For this reason, prevalence statistics must specify the population on which they are based.

Current estimates suggest that about 17% of the total U.S. population have some communicative disorder. About 11% have a hearing loss, and approximately 6% have a speech, voice, or language disorder. Many of those with hearing losses also have speech, voice, or language disorders. Six to 10 million Americans (about 3% of the population) have a disorder of swallowing, and many of these individuals also have a communicative impairment. Although these figures are relatively low, it is likely that more, generally mild, cases are not reported (Tierney et al., 2000).

The percentage of people with hearing loss increases with age. Between 1% and 2% of people under 18 years of age have a chronic hearing loss, compared with approximately 32% of those over age 75. Exposure to noise has contributed to the hearing loss in about a third of those affected.

Impairments of speech-sound production and fluency are more common in children than adults and more common among males than females. Speech disorders due to neurological disorders or brain and spinal cord injury occur more often among adults. It has been estimated that anywhere between 3% and 10% of Americans have voice disorders; the percentage is greater among school-age children and among people over age 65.

The terms *incidence* and *prevalence* are often confused. Incidence refers to the number of *new* cases of a disease of disorder in a particular time period. Prevalence is the number of *new and old* cases in a particular time period.

Communication disorders vary with gender. For example, certain disorders, such as autism spectrum disorder, are four times as prevalent in males as in females.

Language disorders occur in 8% to 12% of the preschool population; the prevalence decreases through the school years. Language deficits in older adults may be associated with stroke or dementia. It is likely that 5% to 10% of people over age 65 experience language disabilities related to these disorders. Table 2.2 highlights some communication disorders that may appear through the lifespan.

Thought Question

TABLE 2.2

Communication disorders that may manifest themselves through the lifespan

Age Range	Disorders	Receptive Communication	Expressive Communication	Swallowing
Infancy	Hearing impairment Fetal alcohol or drug-exposure syndrome Parental neglect/abuse Cerebral palsy	Limited response to sound/speech Limited response to others Atypical physical postures and movement Deaf infants vocalize normally for first 6 mos. Others may have little vocalization Passivity	Atypical birth and other early cries	May have difficulties with breast or bottle; later problems with solid foods
Toddler	Autism/pervasive developmental disorder may be identified (hypersensitive to stimuli) Mental retardation not suspected earlier may now become apparent Brain injury due to falls	Comprehension of spoken language limited	Delay in first spoken word Utterances limited May use objects ritualistically	Rigid food preferences/ dislikes Caution needs to be taken to prevent putting small objects in mouth that may be swallowed/ choked on
Preschool	Delays that were suspected earlier may become more pronounced Fluency difficulties may emerge Specific language disabilities Middle ear problems common	Interactions with peers and others may be difficult	Inappropriate use of toys/objects Vocabulary may be limited, utterances short Alternative/ augmentative communication may be recommended Excessive disfluency; delayed phonology and grammatical development	Food preferences may be more entrenched

TABLE 2.2
(*Continued*)

Age Range	Disorders	Receptive Communication	Expressive Communication	Swallowing
School-age	Language learning problems Attention-deficit/hyperactivity disorder Brain injury due to falls and other accidents	Difficulties in attending, following directions, speech and reading comprehension	Narrative and other pragmatic skills may be affected	Inappropriate eating habits may become established
Young adulthood	Brain injury due to bike, motorcycle, car, and other accidents most prevalent in these years	Comprehension affected, generalized confusion, abstract thinking impaired	Pragmatic skills affected Life plans altered Dysarthria and apraxia may affect speech intelligibility	Neuromotor injury may impact on swallowing
Middle adulthood	Hearing often starts to decline Life-threatening illnesses such as cancer may be diagnosed Neurogenic problems may appear; multiple sclerosis, ALS, Parkinson's, and Alzheimer's diseases; stroke (aphasia)	Speech in noise may be difficult to comprehend Aphasia and Alzheimer's may result in comprehension difficulties	Illness-related depression may affect expressive communication Dysarthria and apraxia may impair speech intelligibility Alzheimer's and aphasia cause language difficulties	Eating/swallowing may be impaired initially following stroke; swallowing difficulties often present in degenerative neuromotor diseases (e.g., multiple sclerosis, ALS)
Advanced age	Hearing deficits common Neurogenic problems become progressively worse	Difficulty understanding speech may cause "tuning out"	Voice may be weak Word-finding problems Inappropriate speech Perseveration	Disinterest in food, swallowing impairments may lead to aspiration pneumonia

Sources: Information from Owens (2014) and Shadden & Toner (1997).

Note: This is a sampling of problems that may be seen. Variability within each age group is the norm.

DECIDING WHETHER THERE IS A PROBLEM

Click here to check your understanding of the concepts in this section.

Not everyone is assessed for communication disorders. Formal assessment occurs only after someone recognizes the possibility of a problem. Selection for assessment may come from referral by another professional or concerned adult, such as a pediatrician or parent, or from screening. Adults may refer themselves if they feel they have a communication disorder.

Children between the ages of birth and 36 months may be brought to special centers for screening for speech, language, hearing, motor, and other functions. Older children are screened in preschools and schools. In addition, every state in

Specialists in communication disorders may encourage referrals from other professionals and concerned individuals by publicizing the nature of the services that they provide.

A person who has been identified during screening may have a communication disorder. A screening is not a diagnostic evaluation. Screenings simply suggest which individuals should receive further evaluation.

Clinicians may differ in their judgments of the severity of a disorder. Use of objective criteria ensures more consistency in this determination.

the United States requires that hearing screening tests be given to infants at their birthing facility or as soon after birth as possible. The purpose of screening is to determine whether a problem exists.

Defining the Problem

Assessment of communication disorders is the systematic process of obtaining information from many sources, through various means, and in different settings to verify and specify communication strengths and weaknesses, identify possible causes of problems, and make plans to address them. If a problem is identified, an SLP may make a **diagnosis**, which distinguishes an individual's difficulties from the broad range of possible problems. Although a diagnostic report might include a label such as *dysphonia*, it should also contain a more complete description of this disorder that reflects the person's ability to communicate, variability of symptoms, severity, and possible causes.

Assessment Goals

The goals of assessment are listed in Figure 2.5. The primary goal of diagnosis is determining exactly what is wrong. Sometimes **diagnostic therapy** is suggested. In this case, the SLP will work with the client for a time and will obtain a clearer picture of the person's communication abilities and limitations in the process.

As mentioned earlier, communication impairments may involve hearing, speech, language, and/or processing or, more likely, some combination of these. During assessment, specifics of all of these are probed. Both the client's communicative strengths and limitations are noted. An SLP provides data reporting the consistency of behaviors and, where appropriate, indicates how the client compares with more typical communicators.

If a problem exists, an SLP will want to describe its severity. Exactly what determines a particular severity rating is related to several factors. Although published tests often suggest severity ratings depending on a client's performance scores, these must be used with caution. There is a broad range of typical communication behavior, and an SLP should not rely overly on any single test.

Figure 2.5 Goals of assessment.

A communication disorders specialist is charged with answering the following questions when assessing an individual:
1. Does a communication problem exist?
2. What is the diagnosis?
3. What are the deficit areas? How consistent are they?
4. What are the individual's strengths?
5. How severe is the problem?
6. What are the probable causes of the problem?
7. What recommendations should be made?
8. What is the prognosis (likely outcome) without and with intervention?

Source: Based on Lund & Duchan (1993).

Whenever possible, an SLP should try to ascertain the reason(s) for the communication deficit, especially if the cause persists. The cause is referred to as the **etiology**. There may be **predisposing causes** that underlie the problem, such as genetic factors, **precipitating causes** that triggered the disorder, such as a stroke, and **maintaining** or **perpetuating causes** that continue or add to the problem. Whether the etiology is known or not, an SLP must thoroughly describe the client's communication behavior.

Recommendations for addressing the client's communicative deficiencies are often the most read portion of an assessment report. In making a plan, the first decision is whether intervention is warranted. If it is, then its nature must be described. Treatment recommendations can be thought of as a "working hypothesis" that may need to be altered as intervention proceeds. Assessment continues throughout treatment, in the forms of data collection and probes of behavior.

In communication disorders, an SLP makes a **prognosis** regarding whether the problem will persist if no intervention occurs and what the likely outcome is if a course of therapy or other treatment plan is followed. A prognosis is an informed prediction of the outcome of a disorder, both with and without intervention, and is based, in part, on the nature and severity of the disorder; the client's responsiveness to trial therapy during assessment; and the client's overall communicative, intellectual, and personal strengths and weaknesses. The client's home and school environments are also important factors that can affect the outcome.

Assessment Procedures

Assessment may take many forms. Ideally, a clinician should sample a broad variety of communication skills through multiple procedures in several settings. The focus should be on the collection of **authentic data**—that is, actual real-life information, in sufficient quantity to be able to make meaningful and accurate decisions.

The need for the use of a variety of procedures should be readily apparent. How often as a student have you said that a test did not accurately measure what you know or what you can do? The same is true for individuals with communication impairments. By using multiple measures and reports, an SLP or audiologist tries to obtain the most accurate description of a child's communication possible. These methods may include:

- A case history filled out by a parent, family member, professional, or the client
- A questionnaire completed by a parent, family member, professional, or the client
- An interview with a parent, family member, and/or the client
- A systematic observation of the client's communication skills
- Testing with more than one assessment tool and including a hearing screening and an **examination of the peripheral speech mechanism**
- **Dynamic assessment**
- Communication sampling and analysis

Most tests are **norm referenced**, meaning they yield scores that are used to compare a client with a sample of similar individuals. Norm-referenced instruments should be chosen carefully to fit the characteristics of each individual child. In contrast, a **criterion-referenced** test evaluates a client's strengths and weaknesses with regard to particular skills and does not make comparisons to other

Family members and clients are often eager to know the prognosis. They will ask questions such as "Will my child outgrow this problem?" or "How long will it take to correct this disorder?"

An SLP obtains background information about a client from a written case history completed by the client, parent, or significant other; an interview; and reports from other professionals.

An SLP makes a determination about a client's current functioning and the nature of the problem from multiple sources and clinical intuition.

Each client has individual needs. An SLP must attempt to determine which are paramount at a particular time and then develop a plan to meet these needs.

Formal test results during assessment differ from baseline data. During formal testing, a wide range of communicative skills are evaluated. Baseline data reveal an individual's performance level with regard to a few selected potential targets.

children. This more descriptive method is usually reserved for dynamic assessment and sampling.

Dynamic assessment includes probing to explore a client's ability to modify behavior by producing previously misarticulated sounds, learning a language rule, reducing disfluencies, and the like. The goal is to mesh more flexible nonstandardized approaches with more formal, structured methods found in most tests. Dynamic assessment often takes the form of a *test–teach–test* paradigm to examine the "teachability" of a communication feature. The child's potential for learning is assessed by giving small amounts of assistance and determining the difficulty for the child of performing the newly learned behavior.

Most clinicians also use a **speech** and/or **language sampling** technique when assessing the communication of both children and adults. Guidelines for sample collection and analysis are described in Chapter 4 and Chapter 8. With adult clients, sampling can be accomplished while reviewing the case history with clients or asking them to explain how they spent their day or tell about their last vacation (Duffy, 2005).

Evidence-Based Practice

Most ASHA assessment guidelines relate to specific disorders and are described in the following chapters. Still, some general guidelines can be deduced from these evidence-based analyses. These are included in Box 2.1.

BOX 2.1 | **Evidence-Based Practice in Assessment of Individuals with Communication Impairments**

Developmental Level

- Early identification may be especially important for young children with significant communication disorders.
- The form of communication varies with a child's age and developmental status and should be reflected in the communication features assessed.

Difference vs. Disorder

- Multilingualism and dialectal variations in the home and other care environments affect the way in which language is learned and used and should be considered in an assessment.
- Bilingual clients should be assessed in both languages in order to provide an accurate picture of speech and language strengths and weaknesses.

Format

- Significant others who interact with the client in an ongoing daily basis should be included in the assessment process.

- Assessment and analysis should be multifaceted and in depth because the dividing line between typical and disordered speech and language is not always clear.
- Assessment materials and strategies should be appropriate to the culture and language of the client and family.
- The setting of the assessment should be appropriate to the developmental stage and/or overall health of the client and be comfortable for both the client and significant others.
- Assessment materials and strategies should reflect the developmental level or condition of the client.

Source: New York State Department of Health. (2002). *Clinical Practice Guideline,* Publication No. 4218. Albany, NY: New York State Department of Health. Recommended by ASHA, Compendium of EBP Guidelines and Systematic Reviews. Accessed June 1, 2009, at www.asha.org/members /ebp/compendium/.

INTERVENTION WITH COMMUNICATION DISORDERS

Each child brings his or her sense of self to the therapeutic situation. Most of this self-concept has grown out of interactions with family members and individuals in the immediate community. An SLP's failure to recognize and include these dimensions of an individual's social identity can negatively impact intervention (Demmert, McCardle, and Leos, 2006).

Providing culturally responsive intervention is extremely important for children from culturally linguistically diverse (CLD) backgrounds. SLPs can integrate culturally based materials into intervention.

Intervention for individuals with communication disorders is influenced by the nature and severity of the disorder, the age and status of the client, and environmental considerations, as well as personal and cultural characteristics of both client and clinician. Despite this, some general principles and procedures can be identified.

As mentioned in Chapter 1, ASHA has taken a proactive position stressing the need to integrate research and clinical practice (Kamhi, 2006a; Katz, 2003; Ramig, 2002; Wambaugh & Bain, 2002). ASHA's Code of Ethics requires clinicians to "provide services that are based on careful, professional reasoning" (Apel & Self, 2003, p. 6). Evidence-based practices ensure that "clinicians abide by these ethical codes while best serving their clients" (Apel & Self, 2003, p. 6). ASHA has established the National Center for Treatment Effectiveness in Communicative Disorders and is currently coordinating a National Institutes of Health–funded effort to promote clinical research that will support EBP.

Intervention can take a variety of forms, based on the type of disorder, the aspects of communication affected, the age of the client, and the severity of the disorder to name just a few of the variable. As you watch this video of one of the highly respected professionals in this field, notice the many different disorders addressed and the varying approaches with each.

Objectives of Intervention

Regardless of the specific nature of a problem, intervention in speech-language pathology has as its overriding goal the improvement of the client's communication skills:

1. The client should show improvement not just in a clinical setting; progress should generalize to his or her real-world environments, such as home, school, and work.

2. The client should not have to think about what has been learned; in large part, it should be **automatic.**

3. The client must be able to **self-monitor**. Although modifications should be automatic, they will still require monitoring. The client should be able to listen to and observe himself or herself and make corrections as needed, without the therapist's being present.

4. The client should make optimum progress in the minimum amount of time.

5. Intervention should be sensitive to the personal and cultural characteristics of the client.

Target Selection

The assessment report should provide recommendations for long-term goals and short-term objectives for communication intervention. The clinician, however, will have to decide which specific targets should be addressed and in what

sequence. The client's personal needs and the potential for intervention to generalization to everyday use are most relevant in making meaningful choices. Likelihood of success and typical behavior of others of the client's age and gender might provide additional insights.

Baseline Data

Before beginning a program of intervention, an SLP obtains **baseline data**; that is, the SLP tries to elicit the target behavior(s) multiple times, under multiple conditions, and record the accuracy of the client's responses. This gives the SLP information about the client's starting point. Baselines are essential in determining a client's progress and the success of a treatment program.

Behavioral Objectives

Once a clinician has obtained baseline data, he or she develops short-term objectives. These are the targets for each treatment session or for several sessions. A behavioral objective is a statement that specifies the target behavior in an observable and measurable way. To do this requires that the clinician identify what the client is expected to do, under what conditions, and with what degree of success. The letters ABCD might help you to remember the format for writing behavioral objectives:

A. *Actor.* Who is expected to do the behavior?

B. *Behavior.* What is the observable and measurable behavior?

C. *Condition.* What is the context or condition of the behavior?

D. *Degree.* What is the targeted degree of success?

For example, *John* [Actor] *will describe pictures* [Behavior] *using both the correct noun and verb* [Condition] *with 90% accuracy* [Degree].

Clinical Elements

Successful intervention is multifaceted and includes a variety of elements. This may include, but is not limited to, direct and incidental teaching, counseling, and inclusion of the family and family environment.

Direct Teaching

Part of the role of an SLP is teacher. Traditional clinical methods include explaining or reviewing the target and guided practice. **Behavior modification** training approaches have been shown to be successful for a broad variety of communication disorders. Behavior modification is a systematic method of changing behavior. During training, the SLP attempts to elicit the desired response from the client by providing a **stimulus**. The client is expected to *respond,* and the clinician **reinforces** this response if correct or provides corrective feedback if it is not.

Incidental Teaching

Behavior modification follows a highly structured format that an SLP directs. A low-structured or more client-led approach may also be used. In this method, the SLP follows the client's lead but teaches along the way. This is referred to as

incidental teaching. The SLP manipulates the environment so that communication occurs more naturally. For example, imaginary play with a young child or a cooking or art project with one who is older may serve as situations in which therapy occurs.

Counseling

In addition to direct work with the client on a communication problem, an SLP can provide a supportive environment for the client and other key people in the client's life. A person with a communication disorder may experience a host of feelings, including embarrassment, anger, depression, and inadequacy. Family members may have similar emotions regarding the client's communication and may also feel pity or guilt, perhaps blaming themselves for the problem.

Family and Environmental Involvement

An individual might spend 2 hours a week with an SLP and 110 awake hours alone and with other people, often family. Depending on the family circumstances, family members may be asked to help the client with specific activities at home to foster carryover to everyday situations. A spouse may be critical in assisting therapy for an adult who had a stroke or has a voice problem due to recent accident or illness. An SLP must recognize the significant others in the client's life, from infancy through advanced age, and engage them in productive ways. **Support groups** consisting of individuals who have similar difficulties often provide an avenue to practice what has been learned in therapy, to share feelings related to the disability, and to maintain communication skills once formal treatment has been terminated.

Measuring Effectiveness

An SLP determines readiness for dismissal from therapy largely by assessing its effectiveness. Did the client meet the long-term goals and short-term objectives? SLP-designed **post-therapy tests** similar to those used to determine baselines are normally used to answer this question. In addition, it is essential that the client has gained a degree of *automaticity* in the use of the communication target. Errors will occur, however, and the client should be able to *self-monitor* and self-correct when needed. If therapy has been effective, the client has been successful in *generalizing* learned skills to the out-of-clinic world.

Follow-up and Maintenance

After a client has been dismissed from therapy, an SLP must take steps to ensure that the progress that was achieved is not lost. This is done in two ways: Upon dismissal, the client or family should be encouraged to return when anyone feels a need. More reliable is the establishment of a regular follow-up schedule. The client may be contacted by telephone or e-mail every 6 months for a period of 2 years or so after the termination of therapy. At this time, retesting may be suggested, and **booster treatment** may be provided, if needed.

Thought Question

Click here to check your understanding of the concepts in this section.

SUMMARY

Communication is an exchange of ideas; it involves message transmission and response. Human communication is remarkable and may take many forms. It is strongly influenced by culture and environment. Not only do people speak different languages, but within language groups, age, gender, socioeconomic status, geographical background, ethnicity, and other factors influence our communication.

The primary vehicle of human communication is language. It may be spoken, written, or signed and has been described in terms of form, content, and use. Form refers to the sound system, or phonology; word structure, or morphology; and syntax, or how the words are arranged in sentences. Content is semantics or meaning, and use is the purpose or pragmatics of the communication. Communication is also transmitted by nonverbal behaviors and characteristics.

A breakdown can occur in any aspect of communication. When communication is unimpaired, we tend to take it for granted, but when it fails, we may feel frustrated and isolated. About 17% of the U.S. population currently experience some limitation of hearing, speech, and/or language. See the ASHA website at the end of the chapter to learn more about various disorders.

Assessment of communication disorders requires an understanding of communication in context. Communication behaviors can be viewed as occurring on a continuum from typical to disordered. With each case, an SLP must decide where the demarcation is.

Referrals and screenings are the primary ways in which individuals are selected for assessment. During assessment, an SLP verifies and defines the client's problem, identifies deficits and strengths, probes causality, makes a treatment plan, and provides a prognosis for improvement. This is achieved through multiple techniques, including sampling of communicative behaviors in several settings.

Assessment and treatment function in a cyclical fashion, with one influencing the other. In many ways, an SLP is assessing the client each time the client is seen in therapy. Successful intervention often uses a team approach that involves family members as well as professionals. Provisions for follow-up ensure that the gains made in therapy are maintained. In the chapters that follow, techniques for assessment and treatment of specific communication disorders are described.

SUGGESTED READINGS

Axtell, R. (1998). Gestures: *The do's and taboos of body language around the world* (rev. ed.). New York: Wiley.

Hirsh-Pasek, K., & Golinkoff, R. (1999). *The origins of grammar: Evidence from early language*. Cambridge, MA: MIT Press.

Ruben, B., & Stewart, L. (2006). *Communication and human behavior* (5th ed.). Boston: Pearson Education.

3

The Biological Mechanism of Speech

## CHAPTER LEARNING GOALS

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

- List and describe the primary structures of the respiratory, laryngeal, and articulatory/resonating systems

- Explain the respiratory processes for quiet breathing and for speech breathing

- Briefly describe the speech production process

- Explain the articulatory and resonating processes for human speech
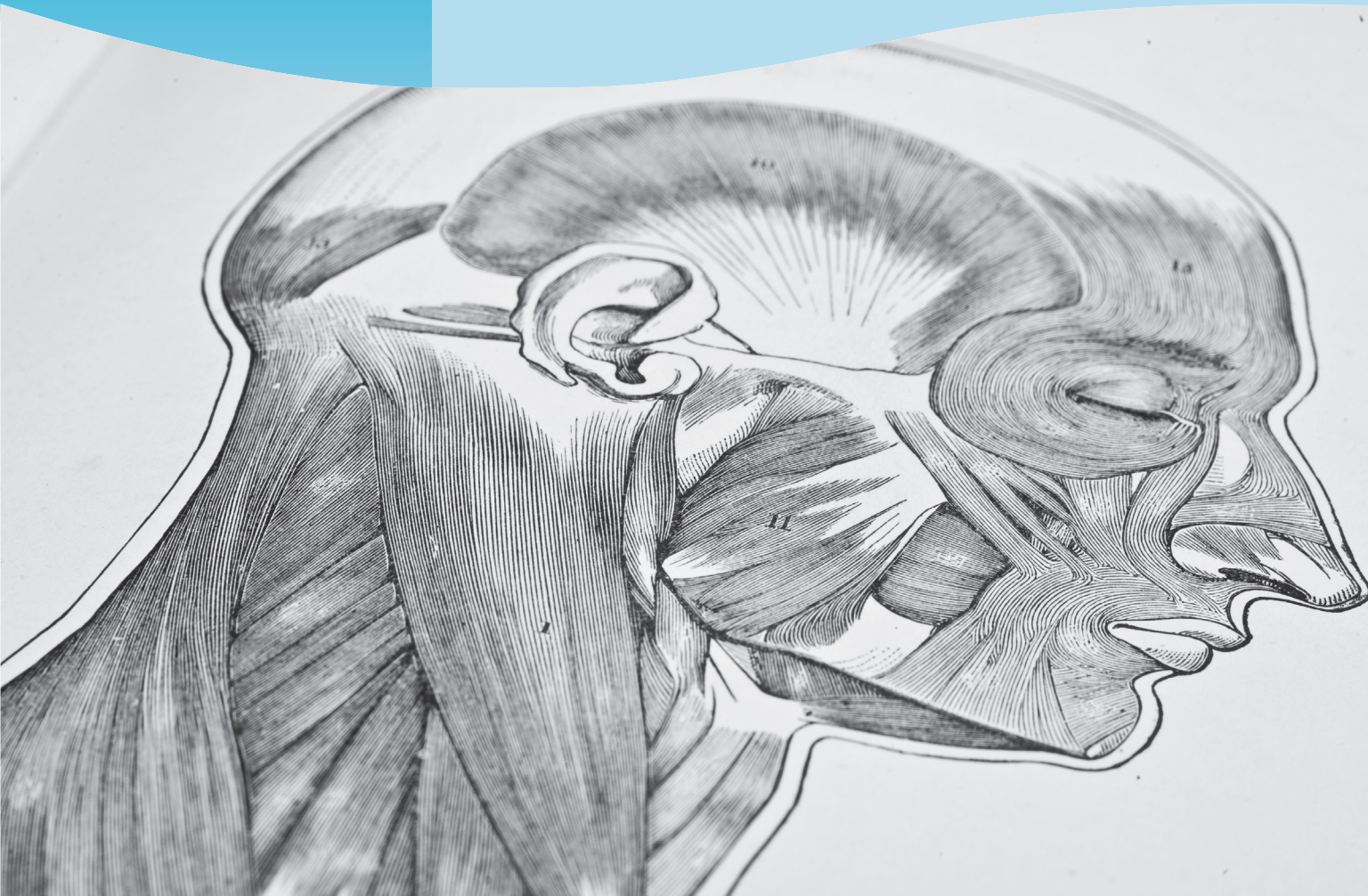
P eople often take for granted speech production as a biological function that takes care of itself; your thoughts and ideas are expressed with little or no apparent effort. But for all its apparent simplicity, the production of speech requires an incredibly complex coordination of biophysical events involving hundreds of muscles and millions of nerves. It is paradoxical that such complex physiological behavior appears to be so effortless. This natural paradox, however, is probably necessary. If we had full conscious comprehension of what we are doing when we speak, we would probably be unable to utter a single word. Monitoring all the nerves and muscles, the tone of the voice, facial expression, and word order would be an impossible intellectual feat (Thomas, 1979).

For many individuals, however, speech production is anything but effortless. Sometimes abnormalities of anatomical structures and physiological systems that support speech interfere with the speech production process. Thus knowledge of the anatomy and physiology of the speech mechanism is fundamental to understanding many different communication disorders that are evaluated and treated by speech-language pathologists (SLPs). Successful treatment of voice and swallowing disorders, laryngectomy (the surgical removal of the larynx), and cleft palate requires a thorough understanding of the anatomy and physiology of the speech mechanism.

THE PHYSIOLOGICAL SUBSYSTEMS SUPPORTING SPEECH

Anatomy is the study of the structures of the body and the relationship of these structures to one another. **Physiology** is a branch of biology that is concerned with the functions of organisms and bodily structures.

Harvard neuroscientist Steven Pinker says, "One easy way to understand speech sounds is to track a glob of air through the vocal tract into the world, starting in the lungs" (Pinker, 1995, p. 163). Obviously, the production of speech is more complicated than Pinker's musing suggests, but speech production does require control of air pressure and air flow from your lungs through your vocal tract into the atmosphere. Three physiological subsystems are involved in speech production: (1) the **respiratory system** provides the driving force for speech by generating positive air pressure values beneath the vocal folds; (2) the vocal folds, anatomical structures in the **laryngeal system** or *larynx,* vibrate at high rates of speed, setting air molecules in the vocal tract into multiple frequencies of vibration; and finally, (3) the **articulatory/resonating system** acts as an acoustic filter, allowing certain frequencies to pass into the atmosphere while simultaneously blocking other frequencies. In this chapter, we discuss the basic structures, muscles, and physiology of the subsystems of speech production and address the changes in each across the lifespan.

The Respiratory System

The primary biological functions of your respiratory system are to supply oxygen to the blood and to remove excess carbon dioxide from the body. This process is automatic and controlled by the respiratory centers located within the brainstem

of the central nervous system. Although the primary function of respiration is to sustain life, it also serves as the generating source for speech production. Air is inhaled into your lungs to become the potential energy source for sound production. The air is then expelled in a controlled manner, to be modified by your vocal folds and articulators to generate speech sounds.

Structures of the Respiratory System

The primary components of the adult respiratory system include (1) the pulmonary apparatus, which is further subdivided into the lungs, the trachea (windpipe), and the pulmonary airways, and (2) the chest wall (thorax), comprising the rib cage wall, the abdominal wall, the abdominal content, and the diaphragm (Hixon & Hoit, 2005). The structures of the chest wall surround and encase the pulmonary apparatus, and together they form a single functional unit (Hixon et al., 2014).

The **lungs** are a pair of air-filled elastic sacs that change in size and shape and allow us to breathe. The left lung is smaller than the right to allow room for the heart. Air moves to and from the lungs via the **trachea** and the intricate network of branching tubes called bronchi (Figure 3.1).

Muscles of the Respiratory System

The respiratory muscles are divided functionally into muscles of inspiration and muscles of expiration. Inspiratory muscles are generally found above the diaphragm; expiratory muscles are located below the diaphragm. With the exception of the diaphragm, all respiratory muscles are paired (i.e., located on both the right and left sides of the body).

Figure 3.1 Anterior view of the trachea and bronchi (a) and anterior view of the bronchi entering the right and left lungs (b).
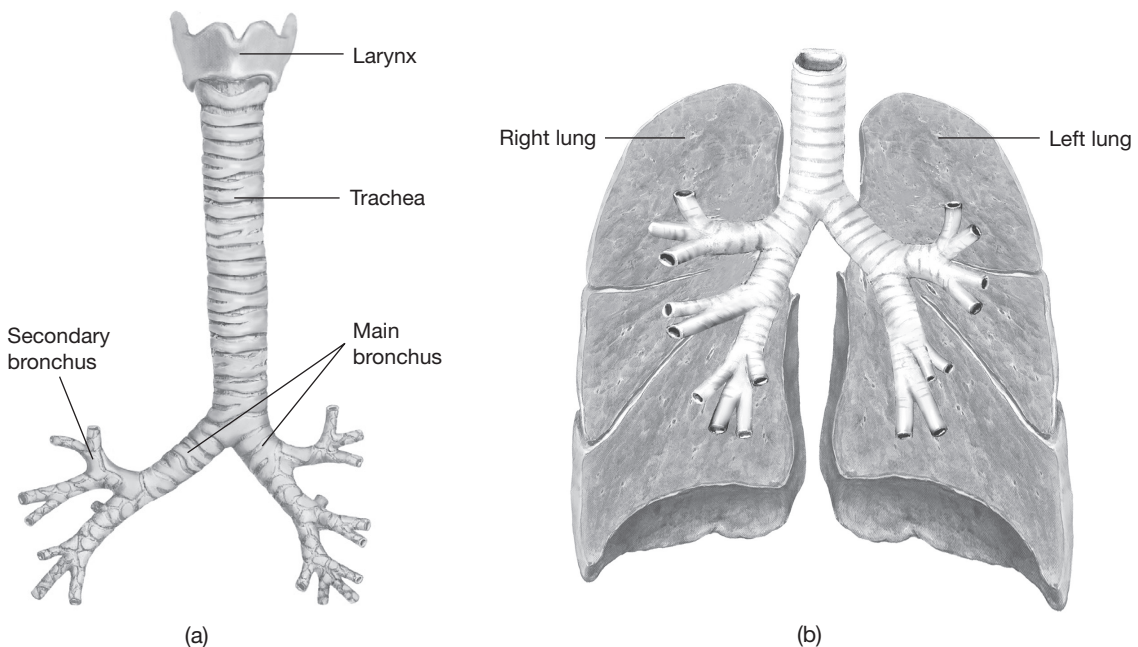
Inspiratory Muscles

The diaphragm is the principal muscle of inspiration. It is a dome-shaped structure composed of a thin, flat, nonelastic central tendon and a broad rim of muscle fibers that radiate up to the edges of this central tendon. The central tendon is in direct contact with each lung, as shown in Figure 3.2a. The diaphragm separates the thorax (chest) from the abdomen. At rest, it looks like an inverted bowl (Hixon & Hoit, 2005). Figure 3.2b shows the relative position of the diaphragm at rest. When the diaphragm contracts during inspiration, it pulls downward and forward, thus enlarging the thorax.

In addition to the diaphragm, numerous thoracic and neck muscles contribute to inspiration. These muscles are illustrated in Figure 3.3.

Figure 3.2 Anterior view of the relationship of the diaphragm to the lungs (a) and anterior view of the diaphragm at rest (b).

Central tendon

(a)

Right lung

Left lung

Diaphragm

(b)
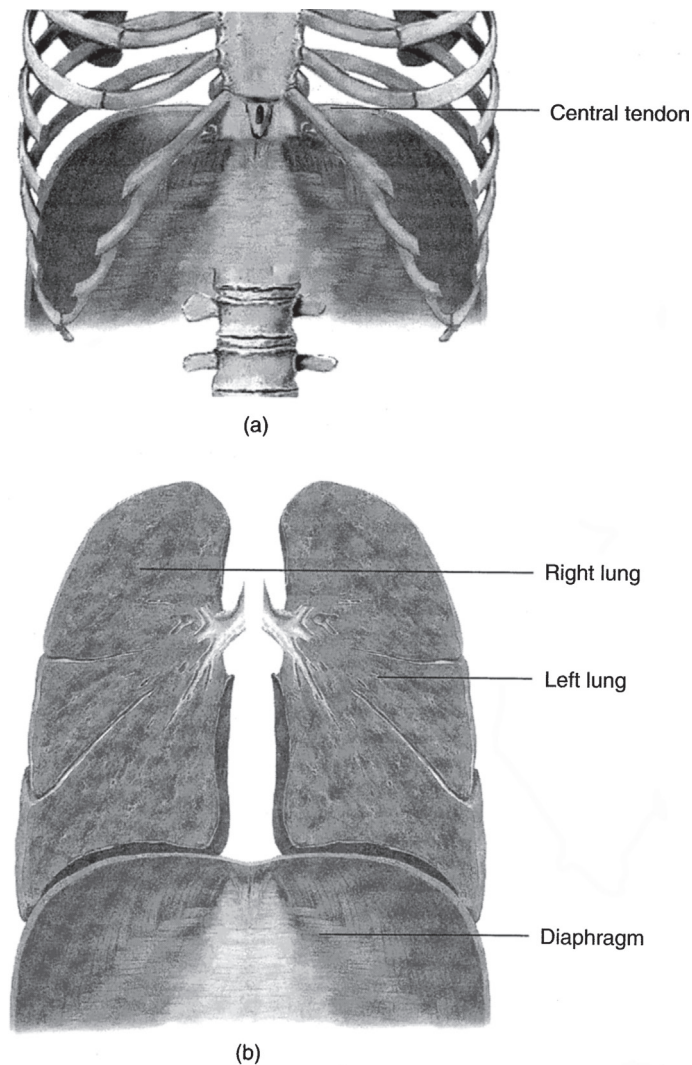
Figure 3.3 Anterior view of thoracic muscles.
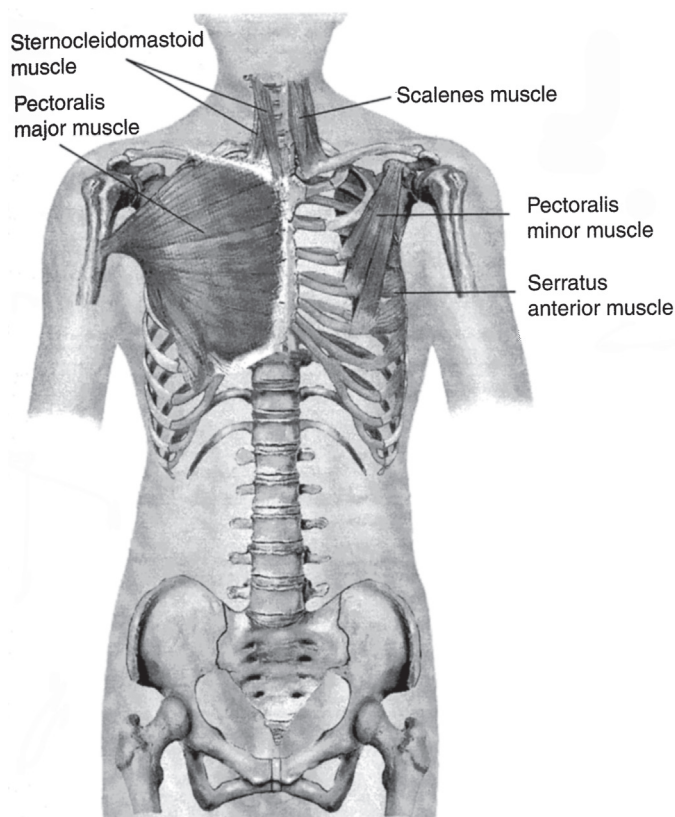
Muscles of Expiration

Expiration allows carbon dioxide to be expelled from the body via the lungs and for speech to be produced. The most important muscles of expiration are located in the front and on the sides of the abdomen. During expiration, these muscles, depicted in Figure 3.4, assist the diaphragm's movement back to its relaxed dome-shaped configuration.

Numerous other muscles located on the front and back of the thorax may also contribute to respiration. The use of other muscles during inspiration and expiration may be related to body position, certain pathological states, and environmental conditions.

The Physiology of Tidal Breathing and Speech Breathing

Quiet breathing, or **resting tidal breathing**, is breathing to sustain life. As you are reading this chapter, you are using tidal breathing. The rate and depth of breaths taken during tidal breathing are determined by your body's oxygen needs and the amount of carbon dioxide in the blood. Resting tidal breathing involves contraction of the diaphragm, moving it downward and slightly forward, which in turn expands the rib cage wall and moves the abdominal wall outward (Hixon & Hoit, 2005). Expansion of the rib cage wall also causes expansion of the lungs. This results in an increase in lung volume and a decrease in **alveolar pressure** (i.e., pressure within

Figure 3.4 Anterior view of abdominal musculature. Muscles are cut to illustrate the different layers of muscle.

External oblique muscle

Internal oblique muscle

Transversus abdominis muscle

Abdominal aponeurosis

Rectus abdominis muscle
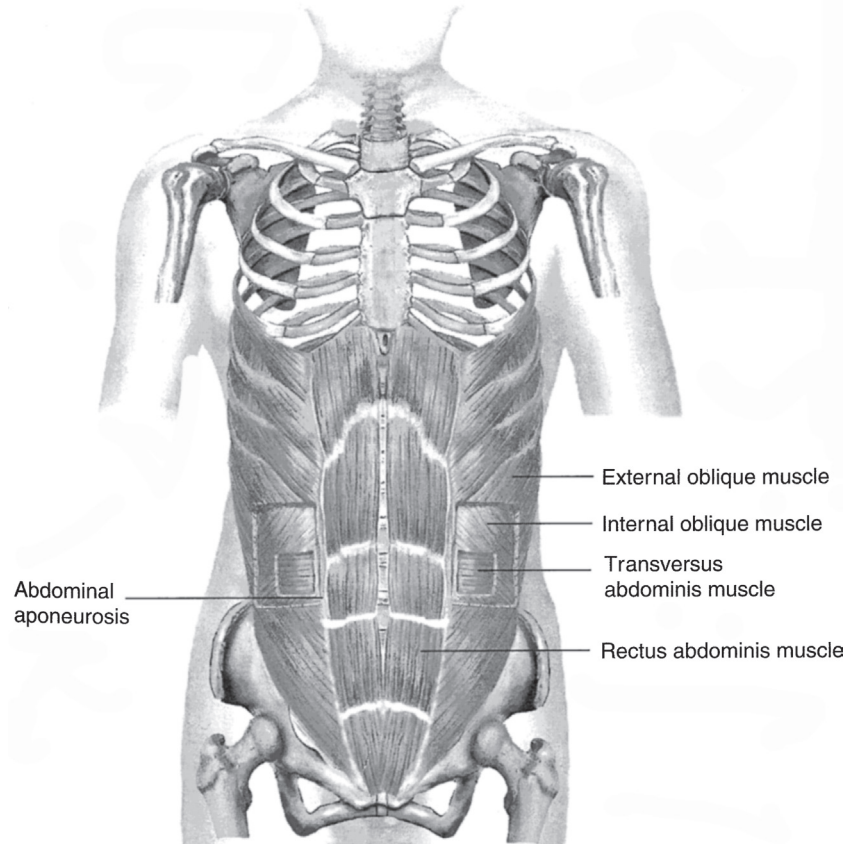
the lungs) below that of atmospheric pressure. Air then rushes into the lungs, equalizing alveolar pressure with atmospheric pressure. Approximately 0.5 L of air are inhaled during quiet breathing.

When the resting tidal inspiratory cycle ends, expiration (or exhalation) begins. Expiration results from the decrease in the size of the rib cage wall, and thus compression of the lungs, which in turn increases the pressure within the lungs (Hixon & Hoit, 2005). Air then rushes out of the lungs until equilibrium with atmospheric pressure is reached. Expiration during quiet breathing does not require active muscle contraction. Rather, it is achieved by gravity and the natural tendency (i.e., passive recoil) of the pulmonary-chest wall unit to return to its relaxed state. A respiratory cycle is defined as one inhalation followed by one exhalation. During resting tidal breathing, the duration of inspiration and expiration are relatively equal.

Breathing for purposes of speech production differs from resting tidal breathing in a number of ways. First, contraction of the diaphragm produces rapid, forceful inspirations. Furthermore, the time spent inhaling is short relative to the time spent exhaling which is much longer. You may inhale as much as 2 L of air during speech breathing, depending on the specific demands of the utterance. Unlike expiration during quiet breathing, active muscle contraction of both

Speech breathing differs from quiet breathing in many ways, but the oxygen and carbon dioxide ratio in the blood is the same for both types of breathing.

inspiratory and expiratory muscles is needed during speech to prevent all the air from rushing out of the lungs too quickly.

Lifespan Issues of the Respiratory System

At birth, you had a rest breathing rate between 30 and 80 breaths per minute. By age 3, your tidal breathing rate had decreased to values between 20 and 30 breaths per minute. This change in rate is due to the fact that newborns have very few alveoli, the areas where gas exchange occur in the lungs. Alveoli increase in number with age such that by adulthood, there are several hundred thousand (Kent, 1997; Zemlin, 1998). Watch preschool children and make note of their more frequent and deeper inhalations relative to adults. By age 7, the number of alveoli approaches adult values, and by 10 years of age, the respiratory system functions in a more adultlike fashion. Tidal breathing rates are between 17 and 22 breaths per minute, and lung and abdominal wall volumes and lung pressures during speech production more closely approximate those used by adults (Hixon & Hoit, 2005).

As children grow, the structures of the respiratory system increase in size, and, in turn, lung capacity increases. Maximum lung capacities are reached in early adulthood and remain fairly constant until middle age. Respiratory function for speech breathing purposes becomes less efficient beginning in the seventh or eighth decade of life.

Respiratory function is also affected by exercise, health, and smoking. It is estimated that smoking in older people could result in a 500 mL (approximately 1 pint) cumulative loss in pulmonary function every 10 years (Kent, 1997).

The Phonatory System

The primary structure of the phonatory system is the **larynx**, which is an air valve composed of cartilages, muscles, and other tissue. It is the principal sound generator for speech production and is colloquially known as the "voice box." The larynx sits on top of the trachea and opens up into the pharynx (throat). The larynx appears to be suspended from the **hyoid bone**, a horseshoe-shaped structure that serves as the point of attachment for both laryngeal and tongue musculature. The primary biological function of the larynx is to prevent foreign objects from entering the trachea and lungs. In addition, the larynx can impound air for forceful expulsion of foreign objects that threaten the lower airways.

The larynx consists of the thyroid, arytenoid, and cricoid cartilages connected to one another by ligaments and membranes (Figure 3.5). The **thyroid cartilage** is the largest laryngeal cartilage. It forms most of the front and sides of the laryngeal skeleton. The upper part has a V-shaped depression called the thyroid notch. It can be felt by palpating the front of the neck. Just below this notch is a jutting protrusion called the **thyroid prominence**, or Adam's apple (Hixon et al., 2014), which can be very prominent in some adult males.

The Vocal Folds

The vocal folds are attached at the front near the midline of the thyroid cartilage and at the back to the arytenoid cartilages via the vocal ligament. When viewed from above, the paired vocal folds appear to be ivory-colored bands of tissue. They abduct (move apart) during respiration and adduct (move together) during phonation.

Figure 3.5 Anterior view of the skeletal framework of the larynx.
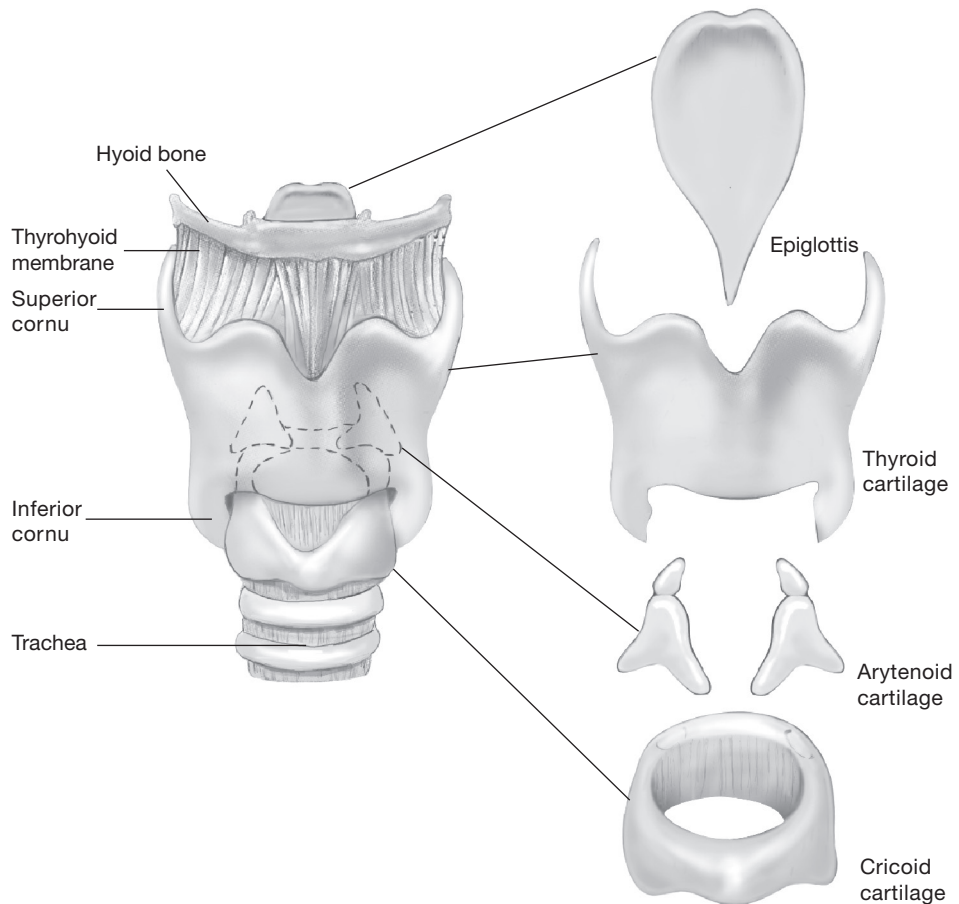
Lifespan Issues of the Laryngeal System

The laryngeal system also goes through significant changes as a function of age. In a newborn, the larynx is small and positioned very high in the neck. The high position of the larynx near the hyoid bone allows the newborn to breathe and nurse simultaneously, while protection of the airway is maintained. The larynx begins to move downward in the neck during the first year of life. It reaches its final position between 10 and 20 years of age (Hixon et al., 2014).

The laryngeal cartilages increase in size and become less pliable with age. The hyoid bone ossifies (turns to bone) by 2 years of age. The vocal folds are approximately 4 to 6 mm long in a newborn. By age 6, they increase to about 8 or 9 mm in length. The increase in length of the vocal folds is equal in boys and girls until puberty. During puberty, the vocal folds increase to approximately 12 to 17 mm in girls and 15 to 25 mm in boys. By adulthood, females' vocal folds are about 21 mm in length; males' are about 29 mm in length (Kent, 1997). The sex difference in adult vocal fold length accounts for the fact that men normally have lower-pitched voices than women.

With advancing age, laryngeal cartilages begin to ossify, although the female larynx, unlike that of males, never completely ossifies. The vocal folds begin to

lose muscle tissue (atrophy) while the more superficial layers of vocal fold tissue thicken and lose their elasticity. As a result, the vocal folds become stiffer and less flexible with age. Age effects are realized in men as an increase in pitch, likely due to muscle atrophy and loss of mass of the folds. Women, in contrast, experience a decrease in pitch with age, likely due to hormone-related changes associated with menopause (Stoicheff, 1981).

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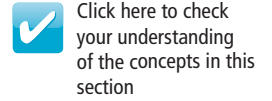
The Articulatory/Resonating System

The articulatory/resonating system extends from the opening of the mouth to the vocal folds and comprises the oral cavity, the nasal cavity, and the pharyngeal cavity, as shown in Figure 3.6. Together these three cavities form the vocal tract, which is a resonant acoustic tube that shapes the sound energy produced by the respiratory and laryngeal systems into all of the English speech sounds (Kent, 1997). Structures important for speech production such as the teeth, tongue, and velum (soft palate) are housed within these three cavities.

Figure 3.6 Schematic of the human vocal tract.
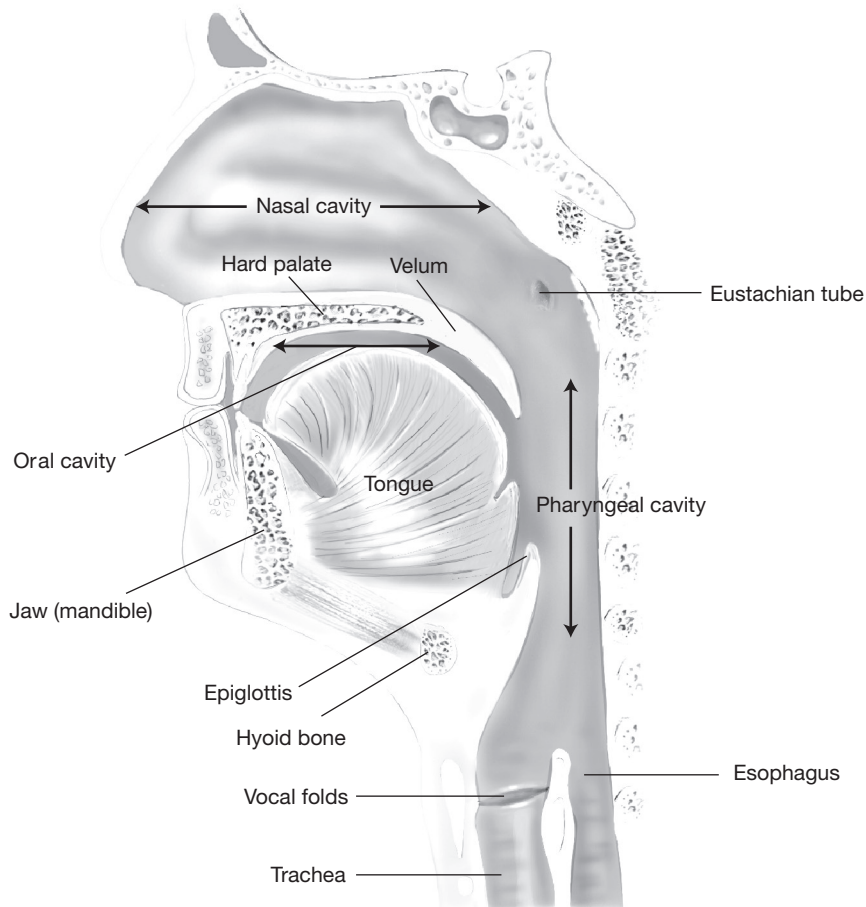
Structures of the Articulatory/Resonating System

The articulatory/resonating system consists largely of the 22 bones that make up the facial skeleton and cranium (braincase). Some of these bones are shown in Figure 3.7. With the exception of the *mandible* (lower jaw), the bones of the face and cranium are fused tightly together by sutures. The mandible articulates with the temporal bone by means of a complex joint known as the *temporomandibular*

Figure 3.7 Anterior (a) and lateral (b) views of skull bones.

Parietal bone — Coronal suture

Temporal bone — Greater wing of sphenoid

Nasal bone

Alveolar process — Maxilla

Mandible

(a) Anterior view

Coronal suture

Frontal bone

Greater wing of sphenoid — Parietal bone

Temporal bone

Zygomatic arch — Occipital bone

Zygomatic bone — Condylar process

Maxilla — Mastoid

Styloid process

Mandible — Temporomandibular joint

(b) Lateral view

joint (*TMJ*). This joint allows the mandible to move up and down and side to side, which is necessary for chewing.

Teeth

Adults have a total of 32 teeth that are held within the *alveolar processes* (thick spongy projections) of the mandible and *maxilla* (upper jaw) inside the oral cavity. The obvious biological function of teeth is chewing food, but the teeth are also important for production of some English speech sounds.

Horizontal bones of the maxilla form the bony hard palate, which comprises the front two thirds of the roof of the mouth. Figure 3.8 shows the structures of the bony hard palate and the relationship of the maxillary teeth.

Tongue

The principal structure within the oral cavity important for speech production is the tongue. The tongue is a muscular hydrostat, meaning it has no bone or cartilage, much like an elephant's trunk. It provides its own structural support through contraction of its muscles but also has a "soft skeleton" of connective tissue that surrounds and separates its different components (Hixon et al., 2014; Kent, 1997).

Velum

The velum, or soft palate, located in the pharynx, is an important structure for both speech and swallowing. You can see a portion of your velum by looking into a well-illuminated bathroom mirror. You will see a structure projecting downward called the **uvula**; the uvula is the termination of your velum.

Figure 3.8 Inferior view of an adult bony hard palate and teeth.
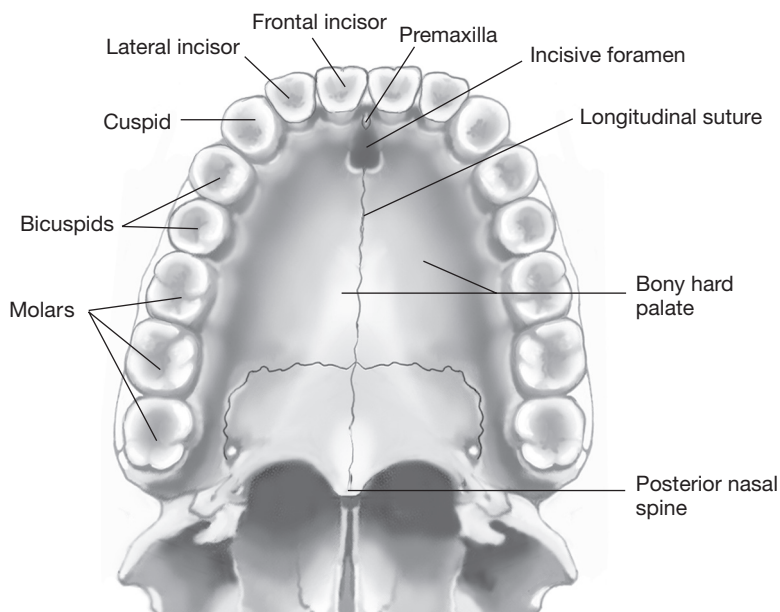
When you breathe through your nose, the velum hangs like a curtain from the posterior aspect of the bony hard palate. During swallowing and speech production, the velum elevates and decouples (separates) the nasal cavity from the pharyngeal cavity, leading to **velopharyngeal closure**, or contact of the velum with the lateral and posterior pharyngeal walls (Kuehn & Henne, 2003). Failure to separate these cavities during swallowing would result in food passing through the nasal cavity.

During speech production, velar elevation is necessary to prevent air from escaping through the nose and allow sufficient air pressure to build up in the oral cavity for production of pressure sounds (e.g., /p/, /b/). Any air that escapes through the nose during speech can result in a nasal-sounding resonance (quality).

Lifespan Issues of the Articulatory/Resonating System

The bones of the skull grow rapidly during the first years of life and reach adult size by about 8 years of age. At birth, the newborn has 45 separate skull bones that ultimately fuse into 22 bones by adulthood. Once they fuse together, the cranium appears to be one solid bone.

The bones of the lower portion of the face grow at a much slower rate than bones of the skull. These lower facial bones do not reach maximum adult size until about 18 years of age. Because of these different growth patterns of the skull bones and the facial bones, the face is able to grow downward and forward relative to the cranium (Kent, 1997).

Dentition in the infant begins to emerge at about 6 months of age. This first set of teeth is temporary and is usually referred to as primary, or deciduous, dentition. Emergence of the primary dentition is usually complete by 3 years of age. At approximately 5 years of age, the primary teeth begin to fall out, and the permanent, or secondary, teeth begin to appear. The emergence of the secondary teeth is usually complete by 18 years of age.

The tongue of the newborn occupies most of the oral cavity (Kent, 1997). During the first several years of life, the posterior portion of the tongue descends into the pharyngeal cavity. The tongue reaches its mature size at about 16 years of age. In general, the growth of the tongue is similar to the growth of the mandible (lower jaw) and to the lips (Kent, 1997).

At birth, the velum is in close proximity to the epiglottis (i.e., the large, leaf-shaped cartilage attached at its lower end to the thyroid cartilage of the larynx, just below the thyroid notch), causing the infant to have to breathe through his nose. As a result, the velopharynx is open during cry and noncry vocalizations, causing the infant to sound nasalized; that is, sound energy is directed through the nasal cavity rather than through the oral cavity (Hixon et al., 2014; Kent, 1981). By 2 months of age, infants are able to close the velopharynx for syllable productions, but this closure is not consistent. At some point between 6 months and 3 years of age, children consistently achieve airtight velopharyngeal closure for production of oral speech sounds. Adult patterns of velopharyngeal closure are achieved by age 3 and subsequently maintained throughout the lifespan (Hixon et al., 2014). Aging has been shown to have minimal impact on velopharyngeal function as it relates to speech production (Hoit et al., 1994; Zajac, 1997).

Finally, as one ages, the length and volume of the oral cavity increases. This anatomical change influences the overall resonant characteristics of the vocal tract in males and females by lowering the frequencies at which the vocal tract naturally resonates (Xue & Hao, 2003).

Click here to check your understanding of the concepts in this section.

THE SPEECH PRODUCTION PROCESS

The production of speech begins with the sound produced by vocal fold vibration, or **phonation**. Phonation is initiated by approximating or adducting the vocal folds and closing the glottis or opening. Once the vocal folds are closed, air pressure generated by the respiratory system increases beneath the vocal folds. Recall that the air pressure generated by the respiratory system that builds beneath the vocal folds is called *alveolar pressure*.

The air pressure from below displaces the lower edges of each vocal fold laterally (apart). This is followed by lateral displacement of the upper edges of each vocal fold, until the vocal folds are fully separated, opening the airway (frames 1, 2, 3, and 4 of Figure 3.9). Following maximum opening of the folds, the vocal folds' natural elastic restoring forces causes the lower edges of the folds to begin to move inward toward midline, followed by the upper edges, until the vocal folds collide with each other, closing off the airway (frames 5, 6, and 7 of Figure 3.9). The entire process is repeated in a cyclical fashion at the **fundamental frequency** of vibration, or the number of cycles (i.e., opening and closing of the vocal folds) per second (Story, 2002).

For each vibratory cycle, the air in the vocal tract is set into vibration, and sound is produced. The sound that results from vocal fold vibration is complex, consisting of a fundamental frequency, or the lowest-frequency component that corresponds to the rate of vocal fold vibration, approximately 40 additional higher frequencies called **harmonics**. The harmonic frequencies are whole-number multiples of the fundamental frequency. For example, when the fundamental frequency is 100 Hz, the second harmonic is 200 Hz, the third is 300 Hz, and so on. Figure 3.10 is a stylized spectrum of the complex sound produced by vocal fold vibration. A spectrum represents the frequencies of a complex sound along the horizontal (x) axis, and their relative intensity is represented on the vertical (y) axis. Note that the relative intensity decreases systematically with increases in harmonic frequency. Download PRAAT for free at www.praat.org to perform your own spectral analysis.

Figure 3.9 Anterior view of the vocal folds during one cycle of vibration. Air from the lungs creates a pressure beneath the vocal folds (1, 2, and 3). This pressure causes the vocal folds to separate (4). The natural elastic restoring forces of the vocal folds and the time delay with respect to the upper and lower portions of the vocal folds causes the vocal folds to begin to close (5 and 6). The vocal folds close the glottis to end the cycle, and the next cycle begins (7).
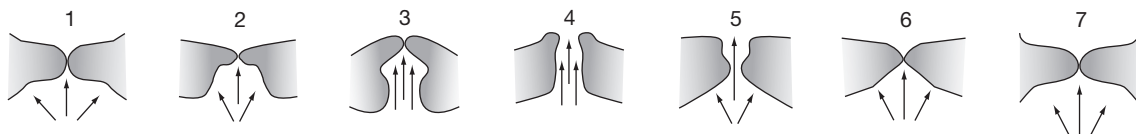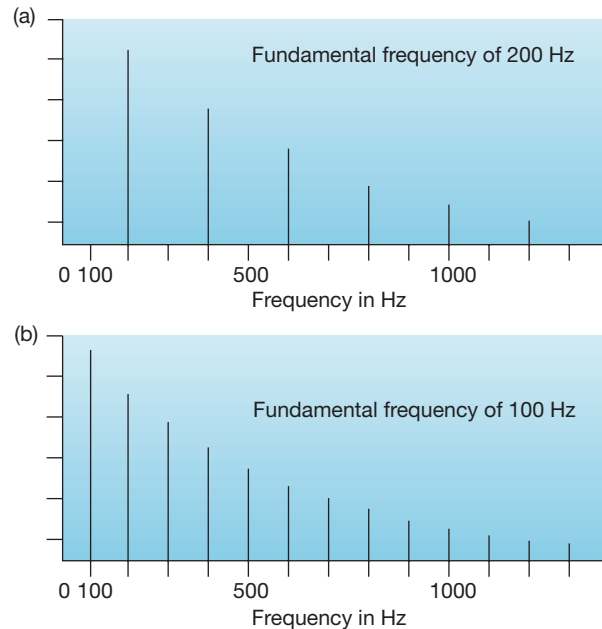
Figure 3.10 A spectrum illustrating a fundamental frequency of 200 Hz and related harmonics (a) and a spectrum of a fundamental frequency of 100 Hz and related harmonics (b).

(a)

Fundamental frequency of 200 Hz

0 100   500   1000
Frequency in Hz

(b)

Fundamental frequency of 100 Hz

0 100   500   1000
Frequency in Hz

Air-filled cavities are acoustic resonators. The frequency or frequencies at which a filled cavity will resonate are determined by the volume of the cavity, the area of the opening of the cavity, and the length of the opening of the cavity.

The vocal tract is an acoustic resonator that will modify the quality of the sound produced by the larynx. In any acoustic resonator, some frequencies are reduced or attenuated and other frequencies are enhanced, depending on certain physical aspects of the resonator.

Movement of the tongue, lips, and larynx will change the shape of the vocal tract and in turn modify the sound emanating from the larynx. Produce the vowels /i/ (as in the word "bee") and /u/ (as in the word "boot"). Try to sense how your tongue and lips change position for the production of these two vowels. Changes in the position of your lips and tongue in turn change certain physical characteristics of the vocal tract that directly affect the quality of the sound that emanates from your mouth.

Figure 3.11 represents how changes of vocal tract shape influence which frequencies are enhanced and which are attenuated. A complex sound is produced by vocal fold vibration (a), and the vocal tract acts as a filter attenuating some frequencies and enhancing others (b). The sound that emanates from the mouth during vowel production (c) is related directly to the general shape of the vocal tract determined largely by tongue position. Note that for the /u/ vowel, low frequencies are enhanced, whereas high frequencies are somewhat attenuated. For the /i/ vowel, low frequencies are somewhat attenuated, whereas high frequencies are enhanced.

During consonant production, your tongue is sometimes used to momentarily occlude your vocal tract for the production of stop sounds such as /t/, /d/, /k/, and /g/. Production of sounds such as /s/ and /sh/ require your tongue to form a constriction in the vocal tract that will produce frication noise when air is passed through the constriction.

Thought Question

Click here to check your understanding of the concepts in this section.

Figure 3.11 Spectra of glottal sound source (a) that sets the air in the vocal tract (b) into vibration. The vocal tract filters the glottal sound source differently for the vowels /i/ and /u/, as seen in the radiated spectra (c).
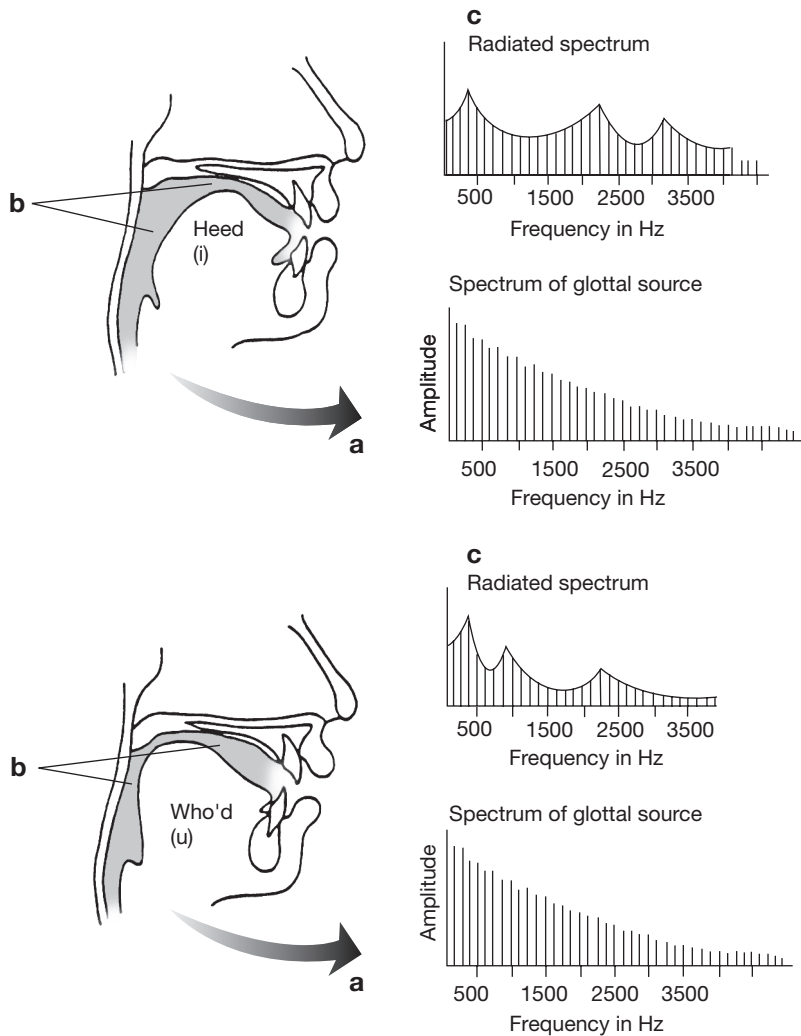
SUMMARY

This chapter provides a general overview of the anatomy and physiology of the speech and voice mechanism. The study of the structures that are used to produce speech and their function is extensive and complex. It is important to remember that although anatomy is static, these structures are capable of dynamic movement that can result in the unique human processes of speech.

The study of anatomy and physiology is essential for a speech-language pathologist. Knowledge and understanding of this topic will assist in the evaluation and treatment of clients whose communication disorder is a direct or indirect result of a breakdown within these systems.

SUGGESTED READINGS

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Kent, R. (1997). *The speech sciences.* San Diego, CA: Singular Publishing.

Zemlin, W. (1998). *Speech and hearing sciences anatomy and physiology* (4th ed.). Boston, MA: Allyn & Bacon.

4

Language Impairments in Children

CHAPTER LEARNING GOALS

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

- Characterize language impairment
- Describe the disorders associated with language impairment
- Explain the process of assessment in language impairment
- Describe the overall design of language intervention

L anguage impairments are a complex group of diverse disorders and delays with a wide range of characteristics, levels of severity, and causes. Some children may exhibit disorders in which language is inappropriate, inefficient, or ineffectual; others use language that is seemingly immature. A word of advice before we begin: It might be helpful to review the parts of language, such as syntax and semantics, mentioned in Chapter 2.

The term **language impairment (LI)** applies to a heterogeneous group of developmental and/or acquired disorders and/or delays that are principally characterized by deficits and/or immaturities in the use of spoken or written language for comprehension and/or production purposes that may involve the form, content, and/or function of language in any combination. Consider the following about this definition of LI:

- Children and adolescents with LIs are very different from each other. The impairment may occur at any time within the lifespan, and individuals vary in terms of symptoms, manifestations, effects, and severity over time and as a result of context, content, and learning task.

- The impairment may be a result of developmental abnormalities and/or may be acquired as a result of accident, injury, or other environmental factors.

- Deficits and/or immaturities may exist in one or more means of communication, such as listening/speech or reading/writing, and may affect receptive and/or expressive language. For example, preschoolers with LIs are often less able to recognize and copy letters and less likely to write and draw every day, to pretend to read, and to ask questions during parental reading (Marvin & Wright, 1997). In short, young children with language impairments are at risk for literacy difficulties when they later attend school (Nathan et al., 2004).

- One or more aspects of language—form, content, and use—may be affected. For example, as a group, children with LIs use shorter, less elaborated sentences than typical children their age (Greenhalgh & Strong, 2001).

Case Study 4.1 presents the story of one child with LI.

Box 4.1 presents an example of the somewhat scrambled language that we might find exhibited by some children with LIs. It is unclear whether most children with LIs exhibit impairments in other areas of development as well, but language deficits persist at least through the primary school years for many children (Tomblin et al., 2003). In the classroom and even on the playground, children with LIs, especially boys and those with severe receptive language deficits, may be reticent to speak and may lack social maturity and exhibit behavioral problems (Hart et al., 2004; Huaquing Qi & Kaiser, 2004).

Noticeably absent from our definition of impairment are language differences, such as those found in some dialectal speakers and in English language learners (ELLs). Differences do not in themselves constitute LIs and do not require clinical intervention by a speech-language pathologist (SLP), although elective intervention is possible at the client's request.

You can find easy-to-read guides to LI and other communication disorders at the American Speech-Language-Hearing Association website (www.asha.org).

Case Study of a Child with Language Impairment: Kassandra

Kassandra, an active 5-year-old, is an engaging child and an enthusiastic kindergartner. Born 1 month preterm and weighing only slightly over 4 pounds, she was kept in the hospital for postnatal care and observation for several weeks. The team of specialists who worked with Kassandra in the hospital recommended to her parents that she receive early intervention services, first in the home and later at a local clinic. The team was concerned because Kassandra was at risk of having later developmental problems.

By 18 months, Kassandra was not talking, and the team recommended to her parents that she attend a special language-intensive preschool where she would receive both individual and group intervention services. Working together, the speech-language pathologist, developmental specialist, and classroom teacher conducted a thorough evaluation of Kassandra's early communication behaviors, motor skills, and cognitive abilities. Although Kassandra's speech and language were delayed, she appeared to have motor and cognitive abilities that were close to those of typical children.

The speech-language pathologist worked closely with both the classroom teacher and Kassandra's parents to ensure that there was consistency across different communication environments in the way the others interacted with the girl and in the communication requirements. Kassandra's program was individualized to include words and phrases for entities in her environment. Once she began to use single words, Kassandra quickly learned to combine them into longer and longer phrases. When she entered kindergarten, she demonstrated language abilities in the low normal range.

As you read the chapter, think about:

- Possible explanations for Kassandra's delay
- Possible evaluative procedures that could be used to measure Kassandra's language
- Possible targets that the intervention team might choose to help Kassandra develop and use language

BOX 4.1 | Example of a Conversation with a Language-Impaired Child

Teacher: Does your family have a pet?

Child: Yeah.

Teacher: Tell me about this pet.

Child: Got a pet.

Teacher: Um-hm, tell me about the pet.

Child: Got a pet.

Teacher: Yes, and I really want to hear about him.

Child: Got with my . . . ah, go with my . . . Dad go with . . .

Teacher: Your dad walks the pet.

Child: No, me.

Teacher: Oh, you and your dad walk the pet.

Child: No, me.

Teacher: Oh, just you walk the dog.

Child: No, me.

Teacher: I'm confused.

Child: Me dog.

Teacher: Oh, it's your dog. Who walks your dog?

Child: With one of them things, you know.

Teacher: What things? Who walks your dog?

Child: With them things like this.

Teacher: Yes, you use a leash.

Click on "Information for: The Public" at the left and then click on "Disorders and Diseases" at the right.

To guide you through this complicated topic, this chapter briefly looks at typical language development followed by a discussion of the major disorders associated with LI. Of necessity, this discussion is an overview, with details left for further study.

LANGUAGE DEVELOPMENT THROUGH THE LIFESPAN

Theoretically, all speakers of a language should be able to communicate. Some differences may be so great as to impair communication but not qualify as a disorder.

As you already know, language is complex; thus any attempt to describe its development is also very complicated. In the following sections, we cover only the highlights of child and adolescent development and relate these to some of the disorders to be discussed later in the chapter. An outline of language development is presented in Table 4.1.

Pre-Language

Children become communicators because they are treated as if they are communicators.

Much of the first year of life is spent learning to be a communicator. Caregivers talk to newborns as if these children understand what the adults are saying. Later on, as children begin to comprehend language in limited ways, caregivers modify their style of talking to maximize comprehension and participation by the child.

Shortly after birth, infants become actively involved in a reciprocal process with caregivers. Infants are especially responsive to their caregivers' voices and faces. Sensitive mothers vary their rate of speech based on their infants' rate of responding (Hane et al., 2003). To maintain attention, caregivers exaggerate their

TABLE 4.1

Language development through the lifespan

Age	Accomplishments
3 months	Responds vocally to partner.
8 months	Begins gesturing.
12 months	First word spoken. Words fill intentions previously signaled by gestures.
18 months	Begins combining words on the basis of word-order rules
2 years	Begins adding bound morphemes. Average length or mean length of utterance (MLU) is 1.6–2.2 morphemes.
3 years	More adultlike sentence structure. MLU is 3.0–3.3 morphemes.
4 years	Begins to change style of talking to fit conversational partner. MLU is 3.6–4.7 morphemes.
5 years	Ninety percent of language form learned.
6 years	Begins to learn visual mode of communication with writing and reading.
Adolescence	Able to participate competently in conversations and telling of narratives. Knows multiple meanings of words and figurative language. Uses a gender style, or genderlect, when talking.

Source: Based on information found in Owens (2013).

facial expressions and voice and vocalize more often. In turn, infants respond with eye contact or vocalizations. Developmental changes affect the dynamic relationship between child and caregiver behaviors and the context.

Infants are full partners, and their behavior is influenced by the communication behavior of their caregivers. Turn taking by adults benefits infant sound making. Infant babbling becomes more speechlike and mature, containing syllables rather than individual sounds.

During the first 3 months, caregivers' responses teach children the "signal" value of specific behaviors, and infants learn a stimulus–response sequence. If they signal—by crying, for example—caregivers respond. In addition, they learn that a relatively constant stimulus or signal, such as a bottle, results in a predictable response, such as feeding.

By 3 to 4 months, rituals and game playing have emerged. Rituals, such as feeding and diaper changing, provide children with predictable patterns of behavior and speech. As they learn that interactions can unfold in predictable ways, they begin to form expectations of events and to participate more. Games such as "peekaboo" and "I'm gonna get you" have many of the aspects of communication. There is an exchange of turns, rules for each turn, and particular slots for words and actions.

At about 8 to 9 months, infants develop **intentionality** in their interactions primarily through gestures. For the first time, a child's behavior is meant to influence the other person. Communicative behaviors, such as requesting, interacting, and attracting attention, are first signaled by prelinguistic communicative means and only later by language.

An intention to communicate is signaled through gestures accompanied by eye contact with the child's communication partner, the use of consistent sound and intonational patterns for specific intentions, and persistent attempts to communicate. Intentional vocalizations or sounds are different from the "private speech" infants use in solitary activities (Papaeliou & Trevarthen, 2006).

Initially, gestures appear without vocalizations, but the two are gradually paired. Consistent vocal patterns, dubbed **phonetically consistent forms (PCFs)** or **protowards**, accompany many gestures.

As an infant, you probably used your first meaningful word to express an intention at around 12 months. Real words are used with or without gestures to accomplish the communication goals previously filled by gestures. To develop spoken language, children must be able to store sounds, use this information for later comparison and identification, and relate these sounds to meaning.

During the first year, an infant learns the sound patterns of the native language. Better speech perception at 6 months of age is related to better word understanding, word production, and phrase understanding later (Tsao et al., 2004). An infant's perceptual ability is usually restricted to his or her native language's speech sounds and syllables by 8 to 10 months of age. These patterns play a critical role in facilitating speaking and learning word meanings. Most words are probably comprehended based on the sound pattern, context, and nonlinguistic and paralinguistic cues.

The task of learning language and learning to represent and to symbolize is strongly related to cognitive abilities. **Representation** is the process of having one thing stand for another. For example, in play, a piece of paper might be used as a blanket for a doll. **Symbolization** is using an arbitrary symbol, such as a

Games and rituals share many characteristics with conversations.

Early intentions, such as attracting attention, are established in gestures, and first words fill these same functions, often with the accompanying gesture.

word or sign, to stand for something. Initially, that "something" is in the context and "triggers" or stimulates production of the word. By about 18 months of age, the child will be able to refer to mom even though she is not present. In this very simplified explanation, the symbol has come to represent the referent or to symbolize it.

Toddler Language

By 18 months, you, like many other children, probably could produce approximately 50 single words and were beginning to combine words in predictable ways. Within a few short months, three- and four-word combinations appeared. Accompanying the increases in utterance length and vocabulary is a decrease in the use of babbling, or sound making.

Use

People who are unfamiliar with young children's language often think that children either imitate all first words or use them only to name. In fact, single words are used to make requests, comments, inquiries, and more.

As mentioned, words are acquired first within the intentions that the child is able to express in previously acquired gestures. Several early intentions are presented in Table 4.2. Note all the uses or intentions expressed in the conversation presented in Box 4.2.

Content and Form

The second year is one of vocabulary growth and word combinations. Vocabulary growth is slow for the first few months but then increases rapidly. Although the ability to comprehend words develops gradually, it is highly context dependent at first (Striano et al., 2003). Eighteen-month-olds are capable of learning new word-referent associations in as few as three exposures (Houston-Price et al., 2005). By age 2, a toddler has an expressive vocabulary of about 150 to 300 words. Two-year-olds with larger vocabularies also use a greater range of grammatical structures (McGregor et al., 2005).

TABLE 4.2

Examples of early intentions of children

Intention	Example
Wanting demand	Says the name of the desired item with an insistent voice. Often accompanied by a reaching gesture.
Protesting	Says "No" or the name of the item while pushing it away, turning away, and/or making a frowning face.
Content questioning	Asks "What?" or "That?" or "Wassat?" while pointing and/or looking at an item.
Verbal accompaniment	Speech accompanies some action, such as "whee-e-e" when swung or "Uh-oh" when something spills.
Greeting/farewell	Waves hi or bye with accompanying words.

Note: A fuller list can be found in Owens (2014).

BOX 4.2 | **Example of Toddler Language**

Stacy and her mother are talking while they are coloring. Note that the language concerns the task. Stacy's mom keeps her utterances short and cues Stacy to respond by asking questions. Stacy participates by talking about the task, often incorporating part of the previous utterance into her own:

Mom: What are you making?

Stacy: Doggie.

Mom: Are you making a doggie? Oh, that's nice, Stacy.

Stacy: Where more doggie?

Mom: Is there another doggie underneath?

Stacy: Yeah.

Mom: Where? Can you find the picture? Is that what you're looking for, the picture of the doggie? Where's a doggie?

Stacy: A doggie. Color a doggie.

Mom: Okay, you color the doggie.

Stacy: Mommy color crayon.

Mom: Mommy has crayons. Mommy's coloring. What's mommy making?

Stacy: Doggie.

Mom: A doggie.

Stacy: Okay.

Mom: All right, I'll make a doggie. Is this the doggie's tail?

Stacy: Doggie's tail. More.

Mom: More doggie?

Stacy: Okay.

Mom: Can Stacy color? Hum?

Stacy: More doggie there. More doggie daddy.

Mom: More doggie daddy?

Stacy: Want a more doggie. More doggie. Put more doggie there.

Mom: Okay, you color the doggie on this page. What color's your doggie?

Stacy: Blue. Color this page, mommy.

Each toddler has his or her own **lexicon**, or personal dictionary, containing words that reflect that child's environment. In general, toddlers' definitions, based on each child's limited experience, are not the same as those of adults.

Early word combinations follow predictable patterns. Some individual words are joined with other individual words, such as "Throw ball" with no discernible patterns. Neither word is combined with other words. In contrast, some words are combined with several others, as in "Eat cookie," "Eat cracker," "Eat candy," and the like. Finally, other words are used flexibly in several different combinations, as in "Mommy drink," "Drink juice," and "More drink."

A child's short utterances represent a complex interaction of syntactic knowledge; limited cognitive resources, especially working memory; communicative goals; and the structure of the conversation (Valian & Aubry, 2005).

> Adult and toddler definitions are very different. Toddler definitions are based almost exclusively on experience, whereas adult definitions are based more on meanings shared with others.

Preschool Language

For preschoolers, most communication occurs within the framework of conversations with caregivers. With increased memory, children expand their conversational skills to include recounting the past and remembering short personal stories. This memory and recall are aided by the child's increased language skills.

> Language rule learning is a lengthy process that involves hypothesis testing and refinement.

The creativity found in preschool language may reflect a process called substitution. A high percentage of preschool children's utterances differ only slightly from utterances produced previously. For example, a child might say, "Doggies are yucky," "Kitties are yucky," "Cows are yucky," and the like, substituting different words in the same frame (Lieven et al., 2003).

From interaction with others, children form hypotheses about the rules of language and use these hypotheses to produce ever more complex language. Caregivers in each child's environment provide feedback and models for further growth, such as repeating the child's utterance in more mature form or reformulating it (Chouinard & Clark, 2003). For example in a **reformulation**, an adult might respond to "Tommy come 'morrow my birthday" with "Yes, tomorrow your cousin Tommy is coming to your birthday party with all the other kids." Through a process of further and further refinement, children's language increasingly reflects that used in their environment.

The process of language rule hypothesis building is evident in constructions such as *eated* and *goed* that are not found in adult speech but represent a rule in English. Verbs are made past tense by adding *-ed*. Unfortunately, not all verbs follow this rule.

Some children are risk takers who attempt new structures and make mistakes. Other children may make few errors because they attempt to produce new structures infrequently (Rispoli, 2005).

Use

In conversations with caregivers, preschool children introduce topics and maintain them for an average of two to three turns. It is often easier for a preschool child to introduce a new topic than to continue an old one, as in the following example:

Child: I got a new bike.

Partner: What color is it?

Child: Red.

Partner: Did you ride it on your birthday?

Child: Mommy saw a spider.

In conversations, preschool children begin to consider that the listener needs to know certain information and the amount of information needed and that there is a need to change conversational style when speaking to younger children.

Style of talking is also reflected in role-playing and narration or storytelling. Four-year-old children can tell simple sequential stories, usually about past events.

Content

Children's expressive vocabularies grow to approximately 300 words by age 2, then mushroom to 900 and 1,500 at ages 3 and 4, respectively (see Box 4.3). They may comprehend two or three times that many words in context.

Words are learned quickly through a process called **fast mapping** in which the child infers the meaning from context and then uses the word in a similar manner. Fuller definitions evolve over time.

In addition to single words, preschool children acquire some relational words and phrases that are used to join other words and create longer units of language.

BOX 4.3 | Example of Preschool Language

G and B are young 4-year-olds. They are playing with firefighter hats, dishes, and dolls. Notice how different this sample is from the toddler language in Box 4.2. Each child supports her portion of the conversation. The syntax seems adultlike, but the content is pure preschool. The rapid change of topics gives this sample a nonsensical quality. With no adult to maintain a cohesive topic structure, this is a free-for-all with only one or two turns on each topic before it shifts:

G: And I gonna wear both of these.

B: At the same time? No, I'm wearing this one.

G: I'm wearing this one.

B: And then I do this.

G: You wear this and I'll wear this.

B: Two colored cups. You drink out of this one. I drink out of the big one. I'm putting the box up there.

G: Okay, I will I have this and you have this.

B: Stay up there.

G: She doesn't look too happy.

B: Uh-oh. Why did I spill it?

G: Mine will only stand.

B: Mine sat.

G: All done with supper. What kind of spoon is this?

B: A plastic one, what else? Now it's time for me to make my own dinner.

G: Time for me too. I have to use this. My baby has to go to bed now. We have to first change their diapers.

B: No we don't.

G: Come here, look.

B: There's a button. I want something to drink.

G: Okay, I'll give you some. Look at this. Watch this. I'm gonna try and make this stand. Do you think this is a girl or a boy?

B: A boy.

G: Oh, cause the boy has the pants on and the girl has the dress on.

B: Happy birthday to you.

G: Grab everythin' up. I'm grabbing most of the doll stuff.

Categories of relational words include locational terms such as *in, on,* and *under*; temporal terms such as *first* and *last*; quantitative terms such as *more than*; qualitative terms such as *bigger than*; familial terms such as *brother*; and conjunctions, such as *and, if, so, but,* and *because.*

In part, semantic development reflects cognitive development. For example, 4-year-olds demonstrate categorization skills that seem to indicate more advanced procedures for storage of learned information than are seen in younger children.

Adultlike forms of many sentences evolve during the preschool years.

Form

During the preschool years, changes in language form are very dramatic. Beginning with two- to four-word sentences at age 2, you probably acquired 90% of adult syntax by age 5. For English-speaking preschoolers, language becomes more complex as it becomes longer. We can describe children's language development by calculating the average, or **mean length of utterance (MLU)**, in morphemes. The calculation of MLU is discussed later in this chapter. Some MLU values are presented in Table 4.1.

The simple constructions found in the utterances of 18- to 24-month-olds form the basis for a more elaborate grammar, and by age 3, most children's utterances contain both a subject and a verb. This basic structure is elaborated with

the addition of articles, adjectives, auxiliary verbs, prepositions, pronouns, and adverbs.

In addition, adultlike negative, interrogative, and imperative sentence forms evolve. For example, a toddler negative consisting of *No cookie* is modified by words such as *no, not, can't, don't,* and *won't* being placed between the subject and verb, as in *Mommy can't catch me.* Other negatives such as *wouldn't, couldn't, is not,* and *isn't* are added later.

Similarly, interrogatives or questions go from single words—such as *Doggie?* and *What?* or *Wassat?*—to more complex questions that ask *what* and *where*; followed developmentally by *who, which,* and *whose*; and, finally, *when, why,* and *how* and a more mature form in which the verb or auxiliary verb and subject are reversed from the statement "She is happy" to form "Is she happy?" or "Why is she happy?" Repeatedly hearing caregiver questions can have a beneficial effect on a preschooler's development of adultlike questions (Valian & Casey, 2003).

By the end of preschool, children are joining two or more independent clauses together to form compound sentences. Late preschoolers can also attach dependent clauses to independent clauses to form complex sentences such as *I didn't liked the big dog that barked at grandpa last night.* These structures appear infrequently in preschool; they develop slowly and are refined throughout the school-age years.

Several bound morphemes are added during the preschool years. These include the progressive verb ending *-ing,* as in *jumping*; plural *-s,* as in *cats*; possessive *-'s* (or *-s'*), as in *mommy's*; and the past tense verb ending *-ed,* as in *talked.* As might be expected, it takes children some time to acquire the use of these morphemes, and it is not uncommon to hear words such as *eated, goed, sheeps,* and *foots.*

School-Age and Adolescent Language

When children begin to attend school, they start the long process of establishing their identity independent of their family. Most communication now occurs in conversations outside the home. In part, the status of adolescents within their own social grouping is determined by communication skills.

The means of communication change in school as children learn to read and write. In turn, this skill enables children to use computers, tablets, and cellphones, and it opens a whole new world of information. This development is discussed in Chapter 5.

Reading and writing development is related to **metalinguistic skills**, which enable a child to consider language in the abstract, to make judgments about its correctness, and to create verbal contexts, such as in writing. Younger children are unable to make such judgments, especially without a supporting nonlinguistic context.

Five-year-olds use very adultlike language form, although many of the more subtle syntactic structures are missing. In addition, these children have not acquired some of the pragmatic skills that are needed to be truly effective communicators.

Over the next few years, language development slows and begins to stabilize, but it will be nonetheless significant. Many complex forms and subtle linguistic uses are learned in the adolescent period. The preschool emphasis on development of language form becomes less prominent, and semantic and pragmatic development blossom.

Conversation continues to be the primary locus of communication, and children and adolescents learn to be more effective and efficient communicators. Adolescents consolidate their self and personal identity through peer relationships and restructured family interactions. Slang is used within the peer group to distinguish adolescents from both children and adults. Interactional lessons from the family form a basis for the deepening relationships with peers (Whitmire, 2000).

Use

During the early school-age years, children's language use changes in two ways: Conversational skills continue to develop, and narratives expand and gain all the elements of mature storytelling. Children refine their conversational skills and learn effective ways to introduce new topics and to continue and to end conversations smoothly and appropriately. While in a conversation, they make relevant comments and adapt their roles and moods to fit the situation. In addition, school-age children learn to make even more and increasingly subtle assumptions about the level of knowledge of their listeners and to adjust their conversations accordingly.

Within conversation, teens demonstrate more affect and discuss topics infrequently mentioned at home. The number of turns on a topic increases greatly. Although interrupting increases, it has evolved into behaviors, such as asking pertinent questions, that serve to move the topic along.

Narratives, both in conversation and in writing, gain the elements needed in our culture to be considered satisfying. English literate narratives contain an introductory setting statement and a challenge or challenges that the characters overcome. Events are organized both sequentially and by cause and effect.

Even with the development of writing, conversation is still the predominant use for language.

*Language is a complex interplay of form, content, and use. As you watch this **video**, notice the way the 13-year-old is able to use all aspects of language to move the narrative along.*

Content

Vocabulary continues to grow, but number of words is only the most superficial measure of semantic change. First-graders have an expressive vocabulary of approximately 2,600 words but may understand as many as 8,000 root English words and possibly 14,000 when various derivations are included. Aided in school, this receptive vocabulary expands to approximately 30,000 words by sixth grade and to 60,000 words by high school.

Definitions become more dictionary-like, which means they become less experiential or less based on individual experience and more shared, more categorical (as in *An apple is a kind of fruit*), and more precise. Multiple word meanings are also acquired. The ability to provide definitions is related to the acquisition of metalinguistics, mentioned previously (Benelli et al., 2006). The increasing size of children's vocabularies requires more precision and an organization into categories for easy retrieval.

School-age children also learn to understand and use **figurative language**. Unlike literal meanings, figurative language does not always mean what it seems to mean. For example, *idioms* are expressions that often cannot be understood literally, such as "hit the road" or "off the wall." Figurative language enriches communication, requires higher language functions of interpretation, and correlates with adolescent literacy skills (Dean Qualls et al., 2003). Some forms are not comprehended until adulthood.

Form

Following the rapid development of language form in preschool, there is a gradual slowing, although development continues. Many forms continue to develop into adolescence.

By age 5, children use most verb tenses with common verbs and auxiliary or helping verbs, such as *would, should, must,* and *might*; possessive pronouns (*his, her, your*); and the conjunctions *and, but, if, because, when,* and *so.* They still have some difficulty with multiple auxiliary verbs, as in *should have been.* Five-year-old children also have limited use of the comparative *-er,* as in *bigger,* and superlative *-est,* as in *biggest*; relative pronouns used in complex sentences (I know *who* lives next door); gerunds (We go *fishing*); and infinitives (I want *to eat* now).

Many syntactic structures appear slowly, and children may struggle with acquisition well into the school years (Eisenberg et al., 2008). During the school years, children gradually add passive sentences, such as *The cat is chased by the dog,* in which the entity performing the action is placed at the end rather than the beginning of the sentence; reflexive pronouns, such as *myself, yourself, himself,* and *themselves*; conjunctions, such as *although* and *however*; and variations of compound and complex sentences. It frequently takes a child several years of practice to gain complete control of these linguistic structures. And children may use some, such as conjunctions, correctly in speech before they fully understand the relationships expressed (Cain et al., 2005).

Morphological development focuses on derivational suffixes—word endings that change the word class, such as adding *-er* to a verb to make a noun, as in *paint/painter*—and prefixes. Development of prefixes, such as *un-, ir-,* and *dis-,* will continue into adulthood.

Thought Question

ASSOCIATED DISORDERS AND RELATED CAUSES

As you can see, language and its use are extremely complex. It stands to reason, then, that language impairment (LI) would be even more so. So many things can go wrong at so many junctures that each child with an LI represents a unique set of circumstances.

In this section, we discuss several disorders in which LI is a significant factor. Of necessity, we discuss groups of children under different categories of disorder. Categories are helpful for discussion of shared characteristics, but categories are not the same as individuals. Each of us is unique.

The effect that any disorder has on communication and on language development varies with the severity of the disorder and the age of the client. As individuals mature, the communicative requirements change.

We'll make some general statements about LI before we get more specific. In a nationwide survey of 4- to 5-year-old children in Australia, researchers reported that 25.2% of parents had concerns about how their child talked and made speech sounds, supported by teachers' reports that 22.3% of children were considered to be less competent than others in their expressive language ability (McLeod & Harrison, 2009). Some of these children had speech sound errors. On formal language testing, approximately 15% of children were below the "normal" range in expressive language.

A second national survey in Australia found that the biggest risk factors for LI include (Harrison & McLeod, 2010):

- Being male
- Having ongoing hearing problems
- Having a more reactive temperament

You may have expected the names of some disorder types here, but there are too many—as you'll soon see—for any one disorder to dominate. Protective factors, or those that can somewhat counter LI, are:

- Having a more persistent and sociable temperament
- Higher levels of maternal well-being

It's easy to see that social and environmental factors, especially the child's temperament and the mother's nurturing, play a key role, along with biological and psychosocial factors intrinsic to each child. Researchers are now identifying important genetic factors that account for variance in children's conversational language skills (DeThorne et al., 2008).

In addition, research indicates sustained attention deficits in children with LI. Although found in both auditory and visual modalities, attention problems are more pronounced for auditory stimuli, the primary input for language learning (Danahy Ebert & Kohnert, 2011).

Although some disorders that we will discuss are characterized by difficulty with specific aspects of language, most children with LI have difficulty in more than one area. For example, many children with pragmatic difficulties also demonstrate poor receptive vocabulary and poor picture-naming abilities. In addition, many of these children make more semantic errors, nonrelated errors, and omissions and circumlocutions than their typically developing (TD) peers (Ketelaars et al., 2011).

It's easy to assume from these data that children with LI perform like younger children with similar language skills. That would be incorrect and would overlook the struggles of children with LI.

The long-term effects of LI for many children are not good, especially without intervention. Children who are identified as late-talkers at 24–31 months still have a weakness in language-related skills in late adolescence (Rescorla, 2009). Although most perform in the average range on all language and reading tasks at 17 years of age, they do significantly more poorly in vocabulary/grammar and verbal memory than socioeconomic status (SES)-matched TD peers. Looking at other aspects of life, a nationwide longitudinal study in the United Kingdom found that when compared to TD peers, children with LI had poorer outcomes in literacy and also in mental health, as well as employment, even at 34 years of age (Law et al., 2009).

We will not be discussing all children with LI. The largest group to be excluded are individuals with hearing impairments. Those individuals are discussed in Chapter 12. Children may also exhibit impairments such as aphasia or loss of language as a result of localized brain injury, as discussed in Chapter 5.

One last caution before we move on: The names of some of the disorders we will discuss are in flux. Where this is occurring, we warn you. For example, *intellectual disability* (*ID*) used to be called *mental retardation*. Although many professionals now use *ID,* the term, strictly speaking, includes any cognitive disorder, including traumatic brain injury and Alzheimer's disease. This muddies the picture some. You've been warned; let's go.

Click here to check your understanding of the concepts in this section.

Intellectual Disability

The American Association on Intellectual and Developmental Disabilities (AAIDD) defines intellectual disability (ID), formerly called mental retardation, as consisting of the following:

- Substantial limitations in intellectual functioning;
- Significant limitations in adaptive behavior consisting of conceptual, social, and practical skills
- Originating before age 18 (AAIDD, 2009)

Accounting for approximately 2.5% of the population, people with ID vary based on causality and other factors, such as the amount of home support, the living environment, education, mode of communication, and age.

Several websites provide more information on ID. The National Institute of Child Health and Human Development website (www.nichd.nih.gov) is a good place to begin your research of intellectual and developmental disabilities. Type "IDDs overview" in the search box.

Severity classifications are usually based on the level of IQ and range from mild (IQ 52–68) to profound (IQ below 20). IQ alone may reveal little about a person's overall functioning. Similar IQs in individuals may result in very different skill levels. Other variables are age and the type of disorder.

The use of IQ as a measure of severity is slowly changing. Newer severity ratings are based on the amount of assistance an individual needs to get through his or her daily life. This measure is more holistic and considers a client's entire life.

Causes of ID are almost as varied as individuals. Two large categories of possible causal factors are biological and socioenvironmental. These factors may be complicated by cognitive limitations that can affect the processing of incoming and outgoing information such as speech and language. Biological factors include the following:

- Genetic and chromosomal abnormalities
- Maternal infections during pregnancy
- Toxins and chemical agents
- Nutritional and metabolic causes
- Gestational disorders affecting development of the fetus
- Complications from pregnancy
- Complications from delivery
- Brain diseases

Socioenvironmental factors include a stimulation-impoverished environment, poor housing, inadequate diet, poor hygiene, and lack of medical care. The effect of each of these factors varies with each child.

Processing of information consists of four steps: attending, discriminating, organizing, and retrieving. In general, individuals with mild to moderate ID can sustain attention as well as mental-age-matched non-ID peers but have difficulty scanning and selecting stimuli to which to attend.

The ability to discriminate likenesses and differences is related to the severity of ID. The more severe the ID, the more difficulty the person will have in

Intellectual disability means more than just low IQ. Values such as IQ usually measure past learning only.

Individuals with intellectual disability may process incoming sensory information differently from those without disability.

discriminating. In general, individuals with ID are limited in their ability to identify relevant cues and attend to all dimensions of a task.

Organization or the categorizing of information for storage is especially challenging for individuals with ID. In short, they do not rely on strategies that link words and concepts to one another. Nor do they spontaneously rehearse information for easy retrieval.

Memory or retrieval of previously stored information is poor and operates more slowly within the population with ID. Organizational deficits contribute to this performance. To some extent, memory is affected by the type of input. In general, individuals with ID have more difficulty with auditory input, especially linguistic, than with visual input.

Incoming linguistic information undergoes several types of decoding. Simultaneous synthesis occurs all at once and extracts overall meaning. Successive synthesis is more linear, occurring one at a time. Although individuals with ID exhibit some difficulty with both types, those with Down syndrome have much greater difficulty with successive processing, possibly reflecting poor auditory working memory. Working memory is the place where incoming and outgoing information is held while it is processed.

Lifespan Issues

Some newborns and infants with ID are identified early because of obvious physical factors, such as syndromes or anatomical anomalies, at-risk indicators such as low birthweight or poor physical responses, or delayed development. Intervention may begin at home or in special early intervention programs. It is best for the child if intervention begins as soon as possible. Early intervention focuses on sensorimotor skills, physical development, and social and communicative abilities. An Individualized Family Service Plan (IFSP) specifying services is written in collaboration with caregivers.

Some children with ID are not identified until age 2 or 3. These youngsters, along with those previously identified, will likely attend a special preschool. They may receive intervention services, such as physical therapy, special education, or speech-language therapy in either the home or school.

Depending on the severity of a school-age child's ID, she or he may either attend a regular education class and receive special services or receive education in a self-contained, special classroom. Education and training will focus on academic skills, daily living and self-help activities, and vocational needs, depending on the abilities of the child.

Only children with the most profound ID accompanied by other disabilities are institutionalized. Generally, children who cannot reside at home live in community residences with 8 to 10 other children their age and with houseparents.

Mike, a boy with profound ID and cerebral palsy, lived at home with his parents as an infant and preschooler. As he matured and his parents aged, Mike was placed in a community residence with other young adults with ID. He received daily care at this center and was able to continue his education at the same school. Most of his training involved daily living skills and use of a communication board to communicate.

In adulthood, living and working arrangements vary widely. People with milder ID often live in the community and work competitively in minimally skilled jobs. More severely involved individuals may live with family members or

Children with ID can offer a special challenge to educators, especially if a child has multiple disabling conditions. As you watch this **video,** observe Carly attempting various tasks and listen to the parents and teacher talk about her achievements.

in community residences containing a small group of similar adults. They may work in a special workshop or be enrolled in a day treatment program in which education and training continue to be the focus.

Language Characteristics

Very few individuals with intellectual disability live in large institutions. Since the 1970s, a philosophy called deinstitutionalization has been responsible for the movement of individuals with ID into small community residences.

Children with ID vary greatly in their communication abilities. For example, children with Down syndrome (DS) and fragile X syndrome (FXS) have moderate to severe delays in communication development in all areas of language (Roberts et al., 2001). In phonology, boys with FXS make errors similar to those of younger typically developing youth, whereas those with DS have more significant phonological differences than might be expected by delayed development alone (Roberts et al., 2005). In contrast, boys with FXS produce longer, more complex utterances than do boys with DS (Price et al., 2008).

For many individuals with ID, language is the single most important limitation. For approximately half of the population with ID, language comprehension and/or production is below the level of cognition. This might be indicative of cognitive processing problems that accompany ID. For example, those with DS exhibit auditory working memory deficits (Seung & Chapman, 2000).

In initial language development, individuals with ID follow a similar but slower developmental path than that of typically developing children. Even so, these children often produce shorter, more immature language forms (Boudreau & Chapman, 2000). In later development, the paths begin to differ more from typical development. All areas of language exhibit some delay and disorder in children with ID.

Learning Disabilities

Children with language learning disabilities have difficulty learning and using symbols for speaking, listening, reading, and writing.

According to the National Joint Committee on Learning Disabilities (1991), the term *learning disability* (*LD*) refers to a heterogeneous group of disorders that are manifested by significant difficulties in the development and use of listening, speaking, reading, writing, reasoning, or mathematical abilities. The disorders reflect difficulties in the central nervous system that are not caused by other conditions or environmental influences. Although similar, the definition of LD found in the fifth edition of the *Diagnostic and Statistical Manual* (DSM-5) of the American Psychiatric Association (APA, 2013) calls LD *learning disorder*. If the disorder is focused in one area, such as reading and writing, it is termed a "specific learning disorder" in that affected area.

Approximately 15% of children with LD have their major difficulty with motor learning and coordination, and more than 75% primarily have difficulty learning and using symbols (Miniutti, 1991).

Approximately 3% of all individuals have LD, but the severity varies widely. Learning disabilities affect males four times as frequently as they do females.

A good place to begin your online exploration of LD is the Learning Disabilities Association website (www.ldaamerica.us). If you click on "For Teachers" or "For Professionals," you will find a wealth of information on intervention. The site also offers links to several other sites. Simply click on "Resources."

The characteristics of LD fall into six categories: motor, attention, perception, symbol, memory, and emotion. Few children exhibit all the characteristics

described. Motor difficulties may include either hyperactivity or hypoactivity. Hyperactivity, or overactivity, is more prevalent, especially among boys. This results in difficulty attending and concentrating for more than very short periods. Children with hypoactivity may be deficient in their sense of body movement, definition of handedness, eye–hand coordination, and space and time conceptualization.

Attentional difficulties include a short attention span, inattentiveness, and distractibility. Irrelevant stimuli may capture the child's attention, and overstimulation easily occurs. Some children become fixed on a single task or behavior and repeat it compulsively, a process called *perseveration.*

Those who have hyperactivity and attentional difficulties but do not manifest other characteristics of LD may be labeled as having **attention-deficit/ hyperactivity disorder (ADHD)**. Children with ADHD have an underlying neurological impairment in executive function that regulates behavior; as a result, they are impulsive. Although ADHD is not a learning disability, children with ADHD often experience problems in social relations that are explained in part by their accompanying pragmatic problems with language use (Leonard et al., 2011). Although teacher estimates of these children's poor social skills can also be attributed to pragmatic difficulties, children with ADHD may not be identified on language testing that ignores pragmatics.

Perceptual difficulties of children with LD involve interpretation of incoming stimuli, although this is not a sensory disorder, as are deafness and blindness. Children with perceptual disabilities often confuse similar sounds, similar-sounding words, and similar-looking printed letters and words. In addition, children with LD may have difficulty both in determining where to focus their attention and in integrating sensory information from different sources, such as vision and hearing. Those children have particular difficulty in comprehending printed symbols and producing written symbols. It's estimated that as many as 80% of children with LD have some form of reading problem and that the incidence of these problems in the overall population may range from 5% to 17% (Sawyer, 2006).

Memory difficulties affect short-term retrieval, as in remembering directions, and long-term retrieval as in recalling names, event sequences, and words. Some children exhibit word-finding problems that result in blocks and the use of fillers ("Ah, ah, you know . . .") or circumlocutions ("Oh, it's that thing that does that stuff that goes round . . .").

> LDs are not caused by emotional disorders; rather, emotional problems result from misperception and from frustration.

Emotional problems are usually a factor that accompanies LD, not a causal factor. They are a reaction to the frustration that these children feel. Although most children with LD have normal intelligence, they perform poorly on language-based tasks, and their parents or teachers may tell them that they are not trying or that they're lazy or stupid. Emotional outbursts may result in children being described as aggressive, impulsive, unpredictable, withdrawn, and/or impatient. These youngsters may exhibit poor judgment, unusual fears, and/or poor adjustment to change.

The fact that LD occurs more frequently in families with a history of the disorder and in children who had a premature or difficult birth suggests possible biological causal factors. A central nervous system dysfunction may involve a breakdown along the neural pathways that connect the midbrain with the frontal cortex, an area that is responsible for attention, regulation, and planning of cognitive activity.

Although not a causal factor, socioenvironmental factors may account for at least some of the behaviors seen in children with LD. For example, misperceptions by a child affect interactions, which influence the child's development, especially language development. Language difficulties, in turn, affect the child's interactions.

Information-processing difficulties are characterized by an inability to use certain strategies or to access certain stored information. In general, children with LD exhibit poor ability to attend selectively, concentrating on inappropriate or unimportant stimuli. They have difficulty deciding on the relevant information to which to attend. As we have seen, discrimination is extremely difficult because children with LD are not sure of the relevant aspects of a stimulus that make it similar or dissimilar to another.

Information that is poorly attended to and poorly discriminated will be poorly organized. The cognitive organization of children with LD reflects this confusion. In short, the organization is too inefficient for easy retrieval, so memory is less accurate, and retrieval is slower.

Lifespan Issues

As preschoolers, children with LD may exhibit little interest in language or even in books. When a child reaches school, the linguistic demands of the classroom are often well above her or his oral language abilities. The result is often academic underachievement.

Most learning disabilities are not discovered until children go to school, although some children may be enrolled in special preschool programs or may receive therapy services because of poor motor coordination, hyperactivity, or failure to develop language typically. When they reach school, with its accompanying demand for language skills, many children with LD require the services of special educators, speech-language pathologists, and reading specialists. Some children might not be identified in early grades. Very bright children may "learn" to read by memorizing word shapes rather than using phonics-based word-attack skills, as discussed in Chapter 5.

Children with LD often receive special services while being included in regular classrooms. They can be successful if the teacher makes some adaptation, such as repeating instructions or allowing for a quiet work space, to accommodate their needs. Case Study 4.2 tells the story of one child with a learning disability.

Some children with LD seem to outgrow aspects of their disability. Hyperactivity seems to lessen in some adolescents. Some adolescents succeed well enough to continue their education and graduate from college. We know adults with LDs who are chemists, engineers, teachers, and speech-language pathologists, although some have lingering vestiges of LD that require lifelong adaptations.

Other adults continue to have difficulty. Matt received special services throughout his school years and finished high school. His language difficulties were complicated by a volatile temper and frequent misinterpretations of the communicative intentions of others. After being fired from a series of jobs, he hit on the idea of informing his new boss that he was "partially deaf" and needed all instructions and feedback repeated face to face. He no longer flies off the handle when given a simple directive by his supervisor and is gainfully employed.

Attentional, discriminatory, and memory deficits along with both receptive and expressive symbol use problems can result in many communication breakdowns.

Personal Story of a Child with Language Learning Disabilities

Darren's language learning disability went undetected until second grade. As a preschooler, Darren had some difficulty with speech sounds and displayed little interest in books, letters, or drawing. His mother considered his lack of interest and his overactivity to be a "boy thing." Darren received no preschool education. In first grade, he was slow to learn to read and write, as were several of his classmates.

When Darren still seemed to be struggling in second grade, his teacher suggested an evaluation to determine whether he had a learning disability. The school psychologist, a reading specialist, a special education teacher, and a speech-language pathologist evaluated him. They found that Darren's mother had received little, if any, prenatal care and that Darren was born preterm, weighing only 4 pounds, 10 ounces. After a stay in the hospital of several days, Darren went home with his mother. The rest of his preschool years were uneventful, and he remained at home with his older sister and younger brother, experiencing occasional middle ear infections and childhood illnesses. Although his sister exhibits no signs of an LD, Darren's younger brother does exhibit hyperactivity.

At age 11, Darren is a very active child who enjoys sports, especially soccer, which he plays with his best friend, Carlos. Darren has great difficulty reading and writing, and letter and word reversal and transposition are common in both. He has great difficulty sounding out new words. His speech is characterized by word retrieval problems and a limited vocabulary, peppered with "Ya know," "thing," and "one," as in "An' I got that one, ya know, that thing that goes like this."

Darren has had some difficulty behaving in school. His attention easily wanders, and he fidgets in his seat often. If he is not kept busy, he bothers the other students and keeps them from working. He finds himself frequently in fights in school, usually because he has misunderstood some comment of another student. His temper flares easily, possibly because school can be very frustrating.

Although his schoolwork has improved somewhat, he is still well behind his classmates in his ability to read, write, and work independently. This deficit, in turn, has inhibited his ability to solve problems and to think critically in class. He continues to receive tutoring in reading and writing and to see a speech-language pathologist weekly to work on vocabulary, word retrieval, and language use skills.

Language Characteristics

All aspects of language, spoken and written, usually are affected in children with LD. These children experience difficulty with the give-and-take of conversation and with the form and content of language. Deducing language rules is particularly difficult, resulting in delays in morphological rule acquisition and in the development of syntactic complexity. As a result, overall oral language development may be slow, and frequent communicative breakdown is possible. Word-finding problems may exist, resulting in the child needing greater time to respond verbally.

Some children with LD experience disfluent speech that on the surface might seem like stuttering. Called **cluttering**, these behaviors are characterized by overuse of fillers and circumlocutions associated with word-finding difficulties, rapid speech, and word and phrase repetitions. Unlike the situation with stuttering, the child seems barely to recognize his or her disfluency, and no fear of words or speech situations seems to exist.

Specific Language Impairment

Approximately 10% to 15% of middle-class U.S. children may be "late bloomers" whose early language development is delayed. About half outgrow it. Other children may continue to have problems characterized as **specific language**

impairment (SLI) (Dale et al., 2003). These children are at risk for academic failure when they begin school because they will not have the basic language skills for reading and writing in first grade (Choudhury & Benasich, 2003).

Children with SLI exhibit significant limitations in language functioning that cannot be attributed to deficits in hearing, oral structure and function, general intelligence, or perception. In other words, no obvious anatomical, physical, intellectual, or perceptual cause seems to exist. Although children with SLI have typical nonverbal intelligence, they exhibit deficits in a variety of nonverbal tasks, suggesting impaired or delayed cognitive functioning (Mainela-Arnold et al., 2006). These same children have age-appropriate visuospatial short-term and working memory, a right hemisphere function (Archibald & Gathercole, 2006).

Similar to those with LD, children with SLI exhibit language performance scores that are significantly lower than their intellectual performance on nonverbal tasks. The major distinction between those with LD and SLI is that those with SLI do not exhibit perceptual difficulties, the misinterpretation of incoming information.

Children with SLI are a very heterogeneous group, especially in their language skills. One study of more than 1,000 preschool children failed to find a distinct group corresponding to children with SLI (Dollaghan, 2004). Still, there are many children with LI for whom no readily identifiable causal factors exist.

Among those with SLI, nonverbal intelligence, birth and delivery, hearing, and self-help and motor skills all seem to be within normal limits. SLI affects males more than females, and the oral and written language deficits of SLI appear to be cross-generational (Flax et al., 2003). There is an increased prevalence of SLI in families with a history *of speech and language problems.*

Brain imaging of children with SLI indicates brain symmetry in the left and right hemispheres unlike the usual asymmetry of left-side predominance in language processing regions (Ors et al., 2005). Further investigation using magnetic resonance imaging (MRI) suggests that children with SLI exhibit different patterns of brain activation and coordination, reflecting less efficient patterns of functioning, including reduced activation in the brain areas critical for communication processing (Ellis Weismer et al., 2005; Hugdahl et al., 2004). In general, children with SLI have increased integration of the parietal lobe and decreased integration of the frontal lobe on encoding and decreased integration of the parietal on decoding.

Many but not all children with SLI show marked deficits in working memory abilities (Archibald & Joanisse, 2009). **Working memory (WM)** is an active process that allows limited information to be held in a temporary accessible state while cognitive processing occurs (Cowan et al., 2005). Tasks that are particularly demanding from either a storage and/or a processing perspective result in fewer resources being available for other aspects of the task. Children with WM deficits, such as those with SLI, exhibit learning difficulties (Swanson & Beebe-Frankenberger, 2004). Relative to age-matched peers, many children with SLI show several significant limitations in WM mechanisms and in processing speed. In addition, many children with SLI show reduced performance relative to age peers in attentional capacity, the limited mental energy available in performing a given task, especially as task complexity increases (Alloway & Archibald, 2008; Mainela-Arnold & Evans, 2005; Windsor et al., 2008). Deficits in WM and processing speed in children with SLI can, in turn, have a negative impact on language learning and functioning.

This can all be very confusing. The Merrill Advanced Study Center at the University of Kansas has an easy-to-read guide titled "Top 10 things you should

know . . . about children with specific language impairment." Simply go to the Merrill website (http://merrill.ku.edu). You'll find "Top 10 Things" under "In the Know" in the middle of the page.

> There is no single, obvious cause for SLI.

Lifespan Issues

As preschool children, those with SLI are perceived negatively by their peers (Segebart DeThorne & Watkins, 2001). In addition, children with SLI exhibit poor social skills (Conti-Ramsden & Botting, 2004).

Many children initially thought to have SLI are later identified as having LD. Lingering effects of SLI may result in reading difficulties that reflect difficulty with earlier language skills, such as rhyming, letter naming, and concepts related to print. In general, children with SLI exhibit slower and poorer processing of both linguistic and nonlinguistic material in elementary school (Miller et al., 2001; Weismer et al., 2000). Children with SLI are less successful than typical peers at initiating play interactions; thus they engage in more individual play and onlooking behaviors (Liiva & Cleave, 2005). Teachers rate these children as exhibiting more reticence and solitary-passive withdrawal (Hart et al., 2004).

Long-term data on children with SLI are sparse. Studies have indicated later academic difficulties, especially with language-based activities. For example, at age 14, children with SLI still exhibit slower response times in language tasks than children developing typically (Miller et al., 2006). Reticence and extreme aloneness may lead to rejection and bullying by others in middle and high school (Conti-Ramsden & Botting, 2004; Rubin et al., 2002). Many adolescents with SLI perceive themselves negatively and are less independent than their TD peers (Conti-Ramsden & Durkin, 2008; Jerome et al., 2002). For example, adolescents with SLI exchange text messages less often than their TD peers (Conti-Ramsden et al., 2010). This suggests that social difficulties may be restricting use, which in turn curtails opportunities to develop social networks and to make arrangements for peer social interaction.

Language Characteristics

In general, children with SLI have difficulty (1) extracting regularities from the language around them; (2) registering different contexts for language; and (3) constructing word-referent associations for lexical growth. As a result, these youngsters experience difficulty in morphological and phonological rule formation and application and in vocabulary development (Redmond, 2003). Pragmatic problems seem to result from an inability to use language forms effectively to make more inappropriate utterances. In addition, children with SLI have deficits in their ability to recognize the impact of and to express emotions (Brinton et al., 2007).

Both semantic and phonological deficits contribute to word-learning difficulties in children with SLI (Gray, 2004). Although word learning is difficult for children with SLI, comprehension seems to be easier than production.

Specific difficulty with grammatical markers suggests language-processing deficits in phonological working memory where words are held while processed (Corriveau et al., 2007; Montgomery & Leonard, 2006). Deficits in phonological working memory mean less capacity to store phonological information. Imagine having limited working memory but communication continuing at a rapid rate, overwhelming and slowing the entire process. You begin to lose information as more comes in. Expressively, children with SLI may speak more slowly and have frequent speech disruptions (Guo et al., 2008).

Language comprehension and processing are active processes, yet children with SLI do not appear to employ them actively. Auditory processing problems may result in difficulties with morphological inflections, such as past tense *-ed,* function words such as prepositions and articles (e.g., *a, the*), auxiliary verbs, and pronouns. Children with SLI exhibit persistent problems with morpheme use regardless of the language (Bedore & Leonard, 2001; Redmond & Rice, 2001), and they are less efficient in using syntax to aid in vocabulary acquisition (Rice et al., 2000). Even as adolescents, children with SLI continue to struggle with morphological markers and exhibit an ongoing maturational lag compared to TD age-matched and language-matched peers (Rice et al., 2009).

Word retrieval problems of children with SLI reflect the limited semantic knowledge of these children (McGregor et al., 2002). This alone, however, does not explain the word-finding problems. Rather, **lexical competition** is a significant factor in these children's poorer word definitions (Mainela-Arnold et al., 2010). In other words, children with SLI experience difficulty inhibiting activation of nontarget competing words (Mainela-Arnold et al., 2008). For example, when a child tries to find a given word, rhyming words, similar words, and those with the same initial sound may all crowd for attention. In addition, a significant subgroup of children with SLI demonstrate deficits in lexical–semantic organization (Sheng & McGregor, 2010). If words are poorly organized into categories, they're harder to retrieve.

Autism Spectrum Disorder (ASD)

For a child or an older individual to be diagnosed as having **autism spectrum disorder (ASD)**, he or she must have all of the following:

- Persistent problems in social communication and interaction across different contexts. Deficits do not result from general developmental delays, such as those in ID. Problems are seen in all of the following:
  - Social-emotional reciprocity
  - Nonverbal communicative and social interaction behaviors
  - Developing and maintaining relationships appropriate for maturity level
- Restricted, repetitive patterns of behavior, interests, or activities characterized by two or more of the following:
  - Stereotyped or repetitive motor movements, use of objects, or speech
  - Excessive reliance on routines, ritualized patterns of behavior, or resistance to change
  - Highly fixated and restricted, abnormally intense interests or focus
  - Hyper-or hypo-sensitivity and reactivity to environmental input or unusual interest in sensory information
- Although symptoms are present in early childhood, they may not manifest fully until social demands exceed a child's limited capacities
- Taken together, symptoms limit and impair daily functioning

This definition is, by design, somewhat sterile and clinical. What it means is that many children with ASD, but not all, have abnormal social interactions and

failure in the give-and-take of conversation; poorly integrated verbal and nonverbal communication, including eye contact and body language; difficulty adjusting to different social situations and stereotypical motor patterns; and echolalia, or repetition of others' speech, repetitive use of objects, and repetition of certain expressions. For example, when the teacher says, "It's time to clean up," the child may "echo" or repeat the phrase over and over again. In general, the more severe the symptoms, the poorer the individual's language and overall development (Pry et al., 2005).

Motor patterns of behavior may include rocking and a fascination with lights or spinning objects. In addition, a child may insist on certain routines or be preoccupied with specific objects, foods, or clothing. Paired with these preferences, a child with ASD may have an adverse reaction to other sounds or textures. One child known by the authors had approximately a half-dozen outfits consisting of exactly the same articles of clothing. Another would eat only foods of certain colors and textures.

ASD is much more common than previously believed. In 2012, after a national survey, the U.S. Centers for Disease Control and Prevention (CDC) announced that the following:

- The incidence of ASD among children was 1 in 88.
- Boys are five times more likely than girls to display ASD characteristics.
- Most children with ASD have IQs above 70 (above the cutoff for ID).

Approximately 25% of children with ASD exhibit intellectual disability (Chakrabarti & Fombonne, 2001; Fombonne, 2003).

At present, many researchers are trying to identify the early signs of ASD. Early identification can lead to early intervention. The Autism Spectrum Disorder Foundation website (www.myasdf.org/site/) provides some possible early warning signs. Click on "About Autism" and then "Identifying the Disorder."

The primary causal factors in autism are biological. Approximately 65% of all individuals with ASD have neurological differences, and 20% to 30% experience seizures. In addition, some researchers have found unusually high levels of serotonin, a neurotransmitter and natural opiate, and abnormal development of the cerebellum, which regulates incoming sensations, and of sections of the temporal lobe responsible for memory and emotions.

At least 15% of children with ASD have a genetic mutation not inherited from their parents (Sebat et al., 2007; Zhao et al., 2007). This is even higher for those with more severe forms of the disorder. Interestingly, the mutations are not similar for all children with ASD. In addition, between 2% and 6% of children with ASD also have fragile X syndrome, a genetic mutation of the X chromosome associated with ID (Belmonte & Bourgerone, 2006).

The incidence of ASD is highest among males and those with a family history of autism. The family pattern suggests a genetic basis for the disorder.

Neural studies suggest that the eye and face detection processing of children with autism may be delayed, explaining, in part, the early failure to bond with caregivers (Grice et al., 2005). In addition, infants with autism show no difference in brain response to familiar and unfamiliar faces, supporting the notion of facial processing impairment (Dawson et al., 2002).

Differences in processing incoming information also suggest a neurological basis for ASD. Individuals with ASD experience difficulty in analyzing and

integrating information. Their responding is often very overselective, resulting in a tendency to fixate on one aspect of a complex stimulus—often some irrelevant, minor detail. As a result, discrimination is difficult.

Overall processing by children with ASD has been characterized as a *gestalt* in which unanalyzed wholes are stored and later reproduced in identical fashion. The storage of unanalyzed information may account for the way in which individuals with ASD become quickly overloaded with sensory information. Storage of unanalyzed wholes also might hinder memory. It's difficult to organize information on the basis of relationships between stimuli if those stimuli remain unanalyzed. Lack of analysis would also hinder transferring or generalizing learned information from one context to another.

Lifespan Issues

At present children with ASD are identified by the time they are 2 or 3 years of age. Although early intervention (EI) is critical to maximizing outcomes for children with ASD, EI is often difficult. Failure to meet the following milestones may indicate need for further evaluation:

- No babbling by 12 months
- No gesturing by 12 months
- No single words by 16 months
- No two-word spontaneous speech by 24 months
- Loss of language or social skills at any age (Filipek et al., 1999)

It may not be possible at this time to make a definitive diagnosis prior to 24 months of age (Woods & Wetherby, 2003).

School-age children and adolescents with ASD may be included in regular education classes or be in special classes, depending on the severity of the disorder. In some children, the severity of ASD lessens with age. For example, as Jeffery became a teenager, his behavior seemed to be less disruptive, and there were fewer outbursts. Although he could engage in conversation easily, he continued to become annoyed and to begin flapping his hands if more than one person spoke at a time.

People with milder forms of the disorder may be able to live on their own and hold competitive employment. For example, Dr. Temple Grandin, a woman with ASD, is employed as a college professor. Unfortunately, the vast majority of people with ASD are not so successful and require supervision and care. Many have adult life patterns similar to those of adults with ID. Case Study 4.3 presents the story of a child with ASD.

Language Characteristics

As a group, children with ASD demonstrate significant delays in language and communication, especially in pragmatics (Tager-Flusberg et al., 2005). A communication problem is often one of the first indicators of possible ASD. Between 25% and 60% of individuals with ASD remain nonspeaking throughout their life. Those who speak often have a wooden or robotlike voice that lacks typical intonational patterns. Many autistic children who use speech and language demonstrate some immediate or delayed echolalia, which is a whole or partial repetition of previous utterances, often with the same intonation. For example,

Personal Story of a Child with Autism Spectrum Disorder (ASD)

Just like other new parents, Jayden's mom and dad awaited their first child with heightened anticipation. He was born full term, with no complications, and seemed healthy. Although he had some difficulties nursing and seemed uninterested in eating, these problems were attributed to his being a generally fussy baby who seemed unable to be comforted.

As Jayden developed, he met physical developmental milestones but seemed to lag slightly in social and cognitive development. The pediatrician assured his parents that there is wide variability across infants and that boys often develop more slowly than girls. His mother described him as irritable and quick to cry. He often had temper tantrums, especially when it was time to eat, bathe, or go to bed. Because of these increasing behavior outbursts, Jayden's parents took him from the home less often than they had previously.

When Jayden had not spoken by 18 months, his parents took him to a speech-language pathologist (SLP) for a speech and language evaluation. They were surprised by the many questions the SLP asked concerning Jayden's early social development.

She explained speech and language development to them, especially the early acquisition of intent to communicate, which is expressed initially in gestures.

Although the SLP did not diagnose Jayden as having ASD, she recommended that he be enrolled in a social play group for late talkers and strongly suggested that they should have him evaluated at a local hospital by an ASD team, if only to rule out ASD as a cause of his delay and his increasing acting out behavior.

Today Jayden, who was diagnosed with ASD, is enrolled in a special preschool for children with ASD. He receives speech and language services in the classroom daily, and his parents continue intervention at home, under the direction of an SLP. Intervention is primarily in the form of play. Jayden signs approximately 50 single words and says about 10 for a variety of purposes.

His parents use signs to inform him about routine changes such as dinner time. His own use of signs seems to have decreased his frustration and acting-out behaviors. Jayden prefers to be alone, and even in his preschool class, he rarely interacts with other children, seeming to prefer the company of adults.

Mickey would say little during the day but store things said to him during the day and repeat them in sequence before he went to sleep at night. In contrast, Adam would echo immediately. For some children, echolalia might either be a language-processing strategy or signal agreement with the previous utterance. Even though echolalia may be outgrown, other problems, especially those related to pragmatics, persist in the child's language. Most children with ASD who learn to talk go through a period of using echolalia (Prizant et al., 1997).

ASD affects pragmatics and semantics more than language form (Lord, 1988). Syntactic errors seem to represent a lack of underlying of semantic relationships. Prosodic features or suprasegmentals, such as stress, intonation, loudness, pitch, and rate, are often affected, giving the speech of children with ASD the sometimes mechanical quality mentioned. Individuals with ASD often have peculiarities and irregularities in the pragmatics of conversation. The range of intentions is often very limited and may consist solely of demands and, in severe cases, unintelligible vocalizations. Some individuals incorporate entire verbal routines, called *formuli,* into their communication. For example, a child might repeat part or all of a television commercial to indicate a desire for the item that had been in the advertisement. A formula represents the person's attempt to overcome the difficulty of matching the content and form of language to the communicative context. Adults with ASD who have good language skills might still misinterpret some of the subtleties of conversation.

Individuals with autism, even those with seemingly typical language, have continuing problems with pragmatics.

Intervention for children with ASD often focuses on social skills and communication. As you watch this **video,** notice the ways in which the adult encourages Allison and helps her to participate.

As with any other disability, ASD offers a challenge to parents. The National Institute of Mental Health website (www.nimh.nih.gov/index.shtml) has a helpful parents' guide to ASD. Click on "Health & Education" at the top, scroll down to "Publications," locate "Find Publications by Topic" in the center, and then click on "Autism." There are several other disorders you can also explore on this site.

Brain Injury

Impaired brain functioning can result from **traumatic brain injury (TBI)**, cerebrovascular accident or stroke, congenital malformation, convulsive disorders, or encephalopathy, such as infection or tumors. Among children, the most common form of injury is TBI. Cerebrovascular accidents and a fuller discussion of TBI are presented in Chapter 7.

Approximately a million children and adolescents in the United States have experienced TBI, which is diffuse brain damage as the result of external force, such as a blow to the head in an auto accident, a fall, or a gunshot wound. Individuals with brain injury differ greatly from one another as a result of the site and extent of the injury, the age at onset, and the age of the injury. In general, the smaller the damaged area, the better the chance of recovery. Some individuals recover fully; others remain in a vegetative state. People with TBI exhibit a range of cognitive, physical, behavioral, academic, and linguistic deficits, any of which may be long term.

Cognitive deficits include difficulties in perception, memory, reasoning, and problem solving. Deficits vary and may be permanent or temporary and may partially or totally affect functioning ability. Children with TBI tend to be inattentive and easily distractible. All aspects of cognitive organization—categorizing, sequencing, abstracting, and generalization—may be affected. Children with TBI have difficulty perceiving relationships, making inferences, and solving problems. They struggle to formulate goals, plan, and achieve their ends. Memory is also affected, although long-term memory before the trauma is often intact.

Psychological maladjustment or "acting out" behaviors, called *social disinhibition,* may occur, in which a person is incapable of inhibiting or controlling impulsive behavior. Other characteristics of TBI may include a lack of initiative, distractibility, inability to adapt quickly, perseveration, low frustration levels, passive-aggressiveness, anxiety, depression, fear of failure, and misperception.

Lifespan Issues

After an accident, some children with TBI may be unconscious for a few minutes or much longer. Upon regaining consciousness, a child usually experiences some disorientation and memory loss. Memory loss may involve only the time of the immediate accident or may be more extensive, including long-term memory. TBI may be accompanied by physical disability and personality changes.

Neural recovery over time is often unpredictable and irregular, and the variables that affect recovery of children with TBI are extremely independent. In general, a better recovery is signaled by a shorter, less severe period of unconsciousness following the injury, a shorter period of amnesia, and better posttraumatic abilities.

The age of the injury can be an inaccurate prognosticator. In general, the older the injury, the less chance of change, although this can be complicated

The severity of TBI is affected by many variables, such as the age of the child and the age of the injury. As you watch this **video,** notice Matt's behavior, what he can do, and what challenges him. Listen to the teachers describe his strengths and what he has learned.

by the delayed onset of some deficits. For example, some neurological problems might not be manifested until later in recovery, making neural recovery unpredictable and irregular over time.

When stabilized, a child with TBI begins a long recovery process that can take years. Within the first few months, she or he might experience spontaneous recovery when large gains in ability are made.

Young children often recover quickly but experience difficulties learning new information and may exhibit severe, long-lasting problems. Older children and adolescents have more to recover from their memory but less new information to learn.

Even individuals who have made a seemingly full recovery may lack subtle cognitive and social skills. For example, although Jane had been injured in an auto accident but made a seemingly full recovery, she began to exhibit learning problems later, when she attended elementary school. Unfortunately, her lack of success in school translated into disciplinary problems later on.

Language Characteristics

Language problems may be evident even after mild injuries. Some deficits, especially in pragmatics, remain long after the injury, even when general improvement is good. Individuals with severe TBI and resultant deficits in executive function or ability to focus the brain demonstrate problems with pragmatics (Douglas, 2010). More specifically, these individuals have difficulty regulating the amount and manner or conversational participation as well as the relevance of their contributions. A child with TBI may lose the central focus or topic in conversation. Utterances are often lengthy, inappropriate, and off topic, and fluency is disturbed, especially if there are accompanying motor problems.

Language comprehension and higher functions such as figurative language and dual meanings are also often impaired, although language form is relatively unaffected. Semantics, especially concrete vocabulary, is also relatively undisturbed, although word retrieval, naming, and object description difficulties may be present. Narration, especially maintaining story structure and providing enough information, may also pose a problem.

Neglect and Abuse

Each year in the United States, approximately 900,000 children are maltreated sufficiently for the neglect and/or abuse to be reported to the authorities (U.S. Department of Health and Human Services [DHHS], 2007). Neglect and abuse are the outward signs of a dysfunctional family, the social environment in which these children learn language.

Although neglect and abuse are rarely the direct cause of communication problems, the context in which they occur directly influences a child's development. Medical and health problems among poor Americans also can contribute, although neglect and abuse are not limited to poor families. Poor maternal health, substance abuse, poor or nonexistent pediatric services, and poor nutrition can all affect brain development and maturation.

The quality of the child–mother attachment is a more significant factor in language development than is maltreatment. Maternal attachment can be disturbed by childhood loss of a parent; death of a previous child; pregnancy and/or birth complications; family, marital, or financial problems; substance

Although the brains of younger children are more malleable or more adaptable than those of older people, this does not mean that younger children will always recover more fully. In addition to recovering the language lost, younger children may still have much language to learn, a task that is possibly made more difficult by the brain injury.

Lack of maternal interaction rather than outright physical abuse accounts for much of the language impairment noted among children from abusive and neglectful environments.

abuse; maternal age; and/or illness. The result is a lack of support for the development of meaningful communication skills.

Lifespan Issues

The effects of childhood abuse and neglect can remain with a child for life. There might be recurring physical, psychological, and emotional problems. Many children who have been abused abuse their own children later, thereby perpetuating this pattern, with all its ill effects.

Language Characteristics

Children with FAS and drug exposure have many learning problems similar to those of children with learning disabilities.

Although all aspects of language are affected, it is in pragmatics that children who have been neglected or abused exhibit the greatest difficulties. In general, they are less talkative and have fewer conversational skills than their peers. They are less likely to volunteer information or to discuss emotions or feelings. Their utterances and conversations are shorter, with less complex language, than are those of nonmaltreated children (Eigsti & Cicchetti, 2004).

Fetal Alcohol Syndrome and Drug-Exposed Children

Within the past 30 years, there has been an increase in the prevalence of **fetal alcohol syndrome (FAS)** and/or other fetal drug exposure. FAS accounts for 1 in every 500 to 600 live births. Alcohol interferes with embryonic development by disrupting activation of a critical signaling molecule in the brain. FAS infants have low birthweight and exhibit central nervous system problems. There is a relationship between severity of the growth deficiency and the dysmorphic features, such as the space between the eyes, and cognitive limitations (Ervalahti et al., 2007). Later, these children demonstrate hyperactivity, motor problems, attention deficits, and cognitive disabilities. The IQs of children with FAS may be in the borderline ID range.

The effects of drugs on a fetus vary with the drug, the manner of intake, and the age of the fetus. Crack cocaine is especially destructive because it alters the fetus's neurochemical functioning. Like infants with FAS, those who are exposed to crack have low birthweight. They also have small head circumference and are jittery and irritable (Lesar, 1992).

Lifespan Issues

Preterm babies, especially those with FAS or early drug exposure, are more likely to die during infancy and to experience developmental difficulties. A drug-exposed child's poorly coordinated behaviors and motor delays may disrupt caregiver–infant bonding. In addition, caregivers who are dependent on alcohol or drugs might not attend to or might reject the child. The limitations noted at birth remain with the child for life and can result in poor academic achievement and antisocial behavior. Parents and teachers report that children with FAS have significantly more and longer instances of passive/disengaged and irrelevant behavior in the classroom that their TD peers (Olswang et al., 2010).

Language Characteristics

Children with FAS exhibit language problems characterized by delayed development of language, echolalia or inappropriate repetition, and comprehension problems. Infants who were exposed to drugs have few infant vocalizations,

inappropriate gestures, and language deficits. As preschoolers, they exhibit word-retrieval problems, short sentences, and inappropriate conversational turn taking and topic maintenance. These difficulties persist and are compounded by problems with abstract meanings, multiple meanings, and temporal and spatial terms, such as *before* and *after, next* and *near, next to,* and *in front of.* Both children with FAS and those with fetal drug exposure are behind their peers in reading and other academic tasks.

Click here to check your understanding of the concepts in this section.

Other Language Impairments

Although we've touched on some of the most prevalent LIs, we have by no means exhausted the discussion. Other forms of LI include but are not limited to non-specific language impairment (NLI), late talkers, and those with childhood schizophrenia, selective mutism (SM), and middle ear infections (otitis media) and children who have received cochlear implants. Children with NLI have a general delay in language development, a nonverbal IQ of 86 or lower, and, as with SLI, no obvious sensory or perceptual deficits but few common characteristics (Rice et al., 2004). Although child health is an important factor among late talkers, most early language delay is due to environmental factors, such as poverty and/or homelessness.

Childhood schizophrenia, a serious psychiatric illness that causes strange thinking, odd feelings, and unusual behavior, is uncommon, occurring in approximately 1 of every 14,000 children younger than 13 years of age. Approximately 55% of children and adolescents with schizophrenia have language abnormalities, including language delay especially in pragmatics (Mental Health Research Association, 2007; Nicolson et al., 2000).

Selective mutism (SM) is a relatively rare disorder in which a child does not speak in specific situations, such as school, although she or he may speak normally in others. From 0.2% to 0.7% of all children may have SM at some time, and girls are nearly twice as likely as boys to be affected (Bergman et al., 2002; Kristensen, 2000).

Many young children suffer from chronic otitis media. In general, the cumulative effect of recurrent otitis media can be a significant factor in delayed language development (Feldman et al., 2003).

Finally, those who receive cochlear implants develop language in a manner similar to typically developing children. Although children implanted later have an initial advantage of maturity that enhances language growth, those who receive implants at an earlier age begin to develop spoken language at an ever-increasing rate that soon eclipses that rate for children receiving implants later in childhood (Ertmer et al., 2003).

Conclusion

So many disorders are associated with LI that they probably all have begun to look similar to you. To help your memory, Figure 4.1 presents the major characteristics of each disorder. In most cases, a child with a language impairment has other physical, cognitive, and psychological difficulties, too. In actual practice, speech-language pathologists treat each child as an individual, not as a member of a category. Of importance is each child's behavior and language features, not group characteristics.

Figure 4.1 Summary of disorders associated with language impairment.

Disorder Most Affected	Expected Deficit Area					Language Features		
	Developmental	Cognitive	Perceptual	Affective	Unknown	Form	Content	Use
ID		X				X	X	X
LD			X			X	X	X
SLI					X	X		
ASD				X				X
TBI		X		X				X
Neglect and abuse	X							X

Although this section has focused on disorders, it does not address all the factors that may be related to language impairment. Factors such as poverty, nutrition, child and maternal health, and maternal sensitivity to and stimulation of a child are also important. For example, most children and mothers living in homeless shelters exhibit language deficits for a variety of reasons (La Paro et al., 2004; O'Neil-Pirozzi, 2003).
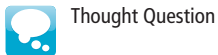
Thought Question

ASPECTS OF LANGUAGE AFFECTED

In addition to the etiological categories we have just described, language impairments can also be characterized by the language features affected. For example, a child may have difficulty with word recall and conversational initiation or may possess a limited vocabulary and seem to talk nonstop. Another child may have poor syntax and very short sentences or withdraw from conversational give-and-take. Figure 4.2 presents the most common language features associated with language impairments. In evaluations, speech-language pathologists assess many language features to determine where to begin intervention.

To understand the range of responsibilities of an SLP in various disorders, check the ASHA website (www.asha.org). Type "scope of practice" in the search field and then click on the communication disorder you want to explore.

ASSESSMENT

Assessment and intervention overlap and are parts of the same process.

An SLP's task in assessment is to distinguish between children who have a disorder and those who do not. Accurate diagnosis is a prerequisite to ensuring that scarce resources, especially in schools, are allocated in the most beneficial way.

As with other diagnostics, language assessment is a systematic process of discovery and information gathering. As should become evident, good clinical practice requires that the boundary between assessment and intervention be

Figure 4.2 Most common language characteristics of children with language impairments.

Pragmatics

Difficulty answering questions or requesting clarification

Difficulty initiating, maintaining a conversation, or securing a conversational turn

Poor flexibility in language when tailoring the message to the listener or repairing communication breakdowns

Short conversational episodes

Limited range of communication functions

Inappropriate topics and off-topic comments; ineffectual, inappropriate comments

Asocial monologues

Difficulty with stylistic variations and speaker-listener roles

Narrative difficulties

Few interactions

Semantics

Limited expressive vocabulary and slow vocabulary growth

Few or decontextualized utterances, more here-and-now; more concrete meanings

Limited variety of semantic functions

Relational term difficulty (comparative, spatial, temporal)

Figurative language and dual definition problems

Conjunction (*and, but, so, because,* etc.) confusion

Naming difficulties may reflect less rich and less elaborate semantic storage or actual retrieval difficulties

Syntax/Morphology

Short, uncomplex utterances

Rule learning difficulties

Run-on, short, or fragmented sentences

Few morphemes, especially verb endings, auxiliary verbs, pronouns, and function words (articles, prepositions)

Overreliance on word order over word relationships

Difficulty with negative and passive constructions, relative clauses, contractions, and adjectival forms

Article (*a, the*) confusion

Phonology

Limited syllable structure

Fewer consonants in repertoire

Inconsistent sound production, especially as complexity increases

Comprehension

Poor discrimination of units of short duration (bound morphemes)

Impaired comprehension, especially in connected discourse such as conversations

Reliance on context to extract meaning

Wh- question confusion

Overreliance on nonlinguistic cues for meaning

permeable. A portion of any good assessment is attempting to determine possible avenues for intervention. In turn, each intervention session should contain some assessment of a client's current skill level.

Assessment should be sufficiently broad and deep so that all areas of possible concern are identified and described as accurately as possible. For example, assessment of semantics must include more than receptive understanding and expressive vocabulary size. A thorough examination might also include areas such as word learning abilities and word storage and retrieval (Brackenbury & Pye, 2005).

Bilingual Children, English Language Learners, and Dialectal Speakers

According to the U.S. Census Bureau (2012), 21% of the U.S. school-age population speaks a language other than English at home. Approximately one third of these children are English language learners (ELLs). African American (AA) children, as the second largest minority racial group in the country, make up approximately 17% of the children enrolled in public schools (Fry, 2007). Some professionals have attributed the reported academic underachievement of some AA children who are from families with low income to the African American English (AAE) that many of these children bring to school. AAE differs from the majority American English dialects that teachers use for instruction.

Any assessment of children with culturally and linguistically diverse backgrounds must recognize the relationship of the risk for LI and SES. Children from low-SES backgrounds with poorer maternal education have an increased incidence of LI (Schuele, 2001).

ELLs and children with dialectal differences are more likely to be identified as needing special education services (de Valenzuela et al., 2006). The higher proportion of ELLs and children with dialectal differences in special education is most likely related to performance on standardized tests. Clearly, there is a critical need to develop language assessment measures that are appropriate for these children.

Diagnostic methods for children from culturally and linguistically diverse backgrounds vary widely, and no single measure seems adequate. Varying formats include parent and teacher reports, both spontaneous and elicited language production, and novel word and morpheme learning. Diagnosis includes published tests, language samples, and dynamic assessments that are more open-ended and include descriptions of a child's use of both English and the child's first language. Although most ELLs in the United States speak Spanish, there is no single measure that stands out as optimal for Spanish–English bilingual children (Dollaghan & Horner, 2011). SLPs therefore use a variety of measures.

Referral and Screening

Referral for a communication evaluation may occur at any point in the lifespan. Some children, such as those with identifiable syndromes or those who are at risk for developing a LI, might be referred at birth or early infancy; those with LD might go undetected until they begin school; and those with either TBI or childhood aphasia may be referred at the age when injury occurs. Parents can be effective referral sources for children with more severe language problems, although they are less reliable in identifying mild impairment (Conti-Ramsden et al., 2006).

In a public school, an SLP may decide to test a child on the basis of results of screening testing or teacher referral. Screening tests, used to determine only the presence or absence of language problems, are routinely administered to all kindergarten and first-grade students. Screening tests must be chosen and administered very carefully. Even though a test is generally considered nonbiased, some items should be interpreted with caution because they may be problematic for children from some cultural or linguistic backgrounds (Qi et al., 2003).

Surveys and parental questionnaires are also effective diagnostic tools. They compare favorably with other language measures (Patterson, 2000; Rescorla & Alley, 2001; Thal et al., 2000).

An interdisciplinary team of child specialists may handle referral and subsequent evaluation. The nature of many of the disorders mentioned previously may necessitate input from a pediatrician, a neurologist, an occupational therapist, a physical therapist, a developmental psychologist, a special education teacher, an audiologist, or a speech-language pathologist. For example, an interdisciplinary assessment that includes families as active participants and collaborators has been shown to be effective with young children with ASD (Prelock et al., 2003).

Information from referrals, questionnaires, and interviews provides needed background from which to begin investigating for possible language impairment and determining what that impairment entails.

Case History and Interview

Administering a case history questionnaire and conducting an interview are the first steps in a formal information-gathering process. In addition to asking questions about birth and development, an SLP asks more specific questions relevant to LI. Questions relate to language development, the language environment of the home, and possible causes for LI. Possible questions are presented in Figure 4.3.

Observation

Language is heavily influenced by the context in which it occurs. It is helpful, therefore, to observe a child using language in as many contexts as possible. Although it is not always convenient to observe in multiple contexts, a school-based SLP might observe in the classroom; a clinic-based SLP might observe on a home visit, in a waiting room, or during a free-play period between the mother and child. In all assessments, testing and sampling periods can provide additional observational periods.

Behaviors that are observed vary with the age of the child and the reported disorder. In addition to observing a child's communicative behavior, an SLP is also concerned with a child's interests and the caregiver's style of communicating and method of behavior control. Figure 4.4 presents some behaviors that might be observed during an assessment.

Hypotheses about a child's LI are formed during observation. These are either confirmed or negated during the remainder of the assessment and during intervention.

An SLP must remain focused during observation. This requires that she or he define very carefully the behaviors and/or language features that are observed and fully describe the events preceding and following them. For example, one adolescent with ID would scream "Don't hit me" repeatedly. It was observed that this occurred when she was asked a question, but the behavior was inconsistent. It was hypothesized that the type of question influenced the response. The hypothesis was confirmed later in the assessment through careful data collection in which the type of question was modified systematically.

Testing

After building rapport with a child, an SLP can begin testing. Tasks should be varied, based on their potential effect on different children.

Figure 4.3 Possible questions for questionnaires/interviews when a language impairment is suspected.

Language Use

Does the child . . .

Ask for information? How?

Describe things in the environment? How?

Discuss things in the past, future, or outside of the immediate context?

Make noises when playing alone?

Engage in monologues when playing?

Prefer to play alone or with others?

Express emotions or discuss feelings? How?

Request desired items? How?

Request attention? How?

Direct your attention? How?

Conversational Skills

Does the child . . .

Initiate conversations or interactions with others? What are the child's frequent topics?

Join in when others initiate?

Get your attention before saying something?

Maintain eye contact while talking?

Take turns easily while talking? Interrupt frequently? Are there long gaps between your utterances and the child's responses?

Demonstrate an expectation that you will respond when he or she speaks? What does the child do if you do not respond?

Seem confused or ask for clarification? How? How frequently?

Respond when asked to clarify? How?

Demonstrate frustration when not understood?

Relay sequential information or stories in an organized fashion so that they can be followed? Relay enough information?

Have different ways of talking to different people, such as adults and smaller children?

React more readily to certain people and situations than to others? When does the child communicate best/most?

How does the child respond when you say something? How does the child respond to others?

What emotions does the child express? How?

Are responses meaningful, mismatched, off-top, or irrelevant?

Form and Content

Does the child . . .

Know the names of common events, objects, and people in the environment?

Seem to rely on gestures, sounds, or immediate environment to be understood?

Speak in single words, phrases, or sentences? How long is a typical utterance? Does the child leave out words?

Use words such as *tomorrow, yesterday,* or *last night*?

Use verb tenses?

Put several sentences together to form complex descriptions and explanations?

Follow simple directions?

Source: **Based on Owens (2014).**

Although standardized, norm-referenced tests are appropriate for determining whether a problem exists, they are less useful in identifying specific language deficits. More descriptive test results allow an SLP to explore a child's strengths and weaknesses. In addition, descriptive results can provide useful information for treatment planning.

It is best to use a series of testing tasks to ensure that many features of language are assessed. One study found that a combination of tasks using children's

Figure 4.4 Possible behaviors to observe during an assessment of language impairment.

With whom the child communicates

Purposes for the child's communication

Effectiveness of the child's communication:

   Obvious patterns of breakdown

Maturity of the child's language:

   Utterance length

   Verb usage

   Complexity

Relative amounts of initiative versus responsive communication

Relative amounts of nonsocial versus social communication

Responsiveness of caregiver

Turn allocation, relative size of child's and caregiver's turns

books, such as joint story retelling (expectancy violation detection tasks in which a familiar story element is altered) and comprehension questions, were effective in identifying 96% of children with LI (Skarakis-Doyle et al., 2008). At the very least, receptive and expressive aspects of language form, content, and use should be tested or sampled in some way.

Test methodology varies widely. Children may be asked to form syntactically similar sentences, to make judgments of correctness, to reconfigure scrambled sentences, or to imitate exactly what they hear. They may have to supply definitions, form sentences, or point to words named. All these tasks require different language skills. Unfamiliar tasks may unintentionally prejudice the results against the child. Examples of language test tasks are presented in Figure 4.5.

During testing, an SLP probes a child's performance to try to identify possible effective intervention procedures. Of interest are strategies that either increase production or result in more correct production of a certain language feature (Peña et al., 2001). Sometimes called **dynamic assessment**, this probing is invaluable in providing direction for subsequent intervention. Dynamic assessment and techniques that ask children to demonstrate skills that represent realistic learning demands are especially well suited for children with multicultural or bilingual backgrounds (Peña et al., 2006; Ukrainetz et al., 2000).

Test scores should be interpreted cautiously. For example, the omission of some morphological endings by bilingual children is similar to the error pattern of children with SLI (Paradis, 2005). This can lead to misdiagnosis. In addition, children with language disorders aren't always identified by low scores (Spaulding et al., 2006). SLPs should consult test manuals carefully and select tests that are sensitive and specific to language disorders.

Testing is an extraordinary situation for most children. Typical performance is most likely to be displayed in language sampling.

Figure 4.5 Examples of language test tasks.

Test Procedure	*Example*
Grammatical completion	I'm going to say a sentence with one word missing. Listen carefully, then fill in the missing word. *John has a dish and Fred has a dish.* *They have two _____ .*
Receptive vocabulary	Look at the pictures on this page. I'm going to name one, and I want you to point to it. *Touch (Show me) the officer.*
Defining words	I'm going to say some words. I want you to tell me what each word means or use it in a sentence in a way that makes sense. For example, if I said "coin," you might respond "money made from metal" or "I put my coin in the vending machine."
Pragmatic functions	I'm going to tell you a story and ask you to imagine what the person in the story might say. *Mary lost her money and she must call home for a ride after band practice. She decides to borrow a quarter from her best friend, Julie. Before practice begins, she sits down next to Julie and says _____ .*
Sentence imitation	I'm going to say some sentences, and I want you to repeat exactly what I say. Let's try one. *We are going to play ball after school tomorrow.*
Parallel sentence production	Here are two pictures. I'll describe the first one, and then you describe the second one, using the same type of sentence as I use. For example, for this picture I would say, "The girl is riding her bike," and for this one you would say, "The man is driving his car."
Grammatical correctness	I'm going to say a sentence, and I want you to tell if it is correct or incorrect. If it is incorrect, you must correct it. For example, if I say, "Thems is going to the dance," you would respond, "Incorrect. They are going to the dance."

Sampling

Not every child with LI does poorly on tests. In addition, tests do not address all aspects of language. For these reasons, SLPs collect language samples as part of an assessment. In language samples, children with SLI demonstrate a persistently lower level of performance (Eisenberg et al., 2001; Rice et al., 2010).

Language is influenced by context. It follows that the context of test taking influences the language a child produces. For some children, test structure decreases performance. This is especially true for young children, children of color, and those with disabilities.

An SLP engages a child in challenging conversation so that he or she will attempt to "stretch" language abilities and, in the process, reveal difficulties. These evocative techniques are especially important for children with ASD who typically do poorly on both standardized tests and spontaneous language samples (Condouris et al., 2003). A variety of discourse types, such as conversation, narration, explanation, and interview, can be included in the sample. For example, although young children engaged in free play produce more utterances than those telling stories, they produce more complex utterances while telling stories and in conversation (Southwood & Russell, 2004).

Typical performance may be enhanced if parents or teachers interact with a child in familiar settings. An experienced SLP can also be an excellent conversational or play partner for the child. Whenever possible, it is best to collect at

least two samples of the child interacting with different partners, locations, and activities or topics (Owens, 2014). For example, parent and teacher perceptions of specific social behaviors in children with ASD do not always agree (Murray et al., 2009). This disparity indicates that specific social behaviors may be context dependent and would suggest collecting data in different communication contexts.

Samples may be either very open ended, in which topics and interactions are not defined, or more closed, in which the SLP tries to elicit specific language features. Responses vary. For example, more restrictive question-and-answer techniques elicit fewer complex utterances than more conversational strategies.

Narratives or stories are especially helpful for exhibiting deficits in older children or those with TBI because of the demands on a speaker. In addition, narratives tend to elicit a large number and variety of syntactic structures. The personal narratives of children with LI are often so disordered that these stories negatively impact the social interactions of these children (McCabe & Bliss, 2004–2005). The shorter personal narratives of children with LI often omit key information and violate chronological sequences of events. With adolescents, posing peer-conflict resolution problems is an effective method for eliciting grammatically complex utterances (Nippold et al., 2007). Figure 4.6 presents two very different types of language samples.

An SLP may record language samples and later carefully transcribe the child's exact words. MP3 players and handheld computers can be used effectively to collect language samples (Olswang et al., 2006).

An SLP can analyze a transcript in several quantitative and qualitative ways to determine the extent and nature of a child's language difficulty. Values such as *mean length of utterance* (*MLU*), the average number of clauses per sentence, and the number of different words used within a given period of time can be

Figure 4.6 Examples of different types of language sampling.

Open-Ended	*Structured*
Clinician: I'll play with this farm set, and you can too, or you can pick another toy.	*Clinician:* Well, here's the puppy. What should we say to him?
Child: Want farm	*Child:* Hi puppy. [GREETING]
Clinician: Oh, you want the farm. We can share. I wonder what we should do first.	*Clinician:* Hi Timmy. I'm hungry. We need to get someone to help us get those cookies.
Child: Open door. Animals come out.	*Child:* You help. Want cookie. [REQUESTING]
Clinician: Okay.	*Clinician:* I wonder how I can reach it.
Child: You be horsie and I man.	*Child:* Get chair. [HYPOTHESIZING]
Clinician: Oh, the farmer.	*Clinician:* Oh, get on the chair. Should I (mumble).
Child: Farmerman chase horsie in barn.	*Child:* Yeah. [DOES NOT REQUEST CLARIFICATION]
Clinician: Oh, he did. I better run fast.	*Clinician:* You want me to (mumble)?
Child: Man go fast in barn.	*Child:* What's that? [REQUESTS CLARIFICATION]
	Clinician: Which do you want, the cookie or the chair?
	Child: Want cookie. No chair. [CHOICE MAKING]

compared to the values for typical children of the same age or developmental level (Johnston, 2001). MLU has been shown to be both a reliable and valid measure of general language development through age 10 for children with SLI (Rice et al., 2006). Samples might also provide information on the percentage correct for a language feature, such as past tense *-ed*. More descriptive measures might be the variety of intentions expressed by the child, the number of conversational styles used, and the types of repair the child uses when the conversation breaks down (Yont et al., 2000). Being as thorough as possible, an SLP attempts to analyze the sample for all aspects of form, content, and use appropriate for the particular assessment. For example, with bilingual clients, an SLP might consider **code switching** (the movement between two languages), dialect, English proficiency, and contextual effects in addition to aspects of both languages (Gutierrez-Clellan et al., 2000).

Thought Question

For school-age clients experiencing literacy difficulties, an SLP may also want to collect samples of written language. These are discussed in Chapter 6.

INTERVENTION

The complexity of language necessitates using multiple intervention methods. Although it is still in its infancy, **telepractice**—provision of language assessment and intervention via the Internet—is slowly expanding, especially in underserved geographical areas (Waite et al., 2010).

Different intervention approaches target specific aspects of language and employ a variety of procedures. Within limits, we explore these diverse approaches to remediation of language impairments.

All aspects of language are interrelated. Changes in one area affect others. For example, development of the /s/ sound may affect morphological markers, such as plural *s* (*cats*) or possessive markers (*cat's*). In intervention, an SLP should not take such changes for granted and focus solely on one aspect of language. Intervention goals should focus on stimulating the language acquisition process beyond the immediate target (Fey et al., 2003).

Similarly, SLPs should use a variety of intervention techniques. For example, children with ASD can improve social skills better through a combination of peer training and written cues than by either method alone (Thiemann & Goldstein, 2004). An SLP can blend methods together to help a child be successful.

The most effective intervention approach for older school-age children and adolescents with deficits in syntax is an integrated one in which naturalistic stimulation approaches are supplemented with deductive teaching procedures. In a deductive method, children are presented with a rule that guides the use of a morphological marker, such as past tense *-ed,* along with models of the inflection (Finestack & Fey, 2009).

Increasingly, SLPs are including other individuals from a child's environment in the training. Without training, day care providers fail to finely tune their language for individual children's needs (Girolametto et al., 2000). SLPs can help preschool teachers implement intervention both through activities such as dramatic play, art, and storybook reading and through language instruction processes (Pence et al., 2008). Preschool staff being trained to respond to children's initiations, to engage children, to model simplified language, and to encourage peer interactions has a significant effect on children's language production

(Girolametto et al., 2003). Even peers can serve as effective tutors or models for children with language impairments (McGregor, 2000).

With the aid of an SLP, these and other care providers, such as parents, may learn how to be better language partners for children. Despite the many demands on and restrictions faced by mothers and children who are homeless, it is possible to teach homeless parents, even those with limited language skills, to use facilitating **language** strategies during interactions with their preschool children (O'Neil-Pirozzi, 2009).

Target Selection and Sequence of Training

The goal of intervention is the maximally effective use of language to accomplish communication goals within everyday interactions. Although most SLPs would agree on this overall goal, less unanimity exists on the route to achieving it. Decisions on target selection and training vary with each child and each SLP.

Using assessment results, SLPs might select different targets for the same child. One SLP might use language acquisition knowledge as a general guide. Another might begin intervention at the point of communication breakdown and frustration for the child. A more classroom-based approaches might suggest training for language used within the class. Still another approach might be to begin with language features that are emerging.

Decisions must also be made about where to begin once the target is selected. Some SLPs prefer to begin with receptive language training and progress to expressive. Others might start with expressive training.

Expressive training may be bottom-up, in which one begins at the symbol level and works toward conversational goals; top-down, in which training is placed within a conversational framework; or a combination of the two. Obviously, the child's abilities are an important determiner of the method selected. To the extent possible, training should be placed within meaningful communicative contexts.

> The criteria for target selection will vary with the child, the affected aspects of language, the child's disorder, and the needs of the environment.

Evidence-Based Intervention Principles

The needs of children with LI suggest several principles that should guide intervention services. These principles, presented in Figure 4.7, recognize the need to target a child's language abilities in their entirety rather than to focus exclusively on one deficit area. The interrelatedness of all areas of language and the importance of communication context on the form and content of language necessitate a more holistic approach.

Throughout this text, we stress the importance of evidence-based practice (EBP). Although a lack of direct empirical evidence should not automatically rule out a new teaching method, it should be grounds for suspicion (Cirrin & Gillam, 2008, p. 19). Box 4.4 presents recommended practices for language disorders.

Intervention Procedures

Remember that as an SLP, wherever you may work, are teaching communicative skills. SLPs are teachers in the broadest sense. Throwing out questions or cues and hoping for the right response or providing the answer when the child is incorrect is not teaching. Teaching is a systematic analysis of what a child is lacking that results in his or her failure to succeed. As an SLP, you need to break any learning

Figure 4.7 Principles of language intervention.

1. The goal of intervention should be greater facility of language use in conversation, narration, exposition, and other textual genres in hearing, speaking, reading, and writing.
2. Deficit areas are rarely, if ever, the only areas of language that should be targeted in an intervention program.
3. Select intermediate goals that stimulate a child's language acquisition processes rather than goals that focus solely on deficit areas.
4. Select specific goals of intervention based on a child's readiness and need for the targeted goals.
5. Manipulate the context to create more opportunities for the language target to occur.
6. Exploit different genres and modalities to develop appropriate contexts for intervention targets.
7. Manipulate clinical discourse so targeted areas are more noticeable and important in various contexts.
8. Systematically contrast a child's language performance with more mature adult usage by recasting a child's utterances.
9. Provide good models of easily comprehended, well-formed phrases and sentences.
10. Use a variety of verbal and nonverbal strategies to elicit and modify a child's language and to give a child practice in using language to accomplish her or his communication needs.

Note: We are deeply indebted to the fine work of Mark Fey, Steven Long, and Lizbeth Finestack (2003) on which this figure is loosely based. See Fey, M. E., Long, S. H., and Finestack, L. H. (2003). Ten principles of grammar facilitation for children with specific language impairment. *American Journal of Speech-Language Pathology, 12,* 3–15.

BOX 4.4 | Evidence-Based Practice for Childhood Language Impairments

General

- More than 200 studies report effectiveness for the vast majority of children.
- Measureable benefits accrue from intervention beginning as early as possible.
- Multiple measures provide the most accurate and valid language assessment.

English Language Learners (ELLs)

- No single measure is adequate for assessment.
- Maintaining the home language enables parents, who may not speak English, to support language development.

Presymbolic Children

- Interactive language intervention in which parents are trained to provide intervention at home is effective. Long-term and standardized measures have not been applied.
- When compared to SLP-only models, gains for children receiving parent-implemented intervention were significantly higher in both receptive language and expressive syntax.

Children with Autism Spectrum Disorder

- Effective interventions are characterized by early intervention and intensive and individualized instruction.
- Methods used with children with ASD form a continuum from very structured behavioral methods stressing specific cues and reinforcers to more naturalistic play and child-based methods. Both behavioral and naturalistic approaches are effective in replacing challenging behavior with

BOX 4.4   *(Continued)*

social interactions, although no method works with all children with ASD.
- Approximately two thirds of children make significant measureable gains.
- The Picture Exchange Communication System (PECS), in which a picture is used to request items, demonstrates only small to moderate gains in communication and small to negative gains in speech.

Preschool

- Speech and language intervention are most effective for children with phonological or expressive vocabulary difficulties.
- Parent-implemented language interventions have a significant, positive impact on both receptive language and expressive syntactic skills.
- Intervention of more than 8 weeks results in better outcomes than shorter intervention.
- 70% of preschool children with language impairments make significant measureable gains with intervention.

School-Age and Adolescent

Syntax and Morphology

- Moderately large to large effects follow use of imitation, modeling, or modeling plus evoked production strategies.
- Computerized input strategies alone have not demonstrated extensive benefit as yet.

Semantics and Vocabulary

- A paucity of research exists on effective vocabulary instruction methods for children in early-elementary grades. We do not yet have evidence on the best possible technique.
- Collaborating with teachers on large-group instruction and slowed presentation rate can positively impact vocabulary development.

- Interactive conversational reading strategies may be somewhat helpful for improving receptive and expressive vocabulary.
- There do not seem to be clear differences in outcome between the various methods used to assist children with word finding.

Language Processing (the manner in which children attend to, perceive, discriminate, and recall sounds, syllables, words, and sentences)

- Computer intervention using modified speech stimuli or speech and language games does not improve performance.

Pragmatics and Discourse

- Direct instruction on topic initiation and group entry behaviors can yield moderately large to large effects for students with social communication deficits.
- It is possible to teach social skills to adolescents with ASD. Although several approaches have been used effectively, the data are not sufficient to identify the most effective method of intervention.

Method of Intervention

- Based on very few studies, we can tentatively conclude that preschool and early-elementary children with LI show greater improvement with a collaborative (teacher and SLP) teaching, classroom-based language intervention model than they do in more traditional pull-out intervention.

Sources: Based on Bedore (2010); Burgess & Turkstra (2006); Cirrin & Gillam (2008); Dollaghan & Horner (2011); Goldstein & Prelock (2008); Johnson & Yeates (2006); Justice & Pence (2007); Law et al. (2004); McGinty & Justice (2006); Prelock (2008); and Roberts & Kaiser (2011).

task into the sequential steps required to move from where the child is now to where we want the child to be. Decisions on sequencing should be determined by the complexity of the task, its cognitive and linguistic requirements, and the learning characteristics of the individual child. The SLP enhances teaching by anticipating the types of support that a child is likely to need and the types of error the child is likely to make (Schuele & Boudreau, 2008).

A few basic tenets of good teaching behavior include, but are not limited to, the following:

- *Model the desired behavior for the client.* Modeling may include multiple exposures, called *focused stimulation* or *priming,* that occur before the child is required to produce the language feature (Leonard, 2011). In a variation called **parallel sentence production**, an SLP provides a model of the *type* of utterance desired. The child is not expected to imitate the model but to provide a similar type of sentence. For example, you might describe a picture by saying "The girl is throwing the ball" and then ask the child to describe a second picture of a boy *catching a ball*. The need for modeling decreases as the feature is learned. Older elementary school children and adolescents may also benefit from an explanation of the targeted behavior and a rationale for why its correct use is important.

- *Cue the client to respond.* Carefully selected cues, such as the use of the word *yesterday* to signal a past-tense response, serve as aids for the client in conversation. Cues may range from very specific, such as *say, imitate,* or *point to,* to more general conversational cues, such as *I wonder what I should say now* to elicit a specific linguistic structure in context or *Maybe Carol can help us if we ask* to elicit a question:

  - Cues may be either verbal or nonverbal. Verbal cues attempt to elicit the language feature by providing a linguistic framework; nonverbal cues use the context of an event to evoke the feature.

  - The SLP should rate each type of cue or prompt from least to most intrusive and supportive (Timler et al., 2007). As intervention proceeds, the SLP works to minimize prompting whenever possible, so the child can become more independent.

SLPs are teachers of language. They must plan their behaviors well to teach without overly relying on less natural strategies, such as drill and the use of edible reinforcers.

- *Respond to the client in the form of reinforcement and/or corrective feedback.* Reinforcement varies from very direct and obvious forms, such as "Good, that was much better," to more conversational responses. Conversational responses come in many varieties, including imitating the child, imitating but expanding the child's utterance into a more mature version, replying conversationally, and asking for clarification, to name a few. With some clients, especially those with vocabulary deficits, the relationship of the response to the content of the child's utterance has more effect on the child's language than the structural input of the clinician's feedback. In other words, respond to the meaning of what the child said:

  - Natural reinforcers flow from the training target. The most obvious example is one in which a child obtains a desired object upon responding to the cue "What do you want?" Conversational responses are natural and reinforcing.

  - Corrective feedback may range from a gentle reminder to an instruction. For example, an SLP might recast a sentence. If the child says, "Boy eating cookie," and the target is use of the auxiliary verb *be,* the SLP might recast the sentence as "He *is* eating" or "The boy *is eating* the cookie." Children with SLI and low MLU scores benefit most from recasting following utterances in which the child is prompted to attempt the structure prior to the adult's recast (Yoder et al., 2011).

- In general, as a language feature is produced more correctly by a client, an SLP relies less on these direct forms. When a language feature is correct most of the time, conversational feedback, such as "What?" or "I don't understand" may be sufficient to cause the client to self-correct the few errors made.

- *Plan for generalization of the learned feature to the everyday use environment of the client.* SLPs can help with generalization by selecting training targets that are highly likely to occur in the client's everyday communication and by including in the training elements of the everyday use environment, such as familiar locations, people, and objects. Parents are often included in the training of young children, whereas teachers may be involved in the intervention of school-age children and adolescents.

Specific examples of each teaching method are presented in Figure 4.8.

Effective language intervention should enhance language and social skills in real-life interactions (Timler et al., 2007). Success occurs when the newly taught language feature generalizes to a child's everyday environment.

Children learn to use language through interactions with many individuals and in varying situations.

Thought Question

Intervention through the Lifespan

Targets of intervention vary with the age and functioning level of a child. An infant in an early intervention program would have different training targets than an adolescent with LD. However, an infant may be receiving some of the same training as an adolescent who has profound ID and is functioning below age 1 year.

Early intervention, especially for children with ID and ASD, can have a very positive benefit. Initial training may target presymbolic communicative skills and cognitive abilities, such as physical imitation, gestures, and receptive understanding of object names. Parents may be trained to treat their child's behaviors as having some communicative value or to interpret consistent behaviors as attempts to communicate. An SLP may attempt to establish an initial communication system by using an augmentative and alternative communication system (AAC) such as gesturing, a communication board, or an electronic device. AAC is discussed in more detail in Chapter 13.

Early symbolic training may focus on vocabulary acquisition, semantic categories, word combinations, and an array of early intentions. The beneficial effects of treatment for children with delayed language extend beyond the trained targets into other areas of linguistic and overall development.

Children at the preschool language level usually work on language form in both conversations and narratives. Longer utterances, bound morphemes, and early phonological processes may be intervention goals. Vocabulary will continue to be targeted.

Intervention with higher-functioning children may focus on pragmatic skills in conversations and semantic targets, such as figurative language, multiple meanings, abstract terms, and more advanced relational terms, such as conjunctions. Academic skills, including summarizing a reading and different types of writing and note taking, may also be targeted. SLPs may use computerized programs to supplement more face-to-face intervention. These must be used with caution and should mesh well with the SLP's overall clinical philosophy and the child's individual needs. Language enhancement can be infused into the

Figure 4.8 Examples of teaching methods.

Method	Example
Modeling	
Focused stimulation	I'll pretend to make a cake first. Watch to see if I make a mistake. I'm *putting* the eggs in the bowl and *taking* them to the table. I'm *cracking* the eggs. Now I'm *beating* the eggs. Next, I'm *sifting* the flour. I'm *adding* the flour to the eggs and *mixing* them. Now I'm *measuring* the sugar and *pouring* it into the mix. . . .
Cuing	
Direct Verbal	
Imitation	Say "I want cookie."
Cloze	This is a _____. She should say _____.
Question	What should I say now? What's this? Which one's this?
Indirect Verbal Pass it on	I wonder if Joan knows the answer. How could we find the answer? [TARGET IS FORMATION OF QUESTIONS]

Nonverbal
   (Inherent in
   the activity)
	Not giving child all the materials needed to complete a task.
	 Not explaining how to accomplish an assigned task. Playing dumb.

Responding	
Direct Reinforcement	Good, I like the way you said that. Much better than the last time.
Indirect Reinforcement	
Imitation	*Child:* I go horsie. *Clinician:* I go horsie.
Expansion	*Child:* I go horsie. *Clinician:* I'm going to go on the horsie.
Extension	*Child:* I go horsie. *Clinician:* Yes, cowboys go on horses, too.
Corrective Feedback	Remember, when we use a number like two, three, or more, we say /s/ on the word. Listen. One cat. Two cats.

In schools, SLPs provide individual, group, and classroom language intervention.

curriculum. SLPs may work with the child on both spoken and written language. It is also important for children with LI to learn to navigate the curriculum and understand classroom expectations.

Language intervention doesn't end with childhood. Adolescents may continue to exhibit language impairments and be in need of services. Adults with

severe ASD or ID will most likely require continued intervention for language and communication deficits and a range of self-care, educational, and vocational needs. Individuals with LD may require additional support in postsecondary education (Downey & Snyder, 2000; Olivier et al., 2000).

Click here to check your understanding of the concepts in this section.

SUMMARY

In this chapter, we discussed several disorders associated with learning impairment (LI). It is sometimes difficult for beginning students to remember the characteristics of the disorders related to LI. Refer to Figure 4.1 for the major differences.

As the definition and the many associated disorders suggest, LIs are very complex and many faceted. We have only touched the surface in this chapter. The number of associated disorders, the language features that are affected, and the individual differences among children result in each child's language being very individualistic. It is very important to remember that each child is a unique case. Given this fact, assessment becomes a search to find and describe each child's individual language abilities. This is accomplished through referral, collection of a case history, interviews, observation, testing, and language sampling.

As a result of the assessment process and through repeated assessment probes during intervention, an SLP attempts to find the most efficient and effective method for teaching new skills. The SLP identifies targets for intervention and trains these through a combination of techniques in various settings with the aid of additional language facilitators.

Obviously, every SLP needs thorough training and extensive experience with a variety of LIs to serve children with these disabilities. As an SLP, you want to gain a firm foundation of speech and language development and take several courses in LI in both children and adults and complete practica with both populations.

SUGGESTED READINGS

Nelson, N. W. (2010). *Language and literacy disorders: Infancy through adolescence.* Boston: Pearson.

Owens, R. E. (2014). *Language disorders: A functional approach to assessment and intervention* (6th ed.). Boston: Pearson.

Reed, V. A. (2012). *An introduction to children with language disorders* (4th ed.). Boston: Pearson.

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5

Literacy Impairments: Assessment and Intervention

CHAPTER LEARNING GOALS

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

- Describe the aspects of literacy that are of concern to a speech-language pathologist (SLP)

- Explain how literacy develops

- Explain the deficits in literacy experienced by children with language impairment (LI)

- Describe an assessment of literacy

- Give examples of intervention for literacy

D emocracy is based on the premise that we are an informed people. In the beginning of the American republic, those who were best informed were literate. What does being informed mean today? Should we be concerned when one segment of the population has deficits in literacy learning? And who is responsible for aiding these individuals? These questions go to the heart of the issue of developmental literacy impairments.

Let's begin with literacy itself. **Literacy** is the use of visual modes of communication, specifically reading and writing. The interrelatedness of aspects of literacy is illustrated by the correlation between reading and spelling ability. Poor readers tend to be poor spellers. But literacy is more than just letters and sounds. Literacy encompasses language; academics; cognitive processes, including thinking, memory, problem solving, planning, and execution; and is related to other forms of communication. Case Study 5.1 presents the narrative of one child with a literacy impairment.

Reading and writing are not just speech in print. In addition to the obvious physical difference, reading and writing lack the give-and-take of conversation, are more permanent, lack the paralinguistic features (stress, intonation, fluency, etc.) of speech, have their own vocabulary and grammar, and are processed in the brain in a different manner (Kamhi & Catts, 2005).

The relationship of early oral language difficulties and literacy problems may be more nuanced than a simple transference of problems from one modality to another. There seems to be an interaction between a child's early reading abilities, conversational language abilities, and history of language difficulties (Segebart DeThorne et al., 2010). Conversational language skills contribute a small but significant amount to children's early reading.

As in other forms of communication, use of literacy presupposes that the user can encode and decode, and, more importantly, that he or she is able to comprehend and compose messages for others. In other words, literacy rests on a language base—and so do literacy impairments.

Many of the disorders mentioned under both childhood and adult LIs (Chapters 4 and 6) figure prominently in literacy impairments. In fact, as many as 60% of children with LI may experience difficulties with literacy (Wiig et al., 2000). Children with language impairments may be unprepared for literacy learning because they lack preliteracy skills and an oral language base. When compared to children developing typically, preschoolers and kindergarteners with LI may be less able to recognize and copy letters and less likely to pretend to read or write, to engage in daily preliteracy activities, or to engage adults in question–answer activities during reading and writing.

Often, literacy impairments do not disappear as children mature. As adults, those who experienced literacy deficits in childhood may continue to struggle with reading and writing. One intelligent man in his 50s—known by one of the authors—has continually worked in manual labor positions because his lack of literacy skills has disqualified him from managerial positions. Hopefully, with advances in intervention research, the future will see better and more evidenced-based intervention with increasingly better outcomes.

Literacy deficits vary in complexity and severity. Maybe you are a college student with a literacy problem who has been able to succeed academically by adjusting to, compensating for, or overcoming deficits in your reading or writing.

Case Study of a Child with Literacy Impairment: Juan

An athletic 7-year-old who loves video games and riding his bike, Juan immigrated to the United States from Colombia when he was 4 years old. With three older sisters, he was the baby of the family and received plenty of attention. His mother reported that his Spanish language development was similar to that of his sisters and that she was not concerned, although her son's speech was sometimes difficult for people outside the family to understand. When the family immigrated, the children began to learn English. As the youngest, Juan learned quickly but experienced some problems with English speech sounds. He received speech and language services in kindergarten, although he was not classified as having a communication disorder.

In first grade, Juan's development of reading was fine initially, but gradually he fell more and more behind his peers. By second grade, he was nearly a year behind his classmates. The speech-language pathologist, reading specialist, and classroom teacher met with the parents to suggest a thorough reading diagnostic. The evaluation confirmed that Juan was reading below his age, and the reading specialist pledged to redouble her efforts. The speech-language pathologist noted Juan's especially poor performance on phonological awareness (PA) tasks and with the other team members recommended clinical intervention in this area.

Although she was unsure of the actual factors related to Juan's difficulties, the speech-language pathologist believed that they might be related to his learning of a second language. As if to confirm this hypothesis, Juan quickly excelled in both phonological awareness and reading. As his PA skills improved, his speech sound production also became more accurate.

As you read the chapter, think about:

- Possible explanations for Juan's reading problems
- Possible ways in which the evaluative team could explore different aspects of reading
- Possible explanations for Juan's success

The authors of this text have worked with college students like yourself who have had to overcome literacy difficulties.

Although primary responsibility for teaching reading and writing still rests with the teacher and other educational specialists, a speech-language pathologist (SLP) is interested in children's language deficits and the ways in which those deficits influence the acquisition of literacy. In recognition of the special skills that SLPs bring to this area, the American Speech-Language-Hearing Association (ASHA, 2001d) recommends that SLPs play a role in literacy intervention.

As a consequence, SLPs are involved in literacy intervention from preschool through adulthood. At both the preschool and early elementary school levels, SLPs focus on preventive intervention. According to ASHA, SLPs have the following responsibilities:

- Educate both teachers and parents in the relationship between oral language and literacy.
- Identify children who are at risk of having literacy difficulties.
- Make referrals to good literacy-rich programs.
- Recommend assessment and treatment in preliteracy skills when needed.

Because children with LI are at high risk for literacy disabilities, preliteracy, reading, and writing assessment should be a portion of any thorough language evaluation, when appropriate.

Of necessity, the concerns of SLPs will differ with the maturational level and preliteracy or literacy abilities of children.

With older children and adults, an SLP is concerned with improving reading and writing skills. The SLP continues to help children and adolescents develop a strong language base and addresses both reading and writing. Assessment and intervention for literacy are also vital parts of any thorough rehabilitative strategy for adults with neurological impairments (see Chapter 6).

As with most other communication impairments mentioned in this text, with literacy impairments, SLPs often work as part of a team, collaborating with teachers to design literacy-based programs on vocabulary, language, and thinking skills (Silliman & Wilkinson, 2004). By working with teachers, SLPs provide opportunities for children with developmental literacy impairments to use skills taught in intervention within meaningful activities in the classroom. Effective collaboration should include curriculum planning, naturalistic language facilitation, and careful teaming of personnel (Hadley et al., 2000). Other members of a literacy intervention team may include a reading specialist, a school psychologist, and a parent.

In the remainder of the chapter, we discuss literacy and associated skills, disorders, assessment, and intervention, first with reading and then with writing. Most language impairments discussed in Chapter 4 also affect literacy acquisition.

READING

Several steps are involved in reading and reading comprehension. Both language and written context play a role in word recognition and in the ability to construct meaning from print (Gillam & Gorman, 2004).

The first step is **decoding** the printed word, which consists of breaking or segmenting a word into its component sounds and then blending them together to form a word that is recognizable to the reader. Words take on more meaning, based on grammar and context. In addition, there is an interaction between the print of the page and linguistic and conceptual information of each reader (Whitehurst & Lonigan, 2001). We interpret what we read based on what we know. Given these processes, it shouldn't surprise us that children with oral language impairments might have reading problems as well. Figure 5.1 is a model of this dynamic process of text interpretation.

Obviously, comprehension requires much more than simply decoding or even interpreting a word. An active reader is concerned with skills such as self-monitoring, semantic organization, summarization, interpretation, mental imagery, connection with prior knowledge, and metacognition (or knowledge about these processes).

In summary, reading basically consists of decoding and comprehending text. Whereas phonological skills are essential for decoding, other areas of language are needed for comprehension (Nation & Norbury, 2005). The reader uses language and experience to interpret the message conveyed by the author. This may give you some idea of why language and literacy go hand in hand. Let's look briefly at aspects of reading that are of particular interest to SLPs: phonological awareness, morphological awareness, and comprehension.

Phonological Awareness

Necessary for reading, **phonological awareness (PA)** is knowledge of the sounds and syllables and of the sound structure of words. Phonological awareness includes **phonemic awareness**, the specific ability to manipulate sounds, such as blending

Figure 5.1 Reading comprehension.

A DYNAMIC Model of Reading
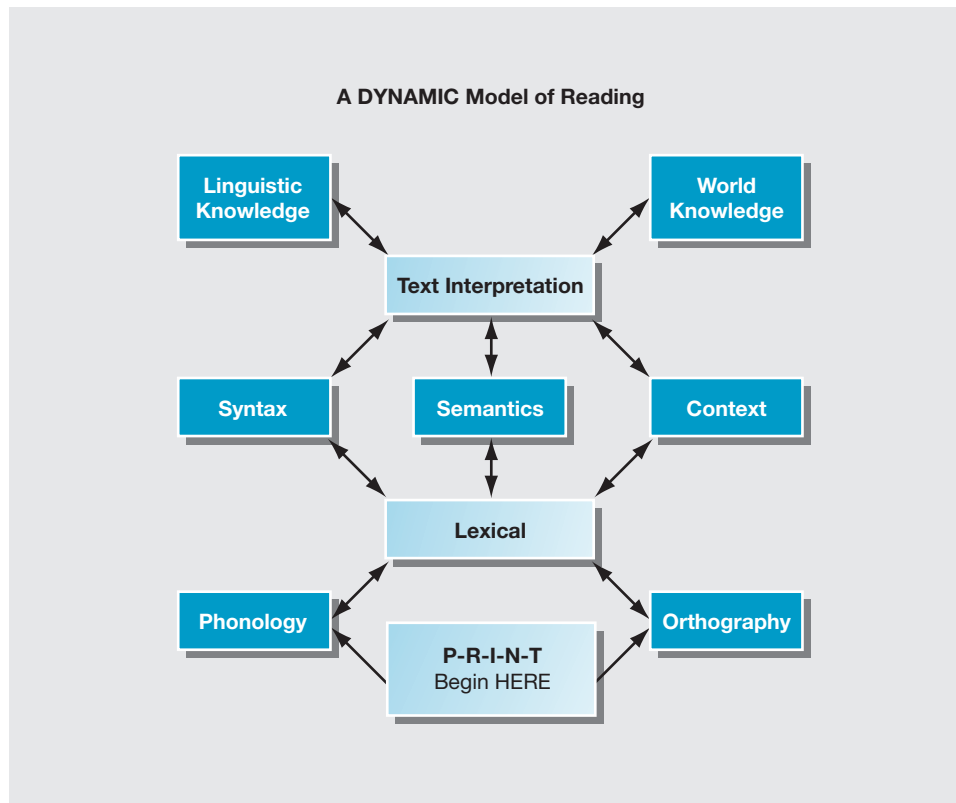
Beginning with print, a reader uses letters and their corresponding speech sounds to decode words that he or she then recognizes based on the reader's lexical or vocabulary memory. The reader combines words with other words and uses syntax, semantics, and context to interpret and comprehend the meaning.

Source: Based on information from "Language and Discourse Contributions to Word Recognition and Text Interpretation," by R. B. Gillam and B. K. Gorman (2004). In E. R. Silliman and L. C. Wilkinson (Eds.), *Language and Literacy Learning in Schools* (pp. 63–97). New York: Guilford.

sounds to create new words or segmenting words into sounds. As you might guess, better phonological awareness, specifically phonemic awareness, is related to better reading skills (Cupples & Iacono, 2000; Hogan & Catts, 2004). In addition, PA skills also are the best predictor of spelling ability in elementary school.

Phonological awareness consists of many skill areas. Not all are required for reading. The auditory ability to determine a word when a phoneme or syllable is deleted (*cart − t = car*), to **blend** or create a word from individual sounds and syllables, and to compare initial phonemes for likeness and difference are areas of PA that are particularly important for the development of reading.

Yes, it does seem easy to confuse terms. Simply put, phonological awareness is an alertness of phonology, so yes, it contains the elements of phonology.

Morphological Awareness

Although phonological awareness skills are essential for learning to read and write, recent findings suggest that by 10 years of age or even earlier, awareness of and knowledge about the morphological structure of words is a better predictor

of decoding ability (Mann & Singson, 2003; Wolter et al., 2009). As children progress through the elementary grades and into middle school, morphologically complex words make up an increasing proportion of the words they encounter.

Comprehension

Several levels of text comprehension exist. At the basic level, a reader is primarily concerned with decoding. Meaning is actively constructed from words and sentences and from personal meanings and experiences. Above this level is **critical literacy**, in which a reader actively analyzes and synthesizes information and is able to explain the content. A reader bridges the gaps between what is written and what is meant (Caccamise & Snyder, 2005). At the highest level, **dynamic literacy**, a reader is able to interrelate content to other knowledge through both deductive and inductive reasoning. Dynamic literacy is comparing and contrasting, integrating, and using ideas for raising problems and solving them (Westby, 2005).

A reader's mental representation of meaning is composed of the text and the mental model the reader creates through the comprehension process. Comprehension occurs as a reader combines textual material, text grammar, and the his or her own world knowledge and experience.

Reading is a goal-directed activity. For example, a reader may be gathering information to be used in a problem-solving task. Knowing what to do and how to do it is called **metacognition**, and two aspects of it are important for reading. One aspect is self-appraisal, or knowledge of one's own cognitive processes. The other is **executive function**, or self-regulation, and includes the ability to attend; to set reasonable goals; to plan and organize to achieve each goal; to initiate, monitor, and evaluate performance in relation to the goal; and to revise plans and strategies based on feedback. As you read, you form hypotheses about the material and predict and confirm or not confirm your predictions.

Studies with twins indicate that both genetics and the environment are important for reading achievement (Harlaar et al., 2008). In contrast, genetic factors alone seem to play a role in the relationship between early speech and reading (Hayiou-Thomas et al., 2010).

> Each reader must interpret what she or he reads in light of personal experiences and knowledge. In other words, our comprehension will differ based on our own unique self.

Reading Development through the Lifespan

You may believe that literacy development begins with reading and writing instruction in school. Actually, though, literacy development begins much earlier and continues throughout our lives.

Emerging Literacy

Reading development begins within social interactions between a child and caregiver(s) at around age 1, as parents or others begin to share books with toddlers. Book sharing is usually conversational in tone, with the book serving as the focus of communication. Here's an example:

Adult: This is a book about a . . .

Child: Bear.

Adult: Yeah. And you found him right here. What do bears say?

Child: Grrrrrrrr.

Adult: Um-hm, they growl. Can you find his eye?

Reading the story is secondary to the conversation.

As children mature, some parents engage in **dialogic reading**, an interactive method of reading picture books. When reading, adults encourage their children to become actively involved in the reading process by asking them questions and allowing them opportunities to become storytellers.

By age 3, most children in the United States are beginning to develop **print awareness**. Early print awareness consists of knowledge of the meaning and function of print, basic concepts concerning the direction print proceeds across a page and through a book, and recognition of some letters. Later-developing skills include recognizing words as discrete units, being able to identify letters, and using terminology, such as *letter, word,* and *sentence.* Children with good language skills seem to enjoy reading activities more than children with poor language and will pretend to read at an early age.

By age 4, children begin to notice phonological similarities and syllable structure in words they hear. This is the beginning of phonological awareness. Four-year-olds also appreciate both sounds and rhymes. Children who have been exposed to a home literacy environment and to print media have better phoneme awareness, letter knowledge, and vocabulary (Foy & Mann, 2003). Children with disadvantaged socioeconomic status, language impairment, and impoverished literacy experiences may be in danger of not developing these skills (McGinty & Justice, 2009).

Phonological awareness may arise from a child's need to store words in his or her brain with increasingly more detailed representation. This becomes necessary as a child's vocabulary grows and there are more and more words, some very similar in sound, to store.

Early childhood settings have great potential as sources of emergent literacy experiences for children at risk because of the multiple opportunities to target literacy skills. Unfortunately, in publicly funded preschool classrooms serving at-risk children in the United States, the overall quality of literacy instruction is low (Justice et al., 2008). Although many preschool teachers have only limited training in emergent literacy, they can learn to facilitate development of emerging literary skills by using a higher rate of utterances that include print/sound references and decontextualized language (Girolametto et al., 2012).

Prekindergarten speech perception skills and receptive vocabulary size are good predictors of PA skills at the end of kindergarten (Rvachew, 2006). In a "literacy-rich" kindergarten environment, children begin to decode the alphabetic system and to broaden their experience with print. Five kindergarten variables seem to predict reading success by second grade: letter identification, sentence imitation, phonological awareness, rapid automatized naming (RAN), and maternal education level (Catts et al., 2001). RAN is the ability to quickly name a series of items in a category, such as types of clothes or food.

In general, children develop the skills associated with reading more rapidly at earlier ages than in later. Development gradually plateaus and is followed by slow refinement.

In first grade, children are introduced to reading instruction and learn the sound–letter correspondence called **phonics**. A child reads words and links them with words and meanings stored in memory. Most of the child's effort goes into

decoding the letters, leaving little cognitive energy for either comprehension or interpretation. This is one reason we don't assign *War and Peace* to first-graders.

Phonology (sound) and orthography (letters) are important for early reading, but increasingly grammar and meaning contribute more. Later, developing knowledge of morphology may aid students in breaking words apart, recombining them, and creating new words (Berninger et al., 2001).

As a child's reading improves, reading becomes more automatic or fluent, especially with familiar words. Fluency is aided by the use of grapheme–phoneme patterns in the child's memory and by analogy, the process of relating unfamiliar words to familiar ones, based on similar spelling.

By third grade, there is a shift from *learning to read* to *reading to learn* (Snow et al., 1999). As language continues to improve, so does comprehension, with a resultant increase in reading fluency.

Mature Literacy

Although all reading begins with the printed word, mature readers like you use very little cognitive energy for determining word pronunciation. At a higher level of processing, a person uses both language and experience to understand text, monitoring automatically to ensure that the information makes sense.

A skilled reader then predicts the next word or phrase and glances at it to confirm the prediction. Printed words are processed quickly, automatically, and below the level of consciousness most of the time. In less than a quarter of a second, your brain retrieves all the information from a word or phrase that it needs to confirm the prediction and form another prediction of the next word or phrase. This process is presented in Figure 5.2.

Figure 5.2 Model of mature reading.
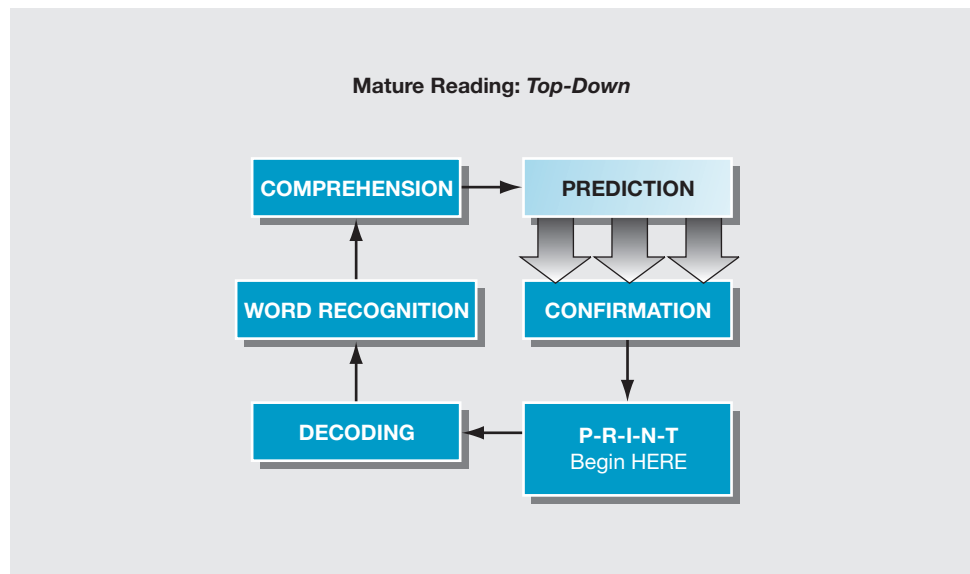
Mature readers use their language skills to predict what words or phrases will appear next in the text, then momentarily glance at the print to confirm their predictions before predicting anew what will follow.

Rapid and accurate reading is enabled by quick retrieval of orthographic and phonological information along with semantic processes. The reallocation of attention to cognitive and higher language processes is essential for comprehension (Wolf & Katzir-Cohen, 2001).

Mature readers don't simply read the text; they dialogue with it. Reading is an active process in which ideas and concepts are formed and modified, details remembered and recalled, and information checked. Much of this is the unconscious process of the brain partaking of new information.

As we mature, the types and purposes of reading change, but we can continue to enjoy the process throughout our lives. Reading skill continues to be strong through adulthood, as long as we exercise our ability and do not experience any neuropathologies, such as those in Chapter 6. Reading is one of the primary ways by which adults increase their vocabulary and knowledge.

Establish a habit of reading now. It will serve you well as you mature.

Reading Problems through the Lifespan

Risk of reading difficulties is greatest for children with a history of problems in both articulation and receptive and expressive language (Segebart DeThorne et al., 2006). In general, poor reading comprehenders have deficits in oral language comprehension, too, but have normal phonological abilities. In contrast, children who are poor decoders have poor phonological abilities but little or no oral language comprehension difficulties (Catts et al., 2006). The story of a young man with learning disabilities and reading difficulties is presented in Case Study 5.2.

The ASHA website (www.asha.org) provides access to many professional articles on reading disorders. For example, click on "Publications" at the top and then click on "Archive" under "The ASHA Leader Online." In "2007," "September 4, 2007 Issue," you'll find the article "The Neurobiology of Reading and Dyslexia."

Some children have a specific type of learning disability or disorder that is primarily manifested in reading and writing. In the past, this disorders was called *dyslexia*. The fifth edition of the *Diagnostic and Statistical Manual* (DSM-5: APA, 2013), as mentioned in Chapter 4, does away with this term in favor of *specific learning disorder*. Types of specific learning disorders are not labeled but are to be described in a diagnosis. To make this less cumbersome, this book uses the term *SLDL,* for *specific learning disorder in literacy*.

Children with SLDL have poor word recognition or decoding abilities, accompanied by problems with phonological processing. SLDL is a type of learning disability, is neurobiological in origin, and is characterized by difficulties with accurate and/or fluent word recognition and decoding abilities and by poor spelling (Lyon et al., 2003). When we compare children with SLDL to typically developing readers, we find:

- Comparable verbal IQ and/or listening comprehension
- Below-average word reading
- Well-below-average word attack or decoding skills
- Well-below-average phonological processing scores (Sawyer, 2006)

Three distinct types of SLDL have been described, including a language-based disorder that may affect comprehension and/or speech sound discrimination, a speech/motor disorder that may affect speech sound blending and motor

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CASE STUDY 5.2

Justin, a Young Man with Learning Disabilities

Justin grew up in a midwestern suburb and attended public schools. He's the youngest of four children and the only male. As an adult, he's personable and friendly, works part time, and is attending the local community college. His sisters, especially the next oldest, help him with his homework when possible.

As a preschooler, Justin cared little for books. His language developed more slowly than his sisters', but his parents assumed that he would be fine and that he didn't talk much because his sisters talked for him. Still, his mom enrolled him in preschool to encourage his development. He scored low on his kindergarten readiness test and, although admitted to kindergarten, was later recommended to repeat the experience because of a lack of pre-academic skills needed for first grade. His parents reluctantly agreed.

When he began school, Justin adjusted well, but he quickly began to fall behind other children in both reading and writing. An evaluation at the end of first grade resulted in Justin's being labeled as learning disabled. It was recommended that he remain in a regular classroom and receive additional instruction in literacy. At home, his parents worked closely with him on his reading and written assignments.

Through most of elementary school, Justin saw a reading specialist and a speech-language pathologist several times each week. His speech-language pathologist focused on Justin's language and listening skills and on his reading comprehension.

When Justin entered junior high school, he stopped seeing both the reading specialist and the speech-language pathologist. Instead, his team, including both him and his parents, decided that other measures would be attempted to compensate for his deficits. These included use of a word processor, recording of class lessons, and pre-preparation of lecture notes by his teachers. All through junior and senior high school, Justin met with different teachers after school for extra instruction.

When he graduated, Justin had few plans. He drifted from job to job for nearly a year before his sisters convinced him to apply to community college. Going part time, he was able to do well in his courses, and he has just been accepted into the physical therapy assistant major. Reading and writing are still difficult, but Justin is determined to do well, and his family members, especially his sisters, are extremely supportive.

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coordination, and a visuospatial disorder that may affect letter form discrimination. The language-based disorder is the most common.

Several websites discuss SLDL. The Learning Disabilities Association of America website (www.ldanatl.org) has a brief checklist of symptoms for parents. Simply go to the site, click on "For Parents" at the left, then "LD Basics" at the top, and "LD: Signs, Symptoms, and Strategies" below, and finally "Dyslexia." Finding the checklist takes a few clicks, but the list is helpful.

Much more detailed information is available on the MedicineNet website (www.medicinenet.com). Click on "Diseases and Conditions" at the top, click on the letter "D," and scroll down to "Dyslexia."

Finally, the website of public service station WETA, LD Online (www.ldonline.org), has a thorough discussion of dyslexia by the International Dyslexia Association titled "Dyslexia Basics." Go to "Getting Started" at the left and click on "Glossary." Once there, click on "D," scroll down to "Dyslexia," and click on "Dyslexia Basics."

Children with SLI may be similar to those with LD, exhibiting grapheme–phoneme (letter–sound) errors and syntactic, semantic, and pragmatic errors or misinterpretations when reading. Comprehension also may be impaired and may be related to a child's poor vocabulary.

Children with **hyperlexia** have poor comprehension but typical or above average word recognition abilities. Hyperlexia is a near-obsessive interest in letters and words found in some children with ASD. Although these children appear very precocious in their reading ability, they often have poor social skills and extremely limited reading comprehension (Treffert, 2009). Many individuals with ASD have word reading skills that are more advanced than their overall reading comprehension (Church et al., 2000; Diehl et al., 2005; Smith-Myles et al., 2002, Wahlberg & Magliano, 2004).

Causal factors for literacy impairment may be extrinsic or intrinsic to an individual (Catts & Kamhi, 2005). Extrinsic factors may include experience and the manner of instruction. Intrinsic factors may include genetics, vision-based deficits, auditory processing problems, attention deficits, language impairment, and neurological problems. For example, there appear to be differences between the brains of children with SLDL and the brains of typical children (Eckert et al., 2004). Differences have been found in the temporal-parietal region (interior to the ear), in both the left and right linguistic processing areas, and in the cerebellum (near the brain stem). Neural pathways in the left temporal-parietal area of the brain are important in the development of fluent reading (Deutsch et al., 2005).

Possibly as many as seven chromosomes are involved in various aspects of SLDL (Grigorenko, 2005). Malformations found in the left hemisphere language processing areas and between these areas and the visual processing portions of the brain may be related to these genetic changes (summarized in Galaburda, 2005). Possible familial links may be seen in other ways. For examples, children at high risk for reading disability have at least one parent with a significantly slower speaking rate than children at low risk for reading disability.

As might be expected given their language learning difficulties, many children with ASD have accompanying literacy impairments and uneven development of skills that are predictive of reading. In general, preschool children with ASD are severely delayed in their vocabulary relative to their nonverbal mental ages (Charman et al., 2003). In addition, oral narratives are challenging for these children (Losh & Capps, 2003). As a result, children with ASD and accompanying limited verbal skills often are excluded from standard literacy curricula, under the misguided assumption that they were incapable of learning to read (Koppenhaver & Erickson, 2003).

Similar to what we see in typically developing readers, children with LD acquire reading skills more rapidly in the initial stages and then gradually slow (Skibbe et al., 2008). Even so, these children are substantially below more typical readers by fifth grade.

Phonological awareness is a beginning stage for most readers. Those with phonological disorders, especially perceptual deficits, will find PA challenging. Speech perception seems to be particularly important for the development of PA (Rvachew & Grawburg, 2006).

In attempting to read, some children with language impairments, especially those with poor phonological skills but average or above-average intelligence, may use memorized word shapes, letter names, or guessing rather than relying on decoding skills. As a result, they are unable to decode unfamiliar words. Without word attack or decoding skills, by second grade, when formal decoding instruction ends, these children begin to fail.

Most initial reading problems are related to deficiencies in both phonological processing and awareness (Catts & Kamhi, 2005). PA difficulties seem to be related to failure to analyze words into syllables and these, in turn, into smaller phonological units.

If a beginning reader has good phonological ability and appears to decode words well, reading comprehension problems may go unnoticed (Nation et al., 2004). Although phonics-based decoding problems often decrease by third grade, comprehension problems persist for many children (Foster & Miller, 2007). Poor reading comprehension is associated not with phonics but with poor oral language (Nation & Norbury, 2005). For example, the majority of individuals with ASD do not become skilled readers because of their difficulties interpreting both oral and written words (Lanter & Watson, 2008). If a child isn't comprehending, he or she isn't reading. Some children have difficulty interpreting written narratives because they have poor oral narrative abilities (Naremore, 2001). They may lack the story framework or linguistic skills for telling narratives.

Reading comprehension is also dependent on communication, especially social inferencing and interpersonal reasoning (Donahue & Foster, 2004). Given the low social competence of some children with language impairments, it's easy to see why this aspect of reading might be difficult (Brinton & Fujiki, 2004).

Good readers actively guide and control their reading. In contrast, poor readers lack such strategies, reflecting possible deficits in executive function. They may approach reading as a random, unfathomable process. You'll recall that executive function deficit is most evident in children with TBI (traumatic brain injury). In addition, children with ADHD (attention deficit hyperactivity disorder) and LD (learning disability) have been described as inattentive and impulsive, disorganized, unable to inhibit behavior, and ineffective learners, which are characteristics of those with impaired executive function.

Competent readers and writers approach the task with a purpose that guides their behavior.

As children experience repeated reading failure, they may become frustrated or passive. Lacking persistence and with low self-esteem, they may become apathetic and resigned to failure. In contrast, some poor readers may become aggressive or display acting-out behaviors. All these behaviors interfere with further learning and development.

Many children with language impairments are at risk for reading impairment (Hambly & Riddle, 2002; Miller et al., 2001). In general, they:

In case you've forgotten, *metalinguistics* includes the ability to consider language out of context, to make judgments about its correctness, and to understand to some extent the process of using language.

- Begin with less language and may have difficulty catching up
- Have poor comprehension skills because they lack language knowledge that would enable them to integrate what they read
- Have poor metalinguistic skills
- Possess linguistic processing difficulties

When something goes wrong in the reading process, the result is reading that is less automatic and less fluent. Word decoding or text understanding may be impaired.

As mentioned, reading difficulties do not disappear. They are often related to other language problems. As adolescents, poor readers exhibit vocabulary, grammar, and verbal memory deficits compared to typical readers (Rescorla, 2005).

There is a significant negative correlation between children's nonmainstream American English (NMAE) dialect use and reading achievement (Charity et al.,

2004; Craig & Washington, 2004; Terry, 2010). This means that the more a child uses NMAE features, the poorer the child's reading. This alone may make reading difficult for the child but is not in and of itself a disorder.

Thought Question

Assessment of Developmental Reading

In this section we discuss overall assessment with a more detailed discussion of assessment of phonological awareness, word recognition, comprehension, and executive function. As mentioned in Chapter 4, assessments begin with an initial data gathering step that may include use of questionnaires, interviews, referrals, and screening testing. Figure 5.3 presents a checklist designed to identify kindergarten and first-grade school children at risk for language-based reading difficulties. No one item on its own indicates a reading problem.

Early literacy questionnaires often ask about the frequency of book reading behaviors, responses to print, language awareness, interest in letters, and early writing. Parental reports of early literacy skills of preschool children with language disorders compare favorably with professional assessments (Boudreau, 2005).

Information can be gathered from interviews with teachers, parents, and the child and by observation within the classroom. Interview questions should include the child's perceptions of the importance of reading and difficulty with different types of reading, along with the child's self-perceptions. Observation can confirm the child, teacher, and parent responses.

Collaborative reading assessment should include standardized measures, oral language samples including analysis of miscues or mistakes, and written story retelling (Gillam & Gorman, 2004). Formal testing might be accomplished by a school's reading specialist, but an SLP may wish to give selected subtests. In a more informal task, a child might be asked to read previously unread curricular materials in an attempt to assess her or his ability to function within the classroom (Nelson & Van Meter, 2002). The child's aloud reading can be recorded for later analysis of the child's miscues. Comprehension can be assessed by using questions, retelling, or paraphrasing.

Phonological Awareness

Phonological awareness assessment is multifaceted and should be accomplished within an overall assessment of reading, spelling, phonological awareness, verbal working memory, and rapid automatized naming (RAN), or the ability to quickly name objects or pictures. In addition to formal testing, an SLP can use informal assessment of rhyming, syllabication, segmentation or breaking words into parts, phoneme isolation, deletion, substitution, and blending or putting word parts together. With school-age children, it is especially important to assess both segmenting and blending.

Word Recognition

Decoding skills, especially knowledge of sound–letter correspondence, is the basis for word recognition. Of interest to an SLP will be decoding of consonant blends, long (*day*) and short (*can*) vowels, different syllable structures, and morphological affixes (*un-, dis-, -ly, -ed*).

Figure 5.3 Checklist for early identification of language-based reading disabilities.

The child . . .

_____   Has difficulty remembering words or names

_____   Has problem with verbal sequences (i.e., alphabet, days of the week)

_____   Has difficulty following instructions and directions and may respond to a part rather than the whole

_____   Has difficulty remembering the words to songs and poems

_____   Requests multiple repetitions of instructions/directions, with little improvement in comprehension

_____   Relies too much on context to understand what's said

_____   Has difficulty understanding questions

_____   Has difficulty understanding age-appropriate stories and making inferences, predicting outcomes, and drawing conclusions

_____   Frequently mispronounces words and names

_____   Has problems saying common words with difficult sound patterns (i.e., *spaghetti, cinnamon*)

_____   Confuses similar-sounding words (i.e., the **Specific** *Ocean*)

_____   Combines sound patterns of similar words (i.e., **nucular** for *nuclear*)

_____   Has speech that is hesitant, contains fillers (i.e., *you know*), or contains words lacking specificity (i.e., *that, stuff, thing, one*)

_____   Has expressive language difficulties, such as short sentences and errors in grammar

_____   Lacks variety in vocabulary and overuses words

_____   Has difficulty giving directions or explanations

_____   Relates stories or events in a disorganized or incomplete manner

_____   Provides little specific detail when relating events

_____   Has difficulty with rules of conversation, such as turn taking, staying on topic, requesting clarification

_____   Doesn't seem to understand or enjoy rhymes

_____   Doesn't easily recognize words that begin with the same sound

_____   Has difficulty recognizing syllables

_____   Demonstrates problems learning sound–letter correspondences

_____   Doesn't engage readily in pretend play

_____   Has a history of language comprehension and/or production problems

_____   Has a family history of spoken or written language problems

_____   Has limited exposure to literacy in the home

_____   Seems to lack interest in books and shared reading activities

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Word recognition assessment should adhere to the following guidelines (Roth, 2004):

- Materials appropriate to the student's age and developmental level
- Various types of tasks to assess different level of processing
- Use of several measures
- Consideration of a child's cultural and linguistic background
- Demonstration and training of unfamiliar tasks
- Children with emergent literacy skills are not the only ones with reading deficits
- Observation and interpretation of a child's test behaviors

Although traditional assessment procedures stress standardized testing, alternative approaches such as curriculum-based measures and dynamic assessment may be more appropriate for children with LI or from culturally linguistically diverse backgrounds (Roth, 2004). Dynamic assessment often follows a test–teach–test format, in which a child is assessed for the amount of change she or he can make during the assessment process.

Materials for curriculum-based assessment usually come from the local curriculum and use criterion-referenced scoring, which measures a child against himself or herself over time. In this way, progress is measured without reference to some abstract norm.

Word recognition is more than just the ability to decode a word in isolation. It's important, therefore, that word recognition testing be accomplished with various clues, such as pictures or sentence forms, available to the child and with words both in isolation and within text. More important than test scores is describing a child's strengths and the strategies used.

When analyzing recorded reading data, an SLP notes all discrepancies in the recorded reading samples. All attempts at word decoding, repetitions, corrections, omitted words and morphemes, extended pauses, and dialectal usages should be noted and analyzed for possible strategies used by the child. Reading errors can be analyzed at the word level by type, such as word order changes, word substitutions, additions, and deletions (Nelson & Van Meter, 2002). The percentage of incorrect but linguistically acceptable words indicates the extent of a child's use of linguistic cues to predict the correct word. In addition, an SLP can note the way in which the child sounds out words (Nelson & Van Meter, 2002).

Morphological Awareness

Textbooks for adolescents and young adults contain a variety of morphologically complex words, such as *regeneration, reptilian,* and *strenuous*. Given the importance of derived words for academic success, morphological awareness should be assessed in older children (Nippold & Sun, 2008). At the very least, SLPs should examine adolescent students' understanding of common morphemes such as *-able* (*acceptable*), *-ful* (*powerful*), *-less* (*speechless*), *-tion* (*prediction*), and the like. Actual words can be chosen based on frequency of word use in text and curricular materials.

Text Comprehension

Assessing text comprehension abilities of children is complicated by the many cognitive and linguistic processes involved. At the very least, as an SLP, you or other team members should assess a child's:

- Oral language, with special attention to the child's use of the more elaborate syntactic style used in literature
- Knowledge of narratives and text grammar
- Metacognition (Westby, 2005)

Narrative schemes or the events in a story might be assessed by having a child tell a narrative from pictures or by asking questions about the pictures that relate to the organization of the story. A child's text grammar, consisting of the parts of a story, can be assessed through spontaneous narratives or by retelling previously heard narratives.

Although several norm-referenced tests measure reading comprehension, tests should be supplemented by other measures of a child's ability to identify grammatical units, interpret and analyze text, make inferences, and construct meaning by combining text with personal knowledge and experience (Kamhi, 2003).

Executive Function

Whereas poor readers act as if reading is simply sounding out words rapidly and fluently, good readers expect text to make sense and to be a source for learning information. As a result, good readers read actively and with purpose, constructing mental models and organizing information as they go.

Self-regulation in reading can be assessed in many ways, including (Westby, 2004):

- Interview questions regarding strategies used with different reading tasks
- Verbalizing thoughts called *think-alouds* accompanying reading
- Error or inconsistency detection while a child reads

Click here to check your understanding of the concepts in this section.

Errors and inconsistencies can be planted in texts specifically for the assessment.

Intervention for Developmental Reading Impairment

Once the diagnostic data are analyzed and a literacy problem is identified, a child and an SLP are ready to begin intervention. Ideally, intervention for developmental literacy impairments is a team effort. The SLP supports the efforts of all the other team members and the explicit instruction of the classroom teacher and reading specialist.

Team members might cooperate in an embedded/explicit model of intervention in which children participate both in literacy-rich experiences embedded in the daily curriculum and in explicit, focused, therapeutic teaching of reading (Justice & Kaderavek, 2004; Kaderavek & Justice, 2004). The literacy-rich environment might include a message board where children learn to decode an "important" message left daily by the teacher, snack activities in which sounds are embedded in snack names, recipes, music and print, book and speech sound play, rhyming pictures, and book sharing with the teacher and others (Towey et al.,

2004). As little as 8 weeks of one-on-one twice-weekly 15-minute book sharing sessions in which adults read and ask both literal and inferential questions can result in gains in both types of comprehension (van Kleeck et al., 2006).

Effective instruction for reading should include sound and letter processes used in word identification, grammatical processes, and the integration of these with meaning and context (Gillam & Gorman, 2004). Training in phonological (sound) and orthographic (letter) processing together seems to offer a more effective strategy than working on PA skills in isolation (Fuchs et al., 2001; Gillon, 2000).

Beginning in preschool, an SLP can increase children's print awareness with print-focused reading activities (Justice & Ezell, 2002). Print-focused strategies emphasize word concepts and alphabetic knowledge and include cues such as the following:

Show me how to hold the book so I can read.

Do I read this way or this way?

Where is the last word on the page?

How many words do you see?

Find the letter C. Whose name starts with C?

Such print-focused prompts are easy to teach, and parents have used them successfully at home with only minimal training.

Most integrated approaches to preliteracy and early literacy consider the two semi-independent sets of preliteracy skills presented in Figure 5.4 (van Kleeck & Schuele, 2010):

- *Form foundations* for decoding include learning about the alphabet and becoming aware of phonological units within spoken words
- *Meaning foundations* for reading comprehension include vocabulary and sentence-level semantic-syntactic skills

Figure 5.4 Two-stage intervention.

Two-stage intervention model for pre- and early readers

Word meaning foundation

At Word Level:
  Vocabulary instruction
  Words that are important,
    utilitarian, conceptually easy,
    and frequently used
At Text Level:
  Providing scaffolding

Sentence form foundation

Understanding underlying
  structure
Relational terms
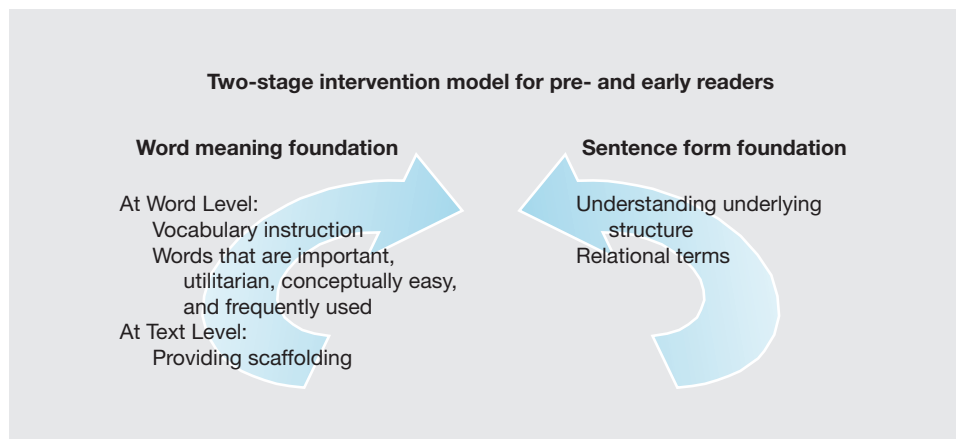
Intervention with young readers should focus on both word meaning and sentence formation.

Source: Based on information from "Emphasizing Form and Meaning Separately in Prereading and Early Reading Instruction," by van Kleeck & Schuele, 2010.

What does a literacy-rich environment include? As you watch this **video,** notice all the elements of literacy in the classroom.

Literacy-rich environments are critical for children with literacy impairments.

Later, reading intervention might target both linguistic and metalinguistic skills, including recognition of key words, use of all parts of the text, such as the glossary and the index, and application of general learning strategies, such as graphic organizers containing photos, drawings, and print. Now let's look at intervention for phonological awareness, word recognition, comprehension, and executive function.

Phonological Awareness

Evidence-based practice (EBP) tells us that children who receive PA training have higher phonemic awareness, word attack, and word identification skills at the end of kindergarten than children who do not receive such training. Even short-term—as little as twice weekly for 6 weeks—high-quality, explicit phonemic instruction with small groups of children can be effective for most children (Koutsoftas et al., 2008). Other EBPs are presented in Box 5.1. In addition to

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BOX 5.1 | **EBP for Reading**

General

- Code-focused interventions that included both phonemic awareness and phonics training are the most effective intervention strategies in increasing phonological awareness, alphabet knowledge, oral language, reading, and spelling skills.

Phonological Awareness and Metalinguistics

- We can have a moderate degree of confidence in techniques designed to improve phonological awareness in school-age children. Tasks designed to improve rhyming, sound identification, phoneme segmentation, phoneme manipulation, and grapheme–phoneme correspondence consistently yield moderately large to large effects. Similar effects can be obtained through classroom collaboration and clinician-only approaches.
- Training should be appropriate for the prereading or reading level of the child. In deciding whether to provide PA practice to older children, an SLP must consider both the nature of the reading deficit and the level of PA knowledge.
- Little is known about the appropriate length and intensity of intervention.
- Not all phonological skills are of equal importance. Segmenting and blending are critical skills needed for reading. Lower-level skills are important to the extent that they facilitate subsequent development of segmenting and

blending. This said, we have not identified the skill level for these two that is needed before word decoding instruction should begin.
- Although the data are limited, it appears that the use of technology/computers can improve PA skills
- Some tasks are easier than others:
  - Consonants are easier to segment than vowels.
  - Initial sounds are easier to segment than final sounds.
  - Shorter words are easier to segment than longer words.
  - It's easier to segment an initial sound in a consonant–vowel–consonant (CVC) word than in a CCV word.
- Highly effective intervention is contingent on adult responses to child errors. In short, adult responses should consider the reason for the child's error and the learning level and facilitate a correct response.
- Teaching is enhanced when SLPs anticipate the types of errors that a child is likely to make and plan scaffolding or guiding strategies to elicit correct responses.

Sources: Based on Cirrin & Gillam (2008); Lee et al. (2013); Pavelko (2010); Schuele & Boudreau (2008).

working with individual students, SLPs can offer phonological awareness instruction to teachers, stressing the importance of PA and its integration into the reading curriculum (Hambley & Riddle, 2002). What seems most important is that PA intervention begin before children lag too far behind others, most likely in preschool or kindergarten (Torgesen, 2000).

SLPs have distinct and extensive knowledge related to PA and can play a critical role on educational teams (Cunningham et al., 2004; Moats & Foorman, 2003; Spencer et al., 2008). While classroom instruction focuses on children's achievement of specific curricular outcomes, SLP intervention focuses on the individual learning needs of children who have not achieved these desired classroom goals.

Whenever possible with older children, phonological awareness should be taught within meaningful text experiences, such as systematic and explicit classroom instruction, so that the emergent nature of both literacy and PA can support each other (McFadden, 1998). Phonological awareness training alone is insufficient to increase reading comprehension (Pugh & Klecan-Aker, 2004).

Within an intervention, an SLP can address both segmentation (*cat → c-a-t*) and blending (*c-a-t → cat*), working at the syllable and phoneme levels. It would seem to make sense to target lower-level PA skills, such a rhyming, to the extent that they facilitate development of more complex skills, such as segmenting and blending. Once blending and segmenting are established, an SLP can provide a link to classroom decoding and spelling instruction by providing practice that facilitates the application of phoneme awareness to spelling and decoding of words (Blachman et al., 2000).

In general, programs focusing on one or two PA skills yield better results than those that try to teach with a broader focus (National Reading Panel, 2000). It's best if an SLP teaches skills that will directly impact the child's performance of an everyday classroom task.

Intervention can begin with syllable and sound recognition and identification and can be both receptive and expressive. Next, the SLP can move to syllable segmentation and blending (*stapler → stap-ler →* stapler) and, finally, to phoneme segmentation and blending (*cat → c-a-t → cat*). In general, segmentation is easier for most children than blending.

The concept of syllables can be introduced as naturally occurring "beats" in a word. Multisensory approaches are also helpful and can make the training interesting. Clapping hands or drum beats can be used to help children recognize and identify syllables. Other examples include dropping objects into cans, stacking toys, playing hopscotch, or taking turns in any number of child games during auditory recognition training.

Phoneme intervention might progress from recognition of a target sound in isolation, through identification when paired with other sounds, to sounds in syllables, then words (Gerber & Klein, 2004). It is best to work with one or two sounds at a time. Memory can be aided by pairing sounds with real objects or pictures and finally with printed letters and words.

Morphological Awareness

Reading and spelling accuracy can be improved through instruction in morphological awareness together with other forms of linguistic awareness, including knowledge of phonology, orthography, syntax, and semantics (Kirk & Gillon,

PA provides the basis for reading. Hearing and recognizing sound differences is important. As you watch this **video,** notice how sound recognition and letter identification, both important prereading skills, are linked.

2009). Intervention might focus on increasing awareness of the morphological structure of words and the orthographic rules that apply when suffixes are added to the base word, such as the *y* in *happy* and *crazy* changing to an *i* before the *-ly* marker in *happily* and *crazily*.

Word Recognition

The goals of intervention for word recognition are:

- To teach decoding skills
- To develop a vocabulary of written words
- To improve reading comprehension (Torgesen et al., 2005)

Success in the last two depends on achievement of the first. Teaching decoding skills can result in gains, followed by increases in reading accuracy, fluency, and comprehension (Torgesen, 2005). Support for learning can be provided through encouragement and positive feedback and by breaking tasks into smaller steps or by giving a child as much direction as necessary to complete the task successfully.

Context can be used to help children predict words in text. Intervention might begin with obvious words, such as *I took my umbrella because it looked like _____*. Training can then move to more ambiguous choices and the use of other strategies that include morphological and orthographic cues, such as *Let's have _____ for lunch* followed by *Let's have p_____ for lunch* or *Let's have p_____s for lunch.*

Text Comprehension

Comprehension relies on many different aspects of processing. As mentioned, when we read, our knowledge and experience blend with the information on the page to form a mental representation of the meaning. An active reader makes inferences from the text and past knowledge and experience that bridge these gaps.

Children who lack internalized story frameworks necessary for interpreting narratives might begin intervention with telling stories (Naremore, 2001). Intervention can progress to oral and then written narrative interpretation (Boudreau & Larson, 2004). Storybook reading can be divided into before, during, and after reading activities to aid comprehension. Postreading might include creating story organizers, retelling, and creating variations of the narrative. Narratives can also be divided into story parts and then recombined.

Similarly, comprehension by children who read with difficulty can be improved by also focusing on before, during, and after reading strategies (Vaughn & Klingner, 2004). Through prereading techniques such as establishing the content and setting the scene or context, establishing relationships, and discussing unfamiliar vocabulary and concepts, an SLP or a teacher can assist students in constructing meaning from what they read. Activation of prior knowledge can improve comprehension, especially for children with LD.

Comprehension may also be enhanced by teaching children the more explicit and precise language style found in written communication (Westby, 2005). This style can be taught through tasks in which children must follow very explicit oral instructions to be successful or tasks in which contextual cues, such as objects or pictures, are present. Literate vocabularies can be enhanced through prereading

activities that focus on the words to be encountered and through use of visual or verbal memory aids. Complex grammar may be taught through books with familiar stories or books in which the grammar becomes increasingly complex.

Adult strategies should differ according to when they are used in the reading process. For example, prior to reading, semantic strategies, such as giving definitions or synonyms for key words, reduce reading miscues or errors. Graphophonemic strategies are more effective during reading (Kouri et al., 2006). Graphophonemic strategies include encouraging a child to "sound out" a word, calling a child's attention to phonetic regularities, and asking a child to identify initial or final sounds or consonant blends.

During reading, SLPs can facilitate comprehension through instruction, questions, visual and verbal cues, explanations, and comments (Crowe, 2003). Using a conversational style, the adult provides cues and feedback as oral group reading occurs. It's important that questions reflect the level of comprehension targeted for each child. This semantic strategy should be accompanied by direct vocabulary instruction (Ehren, 2006).

Ideally, students will internalize comprehension strategies and use them as they read actively. Active strategies might include the following:

- Using context to analyze word meaning
- Activating prior knowledge
- Rereading difficult passages
- Self-questioning to help frame key ideas
- Analyzing text structures to determine type of reading
- Visualizing content
- Paraphrasing in one's own words
- Summarizing (Ehren, 2005, 2006; Pressley & Hilden, 2004)

These strategies can be used along with the monitoring in which a reader actively decides whether a reading passage makes sense and what to do about it if it does not. Good readers recognize when they have not comprehended a written passage, and they therefore reread it.

When we analyze eye movements of typical readers, we find that their eyes are bounding ahead and back, trying to check the accuracy of words within the surrounding meaning. Children with reading impairments can be taught to use this information to determine word meaning (Owens & Kim, 2007).

At another level, comprehension includes a social dialogue with the authors and characters. Comprehension training should also include discussion of the author's goals and the feelings and motivations of characters (Donahue & Foster, 2004). Knowledge of the text can be used to predict a character's behavior within a narrative.

Executive Function

Specific areas of executive function that might be targeted in intervention include working memory, self-directed speech (*How can I figure out the meaning of this word?*), and problem solving (Westby, 2004). Just teaching strategies is not enough. An SLP and a classroom teacher must help each child achieve independent and appropriate use of these strategies.

Of importance for more advanced readers is *distancing,* or moving away from dependence on the text and toward independent thinking about the text. This can be accomplished by questions that move from answers explicitly stated in the text (*What did she do next?*) to ones in which the question is generated by something in the text but the answer is generated from the student's knowledge (*Could she have solved the problem differently?*).

Hopefully, you're motivated to learn more. Several resources are available online. The Mayo Clinic website (www.mayoclinic.com) covers signs, symptoms, causes, and treatment of reading disability. Just type "dyslexia" in the search box to the right. Then click on "Dyslexia: Symptoms" or "Treatments."

Several commercial sites are available. Please be aware that with these commercial sites, materials that are mentioned do not necessarily represent what we authors would recommend. Just browse the possibilities. The Bright Solutions for Dyslexia website (www.dys-add.com) has several definitions and offers useful teaching tips.

The Scholastic Publications website (www.scholastic.com/home/) offers resources and links. Click on "Teachers" and then type "dyslexia" in the "Search the Teachers Site" box. Scroll down to "Dyslexia: What Teachers Need to Know" and read this interesting article on ideas and teaching methods.

Thought Question

WRITING

Like all other modes of communication, writing is a social act. Just like a speaker, a writer must consider the audience, but because the audience is not present when the writing occurs, writing demands more cognitive resources for planning and execution than does speaking.

In short, writing is using knowledge and new ideas combined with language knowledge to create text. It's a complex process that includes generating ideas, organizing, and planning; acting on the plan, revising, and monitoring based on self-feedback; and it motor, cognitive, linguistic, affective, and executive processes.

Writing is more abstract and **decontextualized** than conversation and requires internal knowledge of different writing forms, such as narratives and expository writing. *Decontextualized* means "outside of a conversational context." When you write, the entire context is contained in the writing. You create the context with your language rather than having the context created by your conversational partners.

Several aspects of the writing process are of concern for an SLP. These include (Berninger, 2000):

- Spelling
- Executive function
- Text construction, or going from ideas to writing
- Memory

As mentioned previously, executive function is self-regulation and includes attending, goal setting, planning, and the like. Memory provides ideas for content and language symbols and rules to guide the formation of that content and is used for word recognition and storage of ideas as they are worked and reworked.

As you can see, writing is a very complicated process. Let's look more closely at spelling and then writing development and impairment, followed by assessment and intervention.

Spelling

Spelling of most words is self-taught using a trial-and-error approach. It is esti-mated that only 4,000 words are explicitly taught in elementary school. Rather, classroom teachers focus on strategies and regularities that children can use to determine word spelling.

Good spellers use a variety of strategies and actively search words for patterns and consistency. More specifically, mature spellers, like you, rely on memory; on spelling and reading experience; phonological, semantic, and morphologi-cal knowledge; orthographic or letter knowledge and mental grapheme repre-sentations; and analogy (Apel & Masterson, 2001). Semantic knowledge is concerned with the interrelationship of spelling and meaning, whereas morpho-logical knowledge is knowing the internal structure of words, affixes (*un-, dis-, -ly, -ment*), and the derivation of words (*happy, unhappily*). Mental grapheme representations are best exhibited when you ask yourself "Does that word look right?" Your representations are formed through repeated exposure to words in print. Finally, through analogy, a speller tries to spell an unfamiliar word using prior knowledge of words that sound the same.

Spelling competes with other aspects of writing for our limited cognitive energy. Excessive energy expended at this level comes at the cost to higher lan-guage functions. As a result, poor spellers generally produce poorer, shorter texts.

> Your brain doesn't store words letter-by-letter; rather, it stores them by more useful units. For example, *stand* is probably stored as *st-and,* which enables you to spell *land, band, hand, bland, strand,* and so on.

Writing Development through the Lifespan

Writing and speaking development are interdependent and parallel, and many aspects of language overlap both modes. In turn, writing development includes development of several previously mentioned interdependent processes. For example, typically developing children and those with Down syndrome (DS) matched for reading level both exhibit oral narratives that are longer and more complex than written narratives. Among the children with DS, vocabulary com-prehension is the best predictor of narrative skills (Kay-Raining Bird et al., 2008).

Emerging Literacy

Initially, children treat writing and speaking as two separate systems. Three-year-olds, for example, will "write" in their own way—usually scribbling—but don't yet realize that writing represents sounds. The story may be contained in an accompanying drawings. By age 4, some real letters of the parent language may be included.

As with reading, in early writing, children expend a great deal of cognitive energy on the mechanics, such as sound–letter associations and letter formation. Gradually, spelling, like reading, becomes more accurate and fluent or automatic.

For a few years, the spoken and written systems converge, and children write in the same manner as they speak, although speech is more complex. Around age 9 or 10, talking and speaking become differentiated as children become increas-ingly literate. Writing slowly overtakes speech as written sentences become longer

and more complex than speaking. Children display increasing awareness of the audience through their use of syntax, vocabulary, textual themes, and attitude. Some language forms are used almost exclusively in either speech or writing, such as using *and* to begin many sentences in speech but only rarely in writing.

Mature Literacy

In a phase not achieved by all writers, speaking and writing become consciously separate. The syntax and semantics are consciously recognized as somewhat different, and the writer has greater flexibility of style. You may or may not have achieved this phase yet. If you find yourself using an enlarged vocabulary when writing or pondering how sentences flow from one to the next, then you are probably there. As with reading, practice results in improvement that should continue throughout the lifespan. In general, the writing of adults as compared to adolescents contains longer, more complex sentences and uses more abstract nouns, such as *longevity* and *kindness,* and more metalinguistic and metacognitive words, such as *reflect* and *disagree* (Nippold, Ward-Lonergan, & Fanning, 2005).

Writing includes handwriting, word processing, or texting; spelling; executive function; text construction or going from ideas to written texts; and memory. Let's discuss, in that order, the ones of particular interest to speech-language pathologists.

Spelling

Spelling development is a long, slow process. As mentioned, initial *preliterate* attempts at spelling consist mostly of scribbling and drawing with an occasional letter thrown in. Later, children use some phoneme–grapheme knowledge along with letter names. For example, *bee* might be spelled as *B.* Gradually, they become aware of conventional spelling and are able to analyze a word into sounds and letters, although vowels will be difficult for some time. As mentioned earlier, mature spellers are able to call on multiple learning strategies and different types of knowledge.

As knowledge of the alphabetic system emerges, a child slowly connects letters and sounds and devises a system called "invented spelling" in which the names of letters may be used in spelling, as in *SKP* for *escape* or *LFT* for *elephant.* One letter may represent a sound grouping, as in **s**et for **str**eet. Because children lack full knowledge of the phoneme–grapheme system, they have difficulty separating words into phonemes.

As spelling becomes more sophisticated, children learn about spacing, sequencing, various ways to represent phonemes, and the morpheme–grapheme relationship (Henderson, 1990). The parallel development of reading aids this process.

Children who possess full knowledge of the alphabetic system of letters and sounds can segment words into phonemes and know the conventional phoneme–grapheme correspondences. As children begin to recognize more regularities and consolidate the alphabetic system, they becomes more efficient spellers (Ehri, 2000). Increased memory capacity for these regularities is at the heart of spelling ability.

Many vowel representations, phonological variations (such as *later-latter*), and morphophonemic variations (such as *sign-signal*) will take several years to acquire. Gradually, children learn about consonant doubling (la**dd**er), stressed

and unstressed syllables (***report–r****e****port***), and root words and derivations (*add-addition*).

Most spellers shift from a purely phonological strategy to a mixed one between second grade and fifth grade. As words and strategies are stored in long-term memory and access becomes fluent, the load on cognitive capacity is lessened and can be focused on other writing tasks.

Adults spell in several ways: letter-by-letter, by syllable, and by sub-syllable unit, such as *ck,* used for *back, stick,* and *rock* but never in *ckar* (car). The method used seems to vary with the task. Next time you're typing words, notice whether your spelling is conscious and letter-by-letter.

Executive Function

It is not until early adulthood—about where you probably are right now—that writers develop the cognitive processes and executive functions needed for mature writing (Berninger, 2000; Ylvisaker & DeBonis, 2000). It takes this long because of the protracted period of anatomical and physiological development of your brain's frontal lobe, where executive function is housed.

Until adolescence, young writers need adult guidance in planning and revising their writing. By junior high school, teens are capable of revising all aspects of writing. Improved long-term memory results in improved overall compositional quality.

Text Generation

Once children begin to produce true spelling, they begin to generate text. In first grade, text may consist of only a single sentence, as in *My dog is old.* Early compositions often lack cohesion and use structures repeatedly, as in the following:

> *I like school. I like gym. I like recess. I like art.*

In contrast, mature writers use sentence variety for dramatic effect. The facts and events characteristic of early writing evolve into use of judgments and opinions, parenthetical expressions, qualifications, contrasts, and generalizations (Berninger, 2000).

Initially, compositions lack coherence and organization. Later, ideas may relate to a central idea or consist of a list of sequential events.

Written narratives or stories emerge first, followed by expository texts. Expository writing, the writing of the classroom, is of several genres: procedural, as in explaining how to do something; descriptive; opinion; cause-and-effect; and compare-and-contrast.

By adolescence, expository writing has greatly increased in overall length, mean length of utterance, multi-clause production, and use of literate words that transition between thoughts, abstract nouns, and metalinguistic/metacognitive verbs (Nippold, Hesketh, Duthie, & Mansfield, 2005). Literate words include *however, finally,* and *personally*; abstract nouns are words such as *kindness, loyalty,* and *peace*; and metalinguistic and metacognitive verbs include *think, reflect,* and *persuade.*

Click here to check your understanding of the concepts in this section.

Writing Problems through the Lifespan

Children with LI often have writing deficits. Unfortunately, their writing difficulties may remain through the lifespan, and the gap between their writing abilities and that of children developing typically widens.

In general, children with language impairment (LI) exhibit reduced written productivity, as measured by total number of words, total number of utterances, or total number of ideas (Puranik et al., 2007; Scott & Windsor, 2000). Similarly, these same children exhibit deficits in writing *complexity* (Fey et al., 2004; Mackie & Dockrell, 2004; Nelson & Van Meter, 2003; Puranik et al., 2007; Scott & Windsor, 2000). Finally, children with LI exhibit reduced *accuracy,* as measured by number of errors (Altmann et al., 2008; Mackie & Dockrell, 2004; Nelson & Van Meter, 2003; Puranik et al., 2007).

Children with LD may have difficulties with all aspects of the writing process (Wong, 2000). A sample of the writing of a child with LD is presented in Figure 5.5. Because they have little knowledge of the writing process, these children fail to plan and to make substantive revisions. They are easily discouraged and may devote very little time to a given writing task. Clarity and organization are forsaken for spelling, handwriting, and punctuation, leaving little cognitive capacity for text generation. In the process, meaning suffers.

Deficits in Spelling

Poor spellers view spelling as arbitrary, random, and seemingly unlearnable. Misspellings are characterized by omission of syllables, morphological markers such as plural *s,* and letters; letter substitutions; and confusion of homonyms such as *to/too/two.* Even adults, especially those with LD, often cite spelling as their primary area of concern.

Usually, deficits in spelling represent poor phonological processing and poor knowledge and use of phoneme–grapheme information. Although most spellers shift to greater use of analogy between second grade and fifth grade, poor spellers tend to rely on visual matching skills and phoneme position rules to compensate for their limited knowledge of sound–letter correspondences (Kamhi & Hinton, 2000).

Figure 5.5 Sample writing of an 11-year-old child with SLDL.
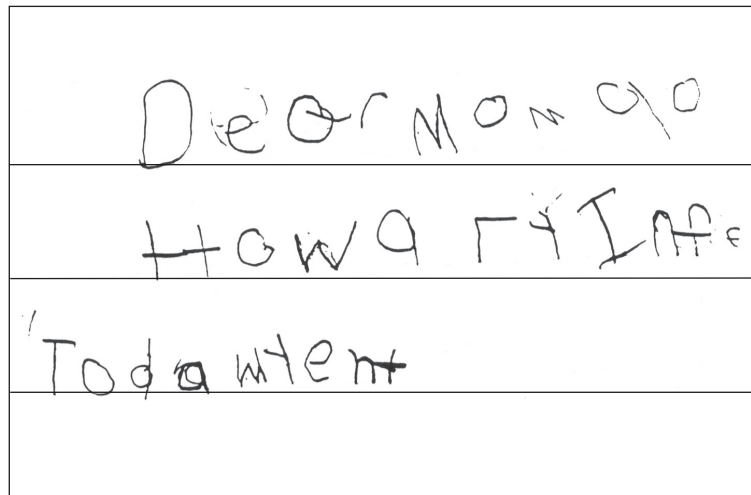
Dear mom and dad, How are you? I am fine. Today we went . . .

Deficits in Executive Function

When you write, you begin with ideas. You convert your ideas into language. At this point, executive function becomes important.

When executive function or self-regulation is impaired, communication and even problem-solving abilities are diminished, especially in complex linguistic tasks, such as writing. Lacking self-regulation, some children with LD follow a writing strategy of putting on paper whatever comes to mind, with little thought to planning. They produce and elaborate little, revise ineffectively and with seeming indifference to their intended audience, detect errors poorly, and experience difficulty executing intended changes. Planning is difficult because of language formulation difficulties.

One adult professional with LD, known to the authors, uses different templates for his reports in which he fills in the blanks. Otherwise, the task of planning, writing, and revising a report would overwhelm his executive abilities. Until he and his spouse devised the templates, he would call from work at the end of each day to have his wife talk him through the report writing process.

Deficits in Text Generation

In narrative writing, as in storytelling, children with LI may lack mature internalized story models or may be unable to visualize the words even from their own spoken narratives. When compared to the narratives of chronological age-matched peers with typical language, the narratives of children with LD contained shorter, less complex sentences (Scott & Windsor, 2000). As a result, both the oral and written narratives often are shorter and have fewer episodes, contain fewer details, and fail to consider the needs of the listener.

Expository writing tasks follow a format, such as statement of a problem, examination of several factors, and conclusion. Children with LI have difficulty with these writing tasks and approach them with seemingly little thought or planning. The results are often extremely short, poorly organized, and containing numerous errors of grammar, punctuation, and spelling. There is often little revision. In addition, children with LD have substantial difficulty with morphological endings, such as regular past tense and regular plurals, even when they demonstrated accuracy with these units in their speech (Windsor et al., 2000).

Just as a poor reader expends all his or her energy in decoding, a poor writer becomes bogged down in the mechanics of the writing and spelling process. Both leave the poor reader or writer with little energy for higher cognitive functions such as comprehension or text generation, respectively.

All elements of writing come together when you begin to write a narrative or a paper for class. As you watch this **video,** notice how the child struggles with concepts and the process as the adult attempts to facilitate the task for the child.

Assessment of Developmental Writing

One method of assessing writing in the classroom is through the use of portfolios of children's writing (Paratore, 1995). A portfolio is a collection of meaningful writing collaboratively selected by a child, an SLP, and a teacher that contains samples of the child's writing over time, thus enabling the child to demonstrate progress. The wide variety helps to increase the validity of the sample. Items in a portfolio may include SLP or teacher observation notes, work samples, and first drafts of writing samples, such as journal entries, and projects/papers, final drafts of the same, and peer and teacher evaluations.

Narrative samples are best for young elementary school children. Older elementary school children or adolescents can provide expository writing samples.

Executive function is best measured within actual writing tasks as part of an overall writing assessment rather than separate from functional communication tasks. Samples should be written in ink to allow for analysis of revisions. It's

Executive function is very difficult to assess without some task to accomplish; thus the context is very important.

helpful to allow children to plan and to write drafts. All notes and plans should be collected, along with the finished product, and added to the child's portfolio.

Whenever possible, an SLP, a teacher, or an instructional aide can observe the writing process for evidence of planning and organizing, drafting, writing, revising, and editing. Added information can be obtained if children read their paper aloud while being recorded. This procedure aids the SLP or teacher in interpreting garbled or poorly spelled words.

Writing can be analyzed on several levels, including textual, linguistic, and orthographic (spelling). At a textual level, an SLP can note length, any indication of the amount of effort, overall quality, and structure or the way in which comments support the topic (Berninger, 2000). Of interest are the total number of words, clauses, and sentences, as well as the structural complexity, as measured in words per clause and clauses per sentence. Writing conventions, such as capitalization and punctuation, plus the use of sentences and paragraphs, should be noted.

Assessment of Spelling

Spelling deficits are very complex and can be difficult to describe. Collection should be of sufficient quantity to allow for a broad-based analysis. Spelling deficits should be assessed through both dictation and connected writing such as that in a child's portfolio (Masterson & Apel, 2000). Standardized tests should also be included and can be administered by a classroom teacher, writing specialist, or school psychologist. Informal assessments should include several phoneme–grapheme variations, such as single consonants in various positions in words, consonant blends (*str-*), morphological inflections (*-est, dis-*), diphthongs, digraphs (two letters for one sound, as in *ch* and *sh*), and complex morphological derivations.

Single-word spelling does not measure a child's ability in a real communicative context. Connected writing, such as that found in a portfolio, can offer samples closer to actual practice.

Descriptive analysis should focus on patterns evident in the child's spelling (Bear et al., 2000). Of interest are the most frequent and the lowest-level patterns. Figure 5.6 presents a possible analysis system that suggests several possible intervention strategies.

Assessment of Text Generation

SLPs and teachers can assess a child's writing using the papers assembled in his or her portfolio. Analysis may include the total number of words and the number of different words. This is an overall measure of a child's vocabulary and flexibility in its use. Other measures might include the maturity of the words used, clause and sentence length, and coherence. Narratives and expository writing can be analyzed for the presence or absence of elements of both. For example, does a narrative include a setting statement of *who, what, when, where?*

Intervention for Developmental Writing Impairment

Intervention for writing may involve both general training and more specific and explicit techniques for both narrative and expository forms. To learn to write, you must write, so intervention needs to focus on the actual writing process.

Figure 5.6 Examples of language-based spelling analysis.

Phonological: Segmenting, blending, and phonemic awareness

Omission of internal and unstressed phonemes and cluster reduction

Stop → SOP   Sand → SAD

Syllable deletion

Elephant → ELFANT

Letter reversal (most common with liquids and nasals)

Sing → SIGN

Orthographic: Sound–symbol relationship (/k/ = k, c, ck, cc, ch, q, x), letter combinations, letter and positional patterns, and grapheme representations

Letter-sound confusion

Cash → CAS

Nonallowable letter sequences

Dry → JRIE   Queen → KWEN

Possible spellings that violate location-pattern rules

Chip → TCHIP   Corn → CKORN

Different spellings on repeated attempts (no cognitive representation or graphemic representation of word)

Morphological: Inflectional (-ed, -ing, -s) and derivational (un-, dis-, -er, -ist, -ment) morphemes, relationship of root word and inflected or derived form

More difficult if a form has more than one meaning (fast**er,** teach**er**), multiple pronunciations (walk**ed,** jogg**ed,** collid**ed**), and both phonological and orthographic properties are changed when inflected or derived (*ascend* and *ascension*).

Semantic: Effect of spelling on meaning

Homophone confusions

Won → ONE   They're → THER   Which → WITCH

Although our evidence is slim, we can make some tentative statements about intervention (see Box 5.2).

The Creative Writing Solutions website (www.creative-writing-solutions .com) has some practical guidelines for teaching writing. Click on "Article Index" at the left and then find the article "Writing with Dyslexia" under "Learning Disabilities."

Spelling

Spelling intervention should be integrated into real writing and reading within the classroom. Words are the vehicles for teaching spelling principles. Ideally, intervention can occur when a child is actually writing and can be reminded

BOX 5.2 | Evidence-Based Practice for Writing

English Language Learners (ELLs)

- Although there is limited evidence on using writing strategies to improve writing, self-regulation strategies, including explicit instruction, self-review, and peer modeling, show promise.
- Literacy instruction in Spanish while children continue to learn English supports ELLs' literacy development in English.

General

- Data are inconclusive on the beneficial effects of the teaching of phonics on spelling.
- Self-regulated strategy instruction, or teaching students a strategy for approaching a writing task, works well with adolescents.

Sources: Based on Brea-Spahn & Dunn Davison (2012); Brooks et al. (2008); Jacobson & Reid (2007); Thomason et al. (2007).

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of alphabetic and orthographic principles (Scott, 2000). Spelling can be taught within teaching of general executive function in which the child is taught to proofread, correct, and edit.

The way children spell is indicative of the way they read (Templeton, 2004). This would suggest that spelling intervention should also be integrated with reading to enable a child to learn and to use word knowledge.

Words selected for intervention should be individualized for each child and should reflect the curriculum, the child's desires, words attempted but in error, and error patterns (Bear et al., 2004). Spelling strategies can be discussed with a child, using the data from an SLP's analysis. The goal is to learn strategies of spelling and rules rather than specific words. For example, if a child's errors are primarily morphologic (see Figure 5.6), the SLP can target root words and the influence of various morphemes through morpheme-finding and word-building tasks. Intervention focusing on increasing awareness of the morphological structure of words with particular attention to the orthographic rules that apply when suffixes are added can significantly increase both spelling and reading accuracy and can generalize to new words (Kirk & Gillon, 2008). In contrast, if a child's errors are orthographic, the SLP can teach rules through key words, demonstrating alternative spellings and acceptable and unacceptable sound–letter combinations.

Children with LD benefit from multisensory input such as pictures, objects, or actions. Several multisensory techniques have been proposed in which the child may complete any of several steps, including listening to the SLP say and spell the word, saying the word aloud while looking at it or touching it, writing it while saying it, checking spelling, saying the letters in sequence, tracing the word while saying it, closing his or her eyes and visualizing the word, and rewriting the word and checking or comparing the spelling.

Word analysis and sorting tasks or placing words into groups can be used (Scott, 2000). Sorting tasks will differ based on the targeted error patterns found in the child's misspellings. Pairs of words that differ on the bases of these patterns, such as *pint–pit, meant–meat,* and *bunt–but,* can be used to demonstrate the consequences of misspelling. For example, word meaning could be used to help a child

> An SLP should not be teaching the class's spelling words for the week. An SLP should target spelling strategies, not individual words.

Figure 5.7 Principles for guiding spelling intervention.

Focus on what students are "using but confusing" in their spelling rather than beginning with focusing on what a child doesn't know.

Step back and consolidate learning before moving forward.

Use words students know and can read so that one literacy aspect influences another.

Compare words that do have the spelling feature, such as silent *e* with words that don't, as in *dime-dim, tone-ton,* and *cube-cub.*

Help a child look at words in many ways through sorting tasks that include sound, sight, and meaning.

Begin with obvious contrasts first—ones that are easy to hear or clearly demonstrate a rule.

Don't hide exceptions; rather, deal with them because they will enhance generalization.

Avoid rules until a child has learned enough examples to see a rule clearly.

Work for sorting and spelling fluency.

Glean words from a child's writing and reading and then return to meaningful tasks and texts.

Source: Based on information from *Words Their Way: Word Study With Phonics, Vocabulary, and Spelling Instruction* (3rd ed.), by D. R. Bear, M. Invernizzi, S. Templeton, and F. Johnston, 2004, Upper Saddle River, NJ: Merrill/Prentice Hall.

note the difference between *head* and *hid.* Other contrasting words might include *dead-did, read-rid,* and *lead-lid.* An SLP should begin with known, frequently used words and gradually introduce less frequently used and unknown words to facilitate generalization. Different spelling/meaning patterns might provide clues to the meaning and spelling of unfamiliar ones (Templeton, 2003). For example, a child might be helped to see the relationship between *evaluate* and *evaluation.* Some principles for word study and spelling intervention are included in Figure 5.7.

Use of computers aids spelling somewhat. Although use of word processing can encourage editing in children, spell checkers, as you know, are not foolproof, and a child may learn little in the process. In general, spell checkers miss words in which the misspelling has inadvertently produced another word. Suggested spelling may also confuse the child with poor word attack skills. In addition, suggested spellings may be far afield if the original word is seriously misspelled. Spell checkers help less for children with LD than for children developing typically.

If children with literacy impairments are taught to spell phonetically when unsure of the correct spelling, spell checkers generate more correct suggestions. Proofing and editing on a hard copy also seems to increase the number of correctly spelled words (McNaughton et al., 1997).

Word prediction programs reduce spelling errors of children with LI by over half, although the user must get the initial letters correct for the program to work effectively. It's important that a word prediction program's vocabulary match the writing task. Several programs can incorporate word frequency or various topics.

Executive Function

Executive function can be targeted within the writing process by using a goal–plan–do–review format. An SLP can provide external support to enable children to experience some level of success (Ylvisaker & DeBonis, 2000).

Intervention can begin by allowing children to select their own topics. This increases motivation and shifts the focus to ideas. In the planning phase, an SLP and a child can brainstorm ideas for inclusion in the writing. Drawings and ideational maps, or "spider diagrams," can help. It is also helpful for a child to focus on the potential audience. The SLP can ask questions such as the following:

Why are you writing?

Who will read this paper?

What does the reader know?

What does the reader need to know?

The SLP and child may prefer to use computers as an assistive technology for writing (MacArthur, 2000). Software, such as Inspiration (Inspiration Software, 2013), can aid text generation, and a child or teach can easily modify the result. Children with LD who receive training in executive function along with word processing make greater gains in the quality of their writing than children instructed only in executive function or word processing alone.

Grammar checkers miss many errors, especially if there are multiple spelling errors. In addition, a child may be unable to figure out just what the error is. Speech recognition software allows a child to compose by dictation, but the software cannot overcome oral language difficulties, although these can be moderated with the additional use of grammar checkers.

Narrative Text Generation

For some children, narrative writing intervention may need to begin at the oral narrative level (Naremore, 2001). They may need to learn to tell common event sequences, such as getting ready for school, and they may need help including all the elements of a narrative, called a **story grammar**.

Children with LI and writing impairment may not realize that they know a narrative or how to get it started. Story swapping with peers, spin-offs from reading or real life, draw–tell–write methods, or topic selection from a prepared list can all be used to facilitate this process (Tattershall, 2004). Once a topic is selected, an SLP can encourage a child to write one statement, then another and another ("And then what happened?"). An SLP or a classroom teacher can guide a child by using narrative-enhancing questions and pictures that outline the story events.

During the writing process, an SLP or a classroom teacher can guide a child's writing through the use of brainstorming of ideas, story guides, prompts, and acronyms. Story guides are questions that help a student construct a narrative, and prompts are story beginning and ending phrases. Acronyms, such as SPACE for *setting, problem, action,* and *consequent events,* can also act as prompts for guiding writing (Harris & Graham, 1996). An SLP or a teacher can also encourage a child to write more with verbal prompts such as "Tell me more." The SLP or teacher can encourage feelings and motivations with pictures and questions such as "How do you think she felt?" (Roth, 2000).

Written narration may require explicit instruction in story grammar or structure. Story maps using pictures that highlight a narrative's main events or story frames may be necessary initially. Story frames are written starters for each main story element. The child completes the sentence and continues with that portion of the narrative. Cards or checklists can also be used to remind the child of story grammar elements.

For some children, reading and writing seem to be arbitrary, unfathomable processes.

Expository Text Generation

Procedures for intervention with expository writing may include collaborative planning and guidance by SLP/teacher and peer input; individual, independent writing; conferencing with the SLP/teacher and peers; individual, independent revising; and final editing (Van Meter et al., 2004; Wong, 2000). Collaborative planning is important. Children should think aloud and solicit opinions. Such brainstorming often provides a child with alternative views.

One promising method of teaching expository text writing is called Em-POWER, which treats writing as a problem-solving task involving six steps: **E**valuate, **M**ake a **P**lan, **O**rganize, **W**ork, **E**valuate, and **R**ework (Englert et al., 1988). In addition, research has indicated that certain strategies, presented in Figure 5.8, are especially effective with children with LLD (Singer & Bashir, 2004).

Once a topic is selected and discussed in small groups, with a peer, and/or with an SLP, the SLP can give the child a planning sheet to help organize her or his thoughts. After the child has completed the sheet, the SLP can help the child organize the information. This is a great time to challenge and help a child clarify views and prepare for independent writing.

Writing, even independent writing, can be fostered through the use of a prompt card containing key words for each major section of the paper. Figure 5.9 presents some sample prompts.

Figure 5.8 Strategies for teaching expository writing.

Include other students in a supportive environment.

Place training within a literacy-rich environment.

Provide extensive modeling.

Teach:

    Writing explicitly and systematically.
    Various types of writing.
    Planning and organizing strategies

Use:

    Verbal prompts to support self-regulation.
    A variety of strategies to address different needs.
    Graphics for display and as a means of storing test-relevant information, such as words, grammar, and ideas.

Move from oral to written forms by integrating the two.

Provide ample opportunity for communication and language to develop.

Collaborate with teachers in mentoring students to write.

Ensure the seamless integration of language intervention and classroom instruction and learning.

Source: Based on information from "EmPOWER, A Strategy of Teaching Students with Language Learning Disabilities How to Write Expository Text" by B. D. Singer and A. S. Bashir (2004). In E. R. Silliman and L. C. Wilkinson (Eds.), *Language and Literacy Learning in Schools* (pp. 239–272). New York: Guilford.

Figure 5.9 Sample prompts for opinion writing.

Section of Paper	*Examples*
Introduction	*In my opinion . . .*
	I believe . . .
	From my point of view, . . .
	I disagree with . . .
	Supporting words: *first, second, finally, for example, most important is . . . , consider, think about, remember*
Counter opinion	*Although . . .*
	However, . . .
	On the other hand, . . .
	To the contrary, . . .
	Even though . . .
Conclusion	*In conclusion, . . .*
	After considering both sides, . . .
	To summarize, . . .

Sources: Based on Wong (2000); Wong et al. (1996).

Click here to check your understanding of the concepts in this section.

Thought Question

After a child has completed the paper, he or she can conference with peers for feedback while the SLP mediates. The child then revises the paper, based on this feedback.

At each stage in the process, a child can record progress on a checklist that provides a model for the writing process. The checklist can also motivate a child as she or he notes progress.

SUMMARY

Although many aspects of literacy impairment clearly are the domain of the classroom teacher and reading specialist, some justifiably belong in the speech-language pathologist's (SLP's) realm. Working with a team, an SLP helps a child obtain language-based skills on which literacy is based. This is a natural extension of the SLP's concern for language in all modes of communication, something you will note in Chapter 7.

SUGGESTED READINGS

Catts, H. W., & Kamhi, A. G. (2012). *Language and reading disabilities* (3rd ed.). Boston: Pearson.

Nelson, N. W. (2010). *Language and literacy disorders: Infancy through adolescence.* Boston: Pearson.

Sanders, M. (2001). *Understanding dyslexia and the reading process: A guide for educators and parents.* Boston: Pearson.

6

Language Impairments in Adults

M any language impairments found in childhood continue into the adult years. Intellectual disability, autism spectrum disorder, and learning disability do not disappear, although they may change or alter with age. Approximately 70% of adults who were initially identified as having a speech or language impairment at age 5 continued to demonstrate less than typical language skills in early adulthood (Johnson et al., 1999). Persistent deficits in adults may entitle them to academic support services or workplace accommodations.

Although the continuation of language disorders of childhood is an important topic, it is not the focus of this chapter. Rather, this chapter focuses on language disorders that occur or develop during adulthood (see Case Study 6.1). Specifically, we discuss aphasia, right hemisphere brain damage, traumatic brain injury, and degenerative neurological conditions. We describe language problems related to interruption of blood supply to the brain, direct destruction of neural tissue, or a pathological process. This will be your introduction, and, of necessity, it will only scratch the surface. Although as a speech-language pathologist (SLP), you'll be concerned primarily with communication, the disorders described in this chapter also require an understanding of the medical conditions from which they originate.

In this chapter, we'll discuss adult language, introduce the nervous system, and explore four neurological impairments that affect adult language. For each impairment, we'll discuss characteristics, causes, lifespan issues, and assessment and intervention for language deficits.

Space precludes examining all possible neurological disorders. For example, we will not be discussing impairments such as chronic schizophrenia, which

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CASE STUDY 6.1

Case Study of an Adult with Language Impairment: Marsha

A single mom, Marsha has been the sole breadwinner in her family for several years. Two of her three children are grown, and her youngest is in high school. With no high school diploma, Marsha has had to work in sales or housekeeping jobs to make ends meet. Most recently, she has been a sales associate in the women's fashions section of a large department store.

Nearly a year ago, Marsha awoke one morning with a very strong headache. Although she felt somewhat unsteady on her feet, she determined that she should go to work anyway. Her right leg became weak as she walked to the bus stop, and she collapsed before she had reached her destination.

She awoke in the hospital several hours later, confused and disoriented. She tried to talk with the staff and with her family but seemed unable to comprehend their speech and to form replies. Her medical team, consisting of her physician, a neurologist, a speech-language pathologist, a physical therapist, and an occupational therapist, recommended that Marsha be released from the hospital after 1 week and that she receive services in a rehabilitation center. Both of her older children were eager to help.

The speech-language pathologist worked with Marsha and her family on strengthening Marsha's comprehension and production of language and on her speech. Her intervention services were comprehensive and involved both physical and occupational therapy as well. To date Marsha has recovered much of her speech and language. Some speech sounds are slightly slurred, and she still has some lingering word retrieval difficulties. She was able to return to her job and is able to communicate well.

As you read the chapter, think about:

- Possible causes of Marsha's stroke
- Possible ways in which the team could coordinate services and work together
- Possible problems Marsha might still experience at work

typically affects pragmatic aspects of language, such as turn-taking, topic selection, and intentions (Meilijson et al., 2004).

As you might suspect, the American Speech-Language-Hearing Association (ASHA) has plenty of good information on adult disorders. The ASHA website (www.asha.org) describes the role of SLPs in these disorders. Go to the website and type "role of SLP" followed by the disorder, as in "role of SLP aphasia" in the search box at the top right. The information the site returns will give you some idea of the scope of practice for SLPs working with these populations.

For easy-to-understand descriptions of some of the adult disorders discussed in this chapter, begin with the ASHA site: Click on "The Public" at the upper left and then click on "Disorders and Diseases" under "Speech, Language and Swallowing" in the center of the page. Go to the bottom of the next page and click on "Adult Speech and Language." Now you're free to click on a whole range of adult language impairments, such as aphasia, dementia, right hemisphere brain injury, and traumatic brain injury. There's a wealth of information here.

LANGUAGE DEVELOPMENT THROUGH THE LIFESPAN

By adulthood, speech and language have matured, and adults are able to communicate in a variety of modes, using not only speech and language but paralinguistic and nonlinguistic signals effectively. A subtle pause or shift in word emphasis can signal important differences of meaning to a mature speaker. Reading and writing are also essential communication tools.

Unless debilitated in some way through accident, disease, or disorder, adults continue to refine their communication abilities throughout their lives. Writing and speaking abilities continue to improve with use, new words are added to vocabularies, and new styles of talking are acquired.

> Language and communication should continue to develop throughout one's life.

Language development proceeds slowly throughout adulthood. Even people with delayed development, such as individuals with intellectual disability (ID), experience continued but slowed language growth.

Use

Through the use of various communication techniques, competent adults can influence others, impart information, and make their needs known. Some adults are even capable of oratory on a par with that of Martin Luther King, Jr., which can call up the heroic and the unselfish in others.

> Adult language use is extremely flexible because of the variety of language forms, the large size of the vocabulary, and the breadth of language uses.

Compared to children, adults are very effective communicators and skilled conversationalists who have a variety of styles of talking, from formal to casual. Styles require modification not only in the manner of talking but also in the topics introduced and the vocabulary used. As the Little Prince noted when talking with adults (Saint-Exupéry, 1968):

> I would talk . . . about bridge, and golf, and politics, and neckties. And the grown-up would be greatly pleased to have met such a sensible man.

Competent adult communicators quickly sense their role in an interaction and adjust their language and speech accordingly. For example, some people are addressed as *sir* and some as *honey*, and adults do well not to confuse the two. Communication may vary from direct, as in *Turn up the heat*, to indirect, as in

Do you feel a chill? These two communications share the same goal, but their linguistic methodologies are very different.

The number of communicative intentions increases gradually so that adults are able to hypothesize, to cajole, to inspire, to entice, to pun, and so on. A skilled speaker knows how to fulfill these intentions and when to use them.

Although adults continue to refine both their writing and reading ability, these changes are not dramatic. In general, the writing of adults as compared to adolescents is more complex lengthy sentences (Nippold, Ward-Lonergan, & Fanning, 2005).

Adult narratives improve steadily into middle age and the early senior years (Marini et al., 2005). Abilities decrease some after the late 70s. Those over 75 have less flexibility and ease with word retrieval and make more language form errors.

Content

Adults continue to add to their personal vocabularies, and most use between 30,000 and 60,000 words expressively. Receptive vocabularies are even larger. Specialized vocabularies develop for work, religion, hobbies, and social and interest groups. Some words fade from the language and are used less frequently, such as *dial* a phone number, while new words are added, such as *texting*. Multiple definitions and figurative meanings are also expanded.

Typical seniors experience some deficits in the accuracy and speed of word retrieval and naming. When compared to younger adults, seniors use more indefinite words, such as *thing* and *one* in place of specific names. These deficits reflect accompanying deficits in working memory and, in turn, they affect ability to produce grammatically complex sentences (Kemper et al., 2001).

Form

Within language form, adults continue to acquire prefixes (*un-, pre-, dis-*), morphophonemic contrasts (*real*, *reality*), and infrequently used irregular verbs. Conversations become more cohesive through more effective use of linguistic devices, such as pronouns, articles, verb tenses, and aspect (which, for example, allows us to talk about the past from the vantage point of the future, as in *Tomorrow, I'll look back and say, "That was a great picnic"*). In general, the form of written language is more complex than the form of spoken language.

The length and syntactic complexity of oral sentences increases into early adulthood and stabilizes in middle age (Nippold, Hesketh, et al., 2005). As mentioned previously, older seniors experience a decline in complex sentence production that seems related to word retrieval problems. There is also a decline in oral and written language comprehension, understanding of syntactically complex sentences, and inferencing.

THE NERVOUS SYSTEM

It's difficult to discuss disorders with neurological causes without first understanding the nervous system itself. In this section, we'll briefly describe the major elements of this system, beginning with nerve cells (or neurons) and progressing through the central and peripheral nervous systems.

The nervous system consists of the brain, spinal cord, and all associated nerves and sense organs. The **neuron** is the basic unit of the nervous system. Each neuron has three parts: the *cell body*, a single long *axon* that transmits impulses away from the cell body to the next neuron, and several branching *dendrites* that receive impulses from other cells and transmit them toward the cell body. A nerve is a collection of neurons. Neurons do not actually touch but are close enough so that electrochemical impulses can "jump" the tiny space, or **synapse**, between the axon of one neuron and the dendrites of the next.

Central Nervous System

The brain and spinal cord comprise the **central nervous system (CNS)**. The CNS communicates with the rest of the body through the nerves. All incoming stimuli and outgoing signals are processed through the CNS. In this section, we introduce the brain and the areas related to incoming and outgoing language processing.

The Brain

The brain consists of the cerebrum (or upper brain), cerebellum, and brainstem. The cerebrum, depicted in Figure 6.1, is divided into right and left hemispheres. For the most part, the sensory and motor functions of the cerebrum are *contralateral*, meaning that each hemisphere is concerned with the opposite side of the body. Each hemisphere consists of white fibrous connective tracts running below the surface and covered by a gray cortex of cell bodies approximately 0.25 inch thick. The cortex has a wrinkled appearance caused by little hills called *gyri* and

Figure 6.1 Schematic diagram of the human brain.
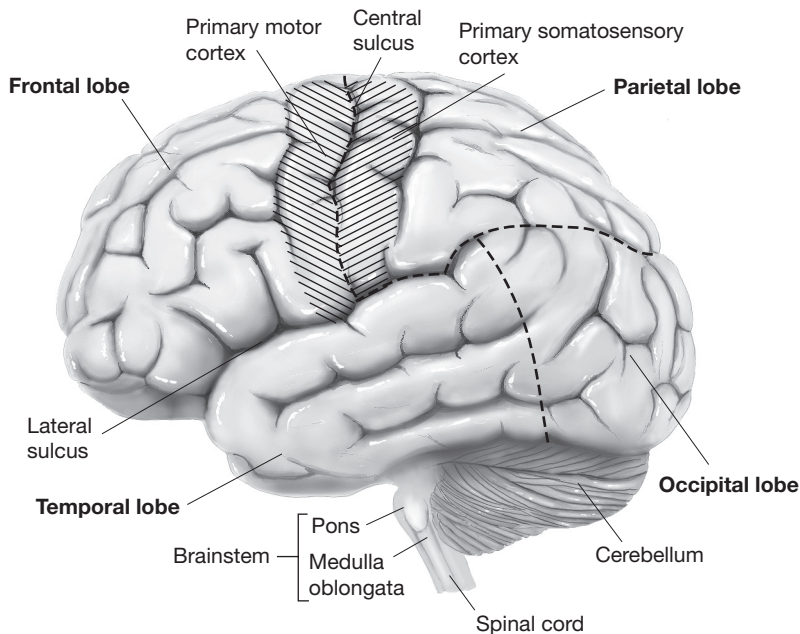
valleys called *fissures*, or *sulci*. Each hemisphere is divided into four lobes: *frontal, parietal, occipital*, and *temporal*.

It is not entirely accurate to conceptualize the brain as having specific, localized areas with unique functions. There is a great deal of redundancy and diffuse organization of function such that damage to a specific brain region may not completely eliminate the ability to perform that particular function. That said, there are generalized areas that are responsible for particular operations.

Although the cerebral hemispheres are roughly symmetrical, for specialized functions such as language and speech, they are asymmetrical. In 98% of individuals, the left hemisphere is dominant for most aspects of receptive and expressive language and motor speech production. In general, all right-handers and 60% of left-handers are left-dominant for language, and the remainder of left-handers are right-dominant. A very small percentage of people have no apparent hemispheric dominance of language function.

The primary anatomical asymmetry in the brain is found in the left temporal lobe, where much language processing occurs. Studies using functional magnetic resonance imaging (fMRI) have shown a strong left hemispheric language dominance of auditory comprehension abilities in children as young as 7 years of age (Balsamo et al., 2002). Other studies have found predominantly bilateral activation of auditory comprehension in younger children. Continued research is needed in this area, using larger sample sizes.

The **cerebellum**, or "little brain," consists of right and left cerebellar hemispheres and a central vermis. The cerebellum coordinates the control of fine, complex motor activities, maintains muscle tone, and participates in motor learning. See Figure 6.2 for the cerebellum and other subcortical and lower brain structures.

Neuroimaging studies indicate that the cerebellum also has considerable influence on language processing and on higher-level cognitive and affective or

Figure 6.2 Subcortical and lower brain structures.
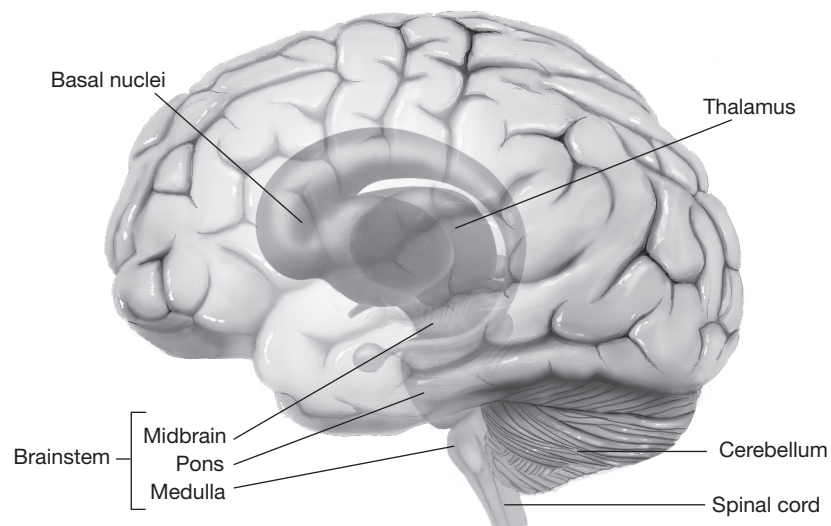
emotional functions (Highnam & Bleile, 2011). The cerebellum's posterior lobe has been shown to modulate nonmotor processing. This may include:

- Executive functioning or the ability to manage several cognitive tasks to reach a particular objective.
- Working memory, which critical for storage and manipulation of information during processing. The cerebellum is actively involved in verbal working memory.
- Divided attention or paying attention to more than one stimulus or to a stimulus presented in more than one modality.
- Modulation of affect.

Information flows from the cortex to the cerebellum and back again in the form of feedback on the progress of the communication process. Although the role of the cerebellum in the processing of language is apparent, the precise nature of this role is unknown.

Language Processing

Let's discuss language processing very briefly so you will have some idea of how various disorders affect this endeavor. In most individuals, linguistic information is processed in the left hemisphere (see Figure 6.1). Nonlinguistic and paralinguistic information are primarily processed on the right. The brain is a complex, interconnected organ, so these are gross overgeneralizations at best.

Incoming auditory information is held in working memory in **Broca's area** in the frontal lobe while it is processed. Most incoming linguistic processing occurs in **Wernicke's area** in the left temporal lobe, assisted by the angular gyrus for words and the supramarginal gyrus for grammar, although information is coming from storage areas throughout the brain. For outgoing information, the process occurs somewhat in reverse. Concepts are formed, and the angular and supramarginal gyri contribute to the overall message formation that occurs in Wernicke's area while held in working memory in Broca's area. In addition, Broca's area sends programming information to the **motor cortex** (see Figure 6.1), which, in turn, sends signals to the motor neurons for speech. The cranial nerves responsible for transmitting information to and from the brain are presented in Figure 6.3. Although the process is much more complex, you should have enough understanding to comprehend why, for example, Wernicke's aphasia can be so devastating for an individual.

Thought Question

APHASIA

Aphasia means literally "without language," a feature that describes the most severe varieties of this impairment. The aphasic population is extremely diverse. Although aphasia results from localized brain damage, the exact locations and the resultant severity and type of aphasia are not a perfect match. Although mildly aphasic individuals may have language that is similar to that of typical elderly persons, individuals with aphasia usually exhibit greater deficits in expressive language and overall efficiency of communication (Ross & Wertz, 2003).

Not all brain damage results in aphasia. Aphasia is not a result of a motor speech impairment, dementia, or deterioration of intelligence. Damage to the

Figure 6.3 Cranial nerves that are important in speech and hearing.

Trigeminal (V): A mixed nerve with both sensory and motor functions for the jaw and tongue for speech and chewing.

Facial (VII): A mixed nerve for sensation of taste and motor control of the facial muscles important in facial expression, such as smiling, tearing, and salivation.

Glossopharyngeal (IX): A mixed nerve with sensory input from the tongue for taste and motor control of the pharynx for salivation and swallowing.

Vagus (X): A mixed nerve serving the heart, lungs, and digestive system. A sensory nerve to the larynx and throat. A motor nerve to the larynx for phonation, the soft palate for lifting, and the pharynx for swallowing.

Accessory (XI): A motor nerve controlling muscles of the pharynx, soft palate, head, and shoulders.

Hypoglossal (XII): A motor nerve controlling the muscles of tongue movement.

brain may result in loss of motor or sensory function, impaired memory, and poor judgment while leaving language intact.

It is estimated that more than 1 million Americans have aphasia. More than 200 individuals—primarily adults—acquire aphasia in the United States each day. For these people, language has suddenly become a jumble of strange and seemingly unfamiliar words that they are unable to comprehend and/or produce. Many of you are likely to have had some experience with aphasia through a relative, friend, neighbor, or possibly firsthand.

Many severities and varieties of aphasia exist. Problems in two areas, auditory comprehension and word retrieval, seem to be common to varying degrees in all. Word retrieval difficulties suggest that memory may also be impaired in some way.

Aphasia may affect listening, speaking, reading, and/or writing as well as specific language functions, such as naming. In general, individuals with aphasia experience more difficulty with reading than with listening, especially for infrequently used words (DeDe, 2012). Related language functions such as doing arithmetic, gesturing, telling time, counting money, or interpreting environmental noises such as a dog's bark may also be difficult. Given the great variation possible, it may be better to think of aphasia as a general term that represents several syndromes.

Expressive deficits may include reduced vocabulary, either omission or addition of words, stereotypic utterances, either delayed and reduced output of speech or hyperfluent speech, and word substitutions. Each of these characteristics is an example of a deeper language-processing problem. **Hyperfluent speech**, very rapid speech with few pauses, may also be incoherent, inefficient, and pragmatically inappropriate.

Language comprehension deficits, whether spoken or written, involve the impaired interpretation of incoming linguistic information. Although individuals with aphasia may have normal hearing and vision, difficulty comes in the interpretation or the ability to make sense of the incoming signal.

Severity may range from individuals with a few intelligible words and little comprehension to those with very high-level subtle linguistic deficits that are barely discernible in normal conversation. Severity is related to several variables, including the cause of the disorder, the location and extent of the brain injury, the age of the injury, and the age and general health of the client. Differences in individual brains may account for different aphasic characteristics and for the lack of similar characteristics when similar areas of the brain are injured.

Although individuals with aphasia differ from one another greatly, several patterns of behavior exist that enable us to categorize the disorder into numerous types, or *syndromes*. Although categories of the disorder describe certain similarities among individuals with aphasia, they do not adequately characterize any one individual. SLPs and other professionals, such as neurologists and psychiatrists, must thoroughly assess each individual and describe individual strengths and weaknesses.

Other neurogenic disorders—those that affect the central nervous system— such as apraxia or dysarthria often exist along with aphasia, and these complicate classification. Apraxia and dysarthria are discussed in Chapter 10. Individuals with aphasia may also experience seizures and depression. Depression is also a common condition in neurological disorders. Most individuals with aphasia also have a variety of attention and other cognitive deficits, indicating an association between attention, language, and other cognitive domains (Murray, 2012).

This is an appropriate place to stress that it is extremely difficult to identify the exact spot where language and speech reside in the brain. Language is a complex process performed by many different areas. Brain-imaging techniques have identified several regions of the brain that are active during speech sound processing. The number and location of activated regions differ across individuals and with the task, the type of input and output, the amount and kind of memory required, the relative difficulty, attention level, and other simultaneous tasks.

It is rare that brain injury is so precise as to affect only language. Other related areas of cognitive function and motor behaviors may also suffer damage.

Although there is little evidence of a unitary language processing area, some areas do seem to be more important than others, especially the frontal and temporal regions of the left hemisphere. These areas are more active than other regions in both perception and production.

As best we can, we'll try to identify the areas of the brain affected by the disorders being discussed. These are presented in Figure 6.4. You'll want to refer back to this figure as we proceed.

Concomitant or Accompanying Deficits

Hemi means "half," as in "hemisphere."

Physical and psychosocial problems may accompany aphasia and may be traced to the same cause. Physical impairments may include hemiparesis, hemiplegia, and hemisensory impairment. **Hemiparesis** is a weakness on one side of the body in which strength and control are greatly reduced. In contrast, **hemiplegia** is paralysis on one side. Finally, **hemisensory impairment** may accompany either and is a loss of the ability to perceive sensory information. The client may complain of cold, numbness, or tingling on the affected side and may be unable to sense pain or touch.

Visual processing deficits may affect communication. Individuals with deep lesions in the left hemisphere interior to the ear and across the top of the brain may experience blindness in the right visual field of each eye. Called **hemianopsia**, this condition will affect the individual's ability to read.

When paresis, or paralysis, and/or sensory impairment involve the neck and face, the client may have difficulty chewing or swallowing. There may be accompanying drooling or gagging. This condition, known as **dysphagia**, is also a concern of SLPs and is addressed in Chapter 11.

In addition, brain damage may result in the seizure disorder or epilepsy seen in approximately 20% of adults with aphasia. Seizures may be of the tonic-clonic type, which result in periods of unconsciousness, or the *petit mal* and psychomotor type, in which the client may lose motor control but remain conscious.

Figure 6.4 Brain schematic showing probable locations of selected aphasias.
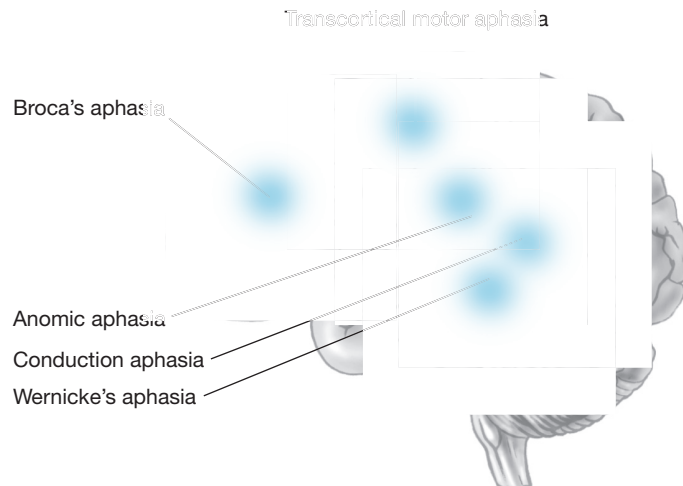
The discussion of aphasia is complicated and uses terminology that might be unfamiliar to you. As we discuss each characteristic related to aphasia, try to think of it as an extreme form of some behaviors that you already manifest. For example, occasionally we all have difficulty recalling a name or remembering a word. In its extreme form, we call this *anomia*. Some of the most common terms follow, with brief descriptions. Examples of written expressive deficits of adults with aphasia are presented in Figure 6.5.

Agnosia: A sensory deficit accompanying some aphasias that makes it difficult for the client to understand incoming sensory information. The disorder may be specific to auditory or visual information.

Agrammatism: Omission of grammatical elements. Individuals with aphasia may omit short, unstressed words, such as articles or prepositions. They may also omit morphological endings, such as the plural *-s* or past-tense *-ed*.

Agraphia: Difficulty writing. Writing may be full of mistakes and poorly formed. Clients may be unable to write what they are able to say. Agrammatism, jargon, and neologisms may be present in written language as well as in spoken.

Alexia: Reading problems. Clients may be unable to recognize even common words they use in their speech and writing. Paraphasia and neologisms may also be present.

Anomia: Difficulty naming entities. Clients may struggle greatly. Individuals who have recovered from aphasia report that they knew what they wanted

Figure 6.5 Examples of the expressive language deficits in the writing of adults with aphasia.
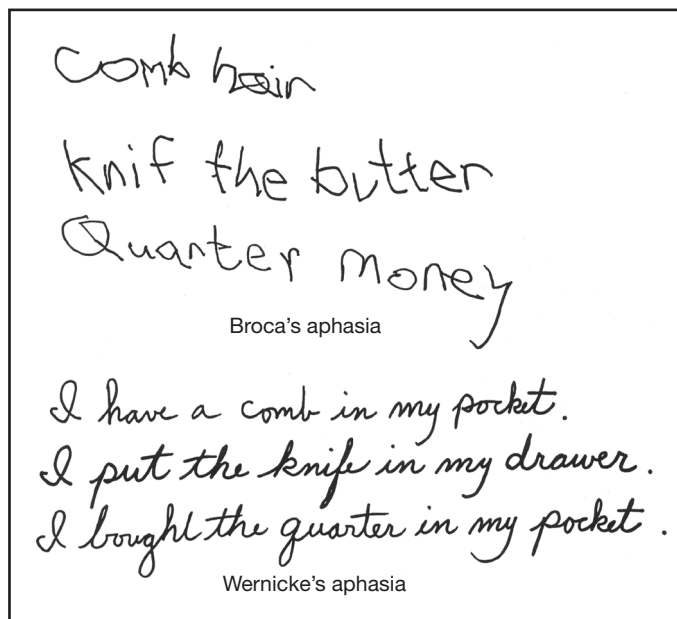
to say but could not locate the appropriate word. An incorrect response may continue to be produced even when the client recognizes that it is incorrect.

Jargon: Meaningless or irrelevant speech with typical intonational patterns. Responses are often long and syntactically correct although containing nonsense. Jargon may contain neologisms.

Neologism: A novel word. Some individuals with aphasia may create novel words that do not exist in their language, using those words quite confidently.

Paraphasia: Word substitutions in clients who may talk fluently and grammatically. Associations to the intended word may be based on meaning, such as saying *truck* for *car*; on similar sound, such as *tar* for *car*; or on some other relationship.

Verbal stereotype: An expression repeated over and over. One young man responded to every question with "I know," occasionally stringing it together to form "I know I know I know." Sometimes the expression is an obscene word or expletive or a neologism. One Mother Superior, seen in the clinic, continually uttered the same obscene word with great gusto, to her total embarrassment, but seemed to be unable to stop.

Types of Aphasia

Aphasias can be classified into two large categories based on the ease of producing speech: **fluent aphasia** and **nonfluent aphasia**. In turn, these can be subdivided. The most common types of aphasia and their characteristics are presented in Table 6.1.

Fluent Aphasias

> Adults with fluent aphasia have typical rate, intonation, pauses, and stress patterns.

The fluent aphasias are characterized by word substitutions, neologisms, and often verbose verbal output. Lesions in fluent aphasia tend to be found in the posterior portions of the left hemisphere of the brain.

Wernicke's Aphasia As a fluent aphasia, **Wernicke's aphasia** is characterized by rapid-fire strings of sentences with little pause for acknowledgment or turn-taking. Individuals are often unaware of their difficulties. Content may seem a jumble and may be incoherent or incomprehensible although fluent and well articulated. Characteristics include the following:

- Fluent or hyperfluent speech
- Poor auditory and visual comprehension
- Verbal paraphasia or unintended words and neologisms
- Sentences formed by strings of unrelated words, called jargon
- Mild to severe impairment in naming and imitative speech

Intonational patterns and sound-combination patterns are maintained.

Poor comprehension extends to reading as well as listening. Clients may demonstrate reduced ability to comprehend their own speech as well as that of others.

TABLE 6.1

Characteristics of fluent and nonfluent aphasias

Aphasia Type	Speech Production	Speech Comprehension	Speech Characteristics	Reading Comprehension	Naming	Speech Repetition
Wernicke's	Fluent or hyperfluent	Impaired to poor	Verbal paraphasia, jargon	Impaired	Impaired to poor	Impaired to poor
Anomic	Fluent	Mild to moderately impaired	Word retrieval and misnaming, good syntax and articulation	Good	Severely impaired in both speech and writing	Good
Conduction	Fluent	Mildly impaired to good	Paraphasia and incorrect ordering with frequent self-correction attempts, good articulation and syntax	Good	Usually impaired	Poor
Transcortical sensory	Fluent	Poor	Paraphasia, possible perseveration	Impaired to poor	Severely impaired	Unimpaired
Broca's	Nonfluent	Relatively good	Short sentences, agrammatism; slow, labored, with articulation and phonological errors	Unimpaired to poor	Poor	Poor
Transcortical	Nonfluent	Mildly impaired	Impaired, labored, difficulty initiating, syntactic errors	Unimpaired to poor	Impaired	Good
Global	Nonfluent	Poor, limited to single words or short phrases	Limited spontaneous ability of a few words or stereotypes	Poor	Poor	Poor, limited to single words or short phrases

Damage in Wernicke's aphasia is near Wernicke's area, in the posterior portions of the left temporal lobe (interior to the left ear). The following is an example of the speech of a client with Wernicke's aphasia:

I love to go for rides in the car. Cars are expensive these days. Everything's expensive. Even groceries. When I was a child you could spend five dollars and get a whole wagon full. I had a little red wagon. My brother and I would ride down the

hill by our house. My brother served in World War II. He moved away after the war. There was so little housing available. My house is a split-level.

Anomic Aphasia   As the name suggests, **anomic aphasia** is characterized by naming difficulties. Most aspects of speech are normal with the exception of word retrieval. Other characteristics include the following:

- Severe anomia in both speech and writing
- Fluent spontaneous speech marred by word retrieval difficulties
- Mild to moderate auditory comprehension problems

Names may be unavailable, or entities may be misnamed with both related and nonrelated words. Imitated or repetitive language is less affected.

With anomic aphasia, brain damage seems to be at the convergence of the parietal–temporal–occipital lobes (above and posterior to the left ear). Memory difficulties are evident. The following is an example of the speech of a client with anomic aphasia:

It was very good. We had a bird . . . a big thing with feathers and . . . a bird . . . a turkey stuffed . . . turkey with stuffing and that stuff . . . you know . . . and that stuff, that berry stuff . . . that stuff . . . berries, berries . . . cranberry stuffing . . . stuffing and cranberries . . . and gravy on things . . . smashed things . . . Oh, darn, smashed potatoes.

Conduction Aphasia   Like the other fluent aphasias, **conduction aphasia** is characterized by conversation that is abundant and quick, although filled with paraphasia. Characteristics include the following:

- Anomia
- Only mild impairment of auditory comprehension, if any
- Extremely poor repetitive or imitative speech
- Paraphasia or the inappropriate use of words formed by the addition of sounds and incorrect ordering of sounds or by substituting related words

Paraphasia may be severe enough to make the speech of an individual with conduction aphasia incomprehensible. Given the good comprehension skills of many individuals with conduction aphasia, self-correction attempts are frequent, although a client may be unable to benefit from the verbal cues of others.

With conduction aphasia, damage may be deep below the brain surface, between areas where language is formulated and speech is programmed. The following is an example of the speech of a client with conduction aphasia:

We went to me girl, my girl . . . oh, a little girl's palace . . . no, daughter's palace, not a castle, but a pal . . . place . . . home for a sivit . . . and he . . . visit and she made a cook, cook a made . . . a cake.

Transcortical Sensory Aphasia   The rarest of the fluent aphasias, **transcortical sensory aphasia**, is characterized by conversation and spontaneous speech as fluent as in Wernicke's aphasia, but filled with word errors. Characteristics include the following:

- Unimpaired ability to repeat or imitate words, phrases, and sentences
- Verbal paraphasia or word substitutions

- Lack of nouns and severe anomia
- Poor auditory comprehension

The unimpaired imitative ability may become persistent. With this type of aphasia, brain damage seems to isolate language areas from other areas of cortical control.

Subcortical Aphasia Although its existence had been hypothesized, **subcortical aphasia** could not be confirmed until the advent of neuroimaging techniques. Lesions occur deep in the brain, without involvement of the cerebral cortex. Characteristics include the following:

- Fluent expressive speech
- Paraphasia and neologisms
- Repetition unaffected
- Relatively unaffected auditory and reading comprehension
- Cognitive deficits and reduced vigilance

Additional language characteristics may include word-finding difficulties, perseveration or saying something over and over, and nonimitative speech. Other characteristics, including dysarthria, have been related to specific sites in the basal ganglia (Kirshner, 1995).

Nonfluent Aphasias

Nonfluent aphasia is characterized by slow, labored speech and struggle to retrieve words and form sentences. In general, the site of lesion is in or near the frontal lobe.

Adults with nonfluent aphasia have slow rate, less intonation, inappropriately placed and abnormally long pauses, and less varied stress patterns than typical speakers.

Broca's Aphasia **Broca's aphasia** is associated with damage to the anterior or forward parts of the frontal lobe of the left cerebral hemisphere, centered in Broca's area, which is responsible for both motor planning and working memory. The most common traits are the following:

- Short sentences with agrammatism in which auxiliary or helping verbs, the verb *to be,* prepositions, articles, and morphological endings are omitted
- Anomia
- Problems with imitation of speech because of overall speech problems
- Slow, labored speech and writing
- Articulation and phonological errors

Auditory comprehension seems unimpaired, although careful testing may reveal subtle deficits in understanding.

The following is an example of the speech of a client with Broca's aphasia:

Foam, foam, phone, damn, phone . . . not ude . . . phone not ude . . . ude . . . ude . . . use . . . can't ude . . . no foam can ude.

Transcortical Motor Aphasia This is the nonfluent counterpart of transcortical sensory aphasia. Individuals with **transcortical motor aphasia** may have

difficulty initiating speech or writing. Characteristics of this syndrome include the following:

- Impaired speech, especially in conversation
- Good verbal imitative abilities
- Mildly impaired auditory comprehension

Severely impaired speech is characteristic of damage to the motor cortex, although the areas that are affected may go well below the surface of the brain.

Global, or Mixed, Aphasia   As the name implies, **global, or mixed, aphasia** is characterized by profound language impairment in all modalities. It is considered the most severely debilitating form of aphasia. Other characteristics include the following:

- Limited spontaneous expressive ability of a few words or stereotypes, such as overlearned utterances or emotional responses
- Imitative speech and naming affected
- Auditory and visual comprehension limited to single words or short phrases

Global aphasia has both the auditory comprehension problems found in some fluent aphasias and the labored speech of nonfluent aphasias. These symptoms are associated with a large, deep lesion in an area below the brain's surface. Often, both the anterior speech and posterior language areas of the left hemisphere are involved.

Thought Question

Additional Types of Aphasia

Not all aphasias can be neatly classified as either fluent or nonfluent. Other aphasias may affect primarily one communication modality, such as writing. Examples of these specific aphasias include the following:

- *Alexia with agraphia:* Reading and writing impairment
- *Alexia without agraphia:* Reading impairment with no accompanying writing difficulty
- *Pure agraphia:* Severe writing disorder
- *Pure word deafness:* Lack of auditory comprehension with error-free spontaneous speech
- *Crossed aphasia:* Aphasia accompanying right hemisphere brain damage

Aphasia classification and its relationship to the location of lesions are controversial issues and areas of continued study.

Causes of Aphasia

The onset of aphasia is rapid. Usually, it occurs in people who have no former history of speech and language difficulties. The lesion or injury leaves an area of the brain unable to function as it had functioned just moments before.

The most common cause of aphasia is a **stroke**, or **cerebrovascular accident**, the third leading cause of death in the United States. Strokes affect half a million

Americans annually. Seventy percent of these are over 65 years of age (Internet Stroke Center, 2005). Although strokes are rare in children, infants suffer strokes at a rate similar to elderly adults (Lee et al., 2005). The National Aphasia Association estimates that as a result of strokes, approximately 100,000 people acquire aphasia each year.

Strokes are of two basic types: ischemic and hemorrhagic. **Ischemic stroke**, which is the more common type of stroke, results from a complete or partial blockage (occlusion) of the arteries transporting blood to the brain, as in cerebral arteriosclerosis, embolism, and thrombosis. **Cerebral arteriosclerosis** is a thickening of the walls of cerebral arteries in which elasticity is lost or reduced, the walls become weakened, and blood flow is restricted. The resulting ischemia, or reduction of oxygen, may be temporary or may cause permanent damage through the death of brain tissue. An **embolism** is an obstruction to blood flow caused by a blood clot, fatty materials, or an air bubble. The obstruction may travel through the circulatory system until it blocks the flow of blood in a small artery. For example, a clot may form in the heart or the large arteries of the chest, break off, and become an embolus. As in cerebral arteriosclerosis, blockage results in a lack of oxygen-carrying blood, depriving brain cells of needed oxygen. Similarly, a **thrombosis** also blocks blood flow. In this case, plaque buildup or a blood clot is formed on site and does not travel. The result is the same.

Some individuals experience a **transient ischemic attack (TIA)**, sometimes called a mini-stroke, a temporary condition whose symptoms mirror those of a stroke. A TIA occurs when blood flow to some portion of the brain is blocked or reduced. After a short interval, the symptoms decrease as blood flow returns. TIAs should be taken seriously because they can be a warning sign of increased likelihood of a stroke occurring in the future.

A **hemorrhagic stroke** is one in which the weakened arterial walls burst under pressure, as occurs with an aneurysm or arteriovenous malformation. An **aneurysm** is a saclike bulging in a weakened artery wall. The thin wall may rupture, causing a cerebral hemorrhage. Most aneurysms occur in the meninges, the layered membranes surrounding the brain, and blood flowing into this space can damage the brain or, in serious cases, cause death.

Arteriovenous malformation is rare and consists of a poorly formed tangle of arteries and veins that may occur in a highly viscous organ such as the brain. Malformed arterial walls may be weak and give way under pressure.

Patterns of recovery differ with the type of stroke. Often, with ischemic stroke, there is a noticeable improvement within the first weeks after the injury. Recovery slows after 3 months. In contrast, the results of hemorrhagic strokes are usually more severe after injury. The period of most rapid recovery is at the end of the first month and into the second, as swelling lessens and injured neurons regain functioning.

Damage from stroke may occur in any part of the brain. In all right-handed individuals and in some left-handed ones, injury to left hemisphere language areas produces aphasia. Injury to the right hemisphere results in aphasia in only a small percentage of cases, usually left-handed individuals whose right hemisphere is more important for language.

Aphasia-like symptoms also may be noted with head injury, neural infections, degenerative neurological disorders, and tumors. In most of these cases, however, other cortical areas are also affected, resulting in clinically different disorders.

Stroke is caused by an interruption of the blood supply to the brain.

The results of a stroke are further complicated by the prestroke storage patterns for language.

One syndrome, **primary progressive aphasia**, should be mentioned here. Primary progressive aphasia is a degenerative disorder of language, with preservation of other mental functions and of activities of daily living. The disorder, which takes at least 2 years to develop, is not dementia or loss of cognitive functioning, and many individuals with primary progressive aphasia can take care of themselves, some even remaining employed. Over its course, the disorder progresses from primarily a motor speech disorder to a near-total inability to speak, although comprehension remains relatively preserved.

The human brain is extremely complex. Categorizing the types of aphasias that we have discussed helps bring some understanding to the subject of brain disorders but may have little practical clinical value. Each client presents unique characteristics. It is all the more important, therefore, that SLPs describe each client's abilities and disabilities carefully and clearly.

✔ Click here to check your understanding of the concepts in this section.

Lifespan Issues

Although children and adolescents can experience aphasia, especially accompanying brain tumors, most victims are adults in middle age and beyond who previously lived healthy, productive lives. The risk of stroke is increased in an individual who has a history of smoking, alcohol use, poor diet, lack of exercise, high blood pressure, high cholesterol, diabetes, obesity, and TIAs or previous strokes. Usually, the onset of symptoms is rapid when the cause is vascular, but it can take months or years to become evident with tumor or degenerative disease. These patterns are presented in Figure 6.6.

In the most common situation, the individual suffers an ischemic stroke, depriving the brain of a needed supply of oxygenated blood. First indications may be loss of consciousness, headache, weak or immobile limbs, and/or slurred speech. This condition *may* be either temporary, in which case function returns

Figure 6.6 Severity of symptoms by neurological condition. Individuals differ in severity and path of the disorder.
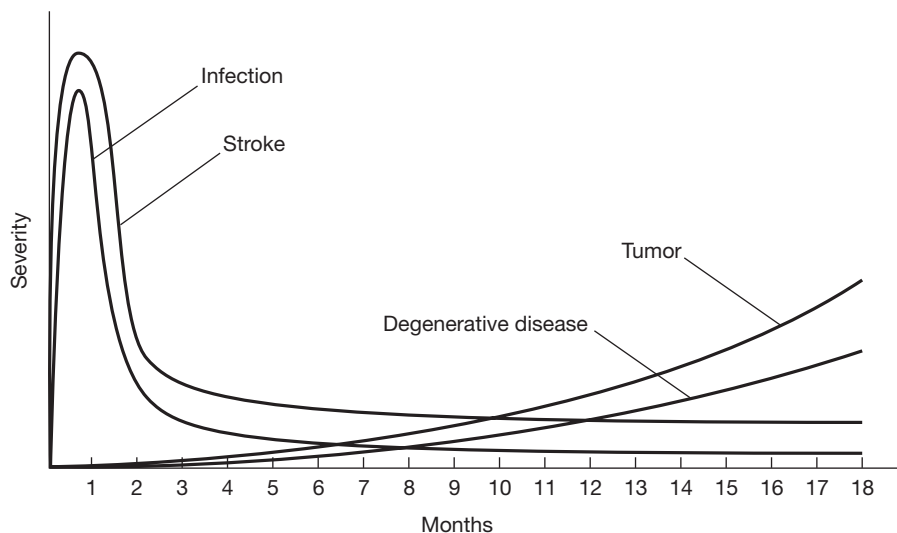
quickly, or more permanent. Some individuals may experience a series of TIAs spaced over a period of years before they become alarmed. Some TIAs go undetected by the individual.

Usually, at the onset of aphasia, the individual is rushed to the hospital. Approximately a third of individuals die from the stroke or shortly thereafter. For those who survive, there may be a period of unconsciousness, followed by disorientation. Deep long-lasting periods of unconsciousness or coma are associated with poorer eventual recovery.

For an individual who has experienced a stroke, language is probably not his or her immediate or central concern. Initial reaction may be fear or anxiety. The patient and the family are focused on survival and may be fearful of another stroke. For most individuals, this is a novel situation, and they are unaware of how possible limitations will affect their future. As chronic effects settle in, an individual begins to focus on the physical and language complications. This can lead to frustration and depression. The mother of one of the authors refused to participate in physical therapy in this stage. A newly aphasic patient may not be ready to receive factual information about his or her condition or structured intervention.

Likewise, families of individuals with aphasia are often frightened and confused. Because no one prepares in advance for stroke, families are usually ill informed. In other words, the patient and family are in crisis.

Most individuals remain in acute care for only a few days until their condition stabilizes. Following this, an individual may receive a variety of types of care, depending on the severity of the stroke. These include rehabilitative hospitalization, outpatient rehabilitation, or nursing home care. Most return home but with some impairment.

Although intervention services may occur for years, most individuals receive services for at least the first several months. In addition to neuromuscular deficits and seizures, an individual with aphasia may exhibit behavior changes, including perseveration, disinhibition, and emotional problems, depending on the site of the lesion. *Perseveration* is the repetition of inappropriate responses in which the client may become fixed on a single task or behavior and repeat it. *Disinhibition* is a seeming inability to inhibit certain asocial or inappropriate behaviors, such as touching others. Finally, brain damage may contribute to exaggerated swings in emotion.

Emotional behavior must be considered in light of the extreme frustration experienced by some individuals with aphasia. Depression is also common.

Given the variety of possible symptoms following a stroke, an individual who has a stroke will most likely receive services from a team of professionals. Team members may include a neurologist, a physical therapist, an occupational therapist, a nutritionist, a speech-language pathologist, and an audiologist. Life changes and family concerns may necessitate the services of a counseling social worker, psychologist, psychiatrist, and/or pastoral counselor.

Speech and language services are part of a team approach to intervention.

Immediately after an incident, neurological functioning is most severely affected. Within days, the body's natural recovery process begins. As swelling is reduced, injured cells may recover and begin to function normally. Adjacent areas of the brain that shared brain functions with the injured area may begin to play a larger role. The course and extent of this recovery process are difficult to predict, but the rate is fastest during the first few weeks and months after the stroke, and then it slows, usually ceasing after 6 months. During this process, the entire

syndrome that the client presents may change and most certainly will lessen in severity. The most frequent linguistic gains are in auditory comprehension. In general, less severely affected individuals and those who are younger, in general good health, and left-handed, recover from aphasia better and faster than those who are more severe, older, in poor health, and right-handed.

Most individuals experience some type of **spontaneous recovery**, a natural restorative process. In general, individuals who experience ischemic strokes begin spontaneous recovery earlier than those who experience intracerebral hemorrhage but improve less rapidly. Although the anatomical and physiological basis for the spontaneous recovery of language is not well understood, maximum improvement is seen in the first 3 months. This immediate physiological restitution may be complemented by reorganization of brain function in the later stages of recovery. Neuroimaging studies show use of left hemisphere structures that were previously involved in language function and use of similar regions in the right hemisphere with a corresponding shift in some language functioning to the right (Pataraia et al., 2004; Thompson, 2004).

With or without spontaneous recovery, assessment and intervention begin as soon as a client's particular condition permits. Clients who are most responsive are probably the best candidates for intervention services. A general rule is that the earlier the treatment, the better the rate of recovery, but clients do not all recover similarly. An SLP's first goal is to determine the feasibility of clinical intervention. Although it is not possible to predict accurately how much gain will result from spontaneous recovery and how much will result from intervention, an SLP attempts to determine which clients will benefit most from clinical intervention.

> Communication is so entwined in our social interactions and in our very definition of who we are that the effects of aphasia reach well beyond speech and language.

Loss of the ability to use language efficiently changes the social role of each individual with aphasia and can result in social isolation. This situation is complicated by the often incorrect assumption that cognitive abilities are also damaged. In addition, inability to communicate may cause an affected individual to become dependent on others for the simplest of daily tasks. Family roles and responsibilities may also change. Wives, husbands, and children may have to take on new responsibilities. If an individual supported his or her family prior to the incident that caused aphasia, there may be economic problems in addition to medical ones. Case Study 6.2 presents the story of one individual with aphasia.

Before we move on to a discussion of assessment and intervention, you might want to check a few web sources. The National Aphasia Association website (www.aphasia.org) has links to several useful sites. Click on "Aphasia Resources" on the left. The National Institute of Deafness and Other Communication Disorders website (www.nidcd.nih.gov/Pages/default.aspx) has an in-depth description of aphasia. Click on "Health Info" at the top, click on "Voice, Speech, and Language," and scroll down to "Aphasia."

Assessment for Aphasia

Assessment and intervention may begin in the hospital and continue as outpatient service. Successful intervention is a team effort. The relative importance of each specialist will change as the client recovers. In addition, a spouse, another family member, or a close friend may be a critical participant in the recuperative process.

CASE STUDY 6.2

Personal Story of an Adult with Aphasia

When Mr. W. was 55 years of age, he looked fitter than most men 10 years his junior. Having earned a master's degree in labor relations from Cornell University, Mr. W. was employed for many years as a labor mediator by the small city in which he lived. Mr. W. was viewed as cheerful by his circle of friends, primarily fellow hikers with whom he explored mountain trails almost every Saturday.

Although Mr. W. had been rugged and capable of vigorous outdoor activity, he knew that he had high blood pressure, and he was taking medication under a doctor's care. Mr. W. was rarely ill, and he had been hospitalized only once, for acute appendicitis, before his stroke.

One Sunday afternoon, Mr. W. decided to lie down after a 4-hour cross-country ski outing. He had a bad headache, and he hoped that a short rest would relieve it before a dinner date with skiing buddies. When he awoke from his nap, he got up to go to the bathroom but collapsed. His friends were concerned when he failed to meet them. They phoned and got no answer, so someone went to his home. Mr. W. was found on the floor, breathing but unconscious. He had suffered a cerebrovascular accident (CVA), or stroke.

Mr. W. was taken to the emergency room of the local hospital. When he became conscious, he was disoriented, did not seem to understand what was said to him, and was unable to speak. The right side of his body was partially paralyzed. The medical report stated that he had "sustained a left CVA that resulted in right hemiplegia and aphasia." He remained hospitalized for 6 weeks. In addition to the attending neurologist and family physician, Mr. W. was seen by a SLP and a physical therapist. The SLP performed an initial bedside assessment and counseled family members and friends. The SLP's initial report stated that "Mr. W. presented with severe expressive/receptive aphasia characterized by severe oral motor apraxia and a severe auditory comprehension deficit with moderate to severe reading comprehension deficits for single words."

When Mr. W. was discharged from the hospital, he moved in with his sister and her family. He was cared for largely by family and friends, and he was taken for medical appointments and twice-weekly physical and speech-language therapy. Early goals were simple auditory comprehension requiring yes/no head nods as responses, and the expression of needs such as "eat."

Two years after the stroke, Mr. W. was able to walk with a walker. Family members reported that they could understand approximately 85% of his intentional speech. Strangers could understand only about 20%. He used gestures and largely unintelligible sounds to express himself. Mr. W.'s ability to comprehend language had improved dramatically, and he was now able to follow directions that contained three critical elements ("put the pencil on top of the card and then put it back"). Friends reported that he often seemed agitated, but he apparently liked their visits. Because Mr. W. had always enjoyed being outdoors, his friends frequently took him for short walks. Family members said that they tried to sing together on a regular basis and that Mr. W. joined in to the extent that he was able.

Recently, Mr. W. was evaluated for augmentative/ alternative communication. He has received an electronic voice output system and is being taught how to use it. He will never be able to speak normally, but this device should greatly facilitate his ability to communicate.

Before beginning any intervention, it is necessary to complete a thorough assessment of each client's abilities and deficits. This process may continue in several stages as the client stabilizes and experiences spontaneous recovery.

Especially important are the client's medical history, the interview with the client and family, examination of the peripheral speech mechanism, hearing testing, and direct speech and language testing. The medical history can reveal information about general health and previous cerebrovascular incidents. In addition, current neurological reports and medical progress notes provide valuable information on present and changing status.

The severity of aphasia is affected by the location of the injury and its age, as well as the age of the client. As you watch this **video**, notice that the client is initially confused. He also says, "The sink is falling" when he means "overflowing." He struggles somewhat with words and names individual parts of the picture rather than describing the entire scene.

Comprehensive testing of clients with aphasia should include at least the two input modalities vision and audition and the three output modalities speech, writing, and gestures.

In addition to collecting data during the interview, it will be necessary for an SLP to provide information. The client may be disoriented and need reassurance. Family members will have many questions regarding recovery, family dynamics, income, medical expenses, and the like. Often a social worker will address these issues also. It is important for families to know the extent of the injuries and to have a realistic appraisal of recovery with and without professional assistance.

Counseling with the family by team members will be ongoing. The family and client may need professional counseling to cope with the enormous changes that have occurred in their lives.

Careful observation is essential, especially shortly after the incident, when more formal testing is not possible. It is important to observe the client's general speech and language behavior and to listen to and observe what is communicated and how. Observing spontaneous language use can give an SLP important information on the nature and extent of the disorder.

A thorough examination of the peripheral speech mechanism is important because of the potential for either neuromuscular paralysis or weakness. Speech disorders such as apraxia and dysarthria frequently are associated with aphasia and should be described or ruled out. See Chapter 10 for a fuller discussion.

Possible hearing loss must also be ascertained, especially given the older age of most individuals with aphasia. It is important to separate hearing loss from comprehension deficits.

Initial speech and language testing often occurs at the patient's bedside and can be confounded by spontaneous recovery that decreases the need for extensive formal testing at this stage. Therefore, an SLP administers informal probes of the patient's language strengths and weaknesses. More formal testing is usually postponed until the patient has maintained a stable level on simple language tasks for at least several days. Simple tasks are administered at least once daily in a short 15-minute time frame (Holland & Fridriksson, 2001). The SLP notes subtle changes in the patient's behavior. It's important not to tire the patient because fatigue can have a negative effect on communicative ability. Figure 6.7 presents a sample of some of the tasks involved in a bedside assessment.

SLPs should expect some improvement in some areas over just a few days. Positive changes should be reinforced and pointed out to the patient and family members.

Later, more formal speech and language testing and sampling should assess overall communication skills as well as receptive and expressive language in all modalities (reading, writing, auditory comprehension, expressive language, and gestures and nonlinguistic communication) and across all five aspects of language (pragmatics, semantics, syntax, morphology, and phonology). With higher-functioning clients, an SLP will want to assess higher language skills such as verbal reasoning and analogies, figurative language, categorization, and explanations of complex tasks. Table 6.2 is an overview of the areas that ASHA recommends be evaluated in a functional assessment of communication abilities.

Several standardized tests are available for assessing specific language skills. Formal tests must be selected carefully. Most tests include picture or object naming, pointing to pictures named, automatic language, repeating sentences, describing pictures and answering questions, reading and answering questions and/or drawing conclusions, and writing. It is important for an SLP to remain flexible and to continue to probe a client's behavior for the duration of intervention, especially as behaviors change.

Figure 6.7 Possible components of an informal bedside evaluation.

Memory: Once introduced, names can be used to assess verbal memory on subsequent visits.

Reading: Ask the patient to read get-well cards.

Writing: Observe patient studying and filling in a hospital menu.

Word retrieval and writing: Provide writing implements and ask the patient to write a few words, such as the names of his or her children.

Memory and more complex language: Ask the patient to identify the person who sent each greeting card.

Naming: Ask patient to name a few common objects around the room.

Auditory comprehension: Note how the client responds during conversation.

Auditory comprehension and working memory: Have the patient follow a few simple commands.

Automatic language: Ask the patient to count or say the alphabet or days of the week.

Pragmatics: Note greeting and leave-taking; make a few simple mistakes, such as calling the patient by the wrong name, and observe the response; ask absurd questions (e.g., "Do helicopters eat their young?"); and take careful note of the conversational repairs, turn-taking behavior, and general appropriateness of the conversation structure.

Interpretation of client behavior during testing is extremely important. It is critical, for example, to determine whether the client failed to respond because she or he could not retrieve the answer or because she or he did not comprehend the verbal cue.

Most test tasks involve decision making or problem solving, the endpoints of several cognitive and linguistic processes. Subcomponents of the process are not assessed individually. *Online* assessment, which measures effects at various points within the process, may be more sensitive to individual client strengths and weaknesses. To date, most online analysis is limited to research, but such procedures are slowly being adapted for clinical use.

Because most individuals with aphasia have some residual communication impairment, the goal of intervention is to maximize communication effectiveness in the face of this impairment.

Intervention

The overall goal of intervention is to aid in the recovery of language and to provide strategies to compensate for persistent language deficits. Individual intervention goals are determined by the results of the assessment and by the desires of both the client and family. Goals will be individualized according to the type and severity of the aphasia and upon the individual needs of each client. It cannot be stressed enough that intervention that is effective for one client may be less so for another who differs in the type of aphasia and the severity (Edmonds & Babb, 2011)

Ideally, the goals are mutually acceptable to the client, family, and SLP. All members of the team coordinate their efforts to strengthen treatment received from others. Some guidelines for working with individuals with aphasia are presented in Figure 6.8.

TABLE 6.2

ASHA recommendations for a functional assessment of communicative abilities with adults with aphasia

Assessment Domain	Behaviors
Social communication	Use names of familiar people
	Express agreement and disagreement
	Request information
	Exchange information on the telephone
	Answer yes/no questions
	Follow directions
	Understand facial expressions and tone of voice
	Understand nonliteral meaning and intent
	Understand conversations in noisy surroundings
	Understand TV and radio
	Participate in conversations
	Recognize and correct communication errors
Communication of basic needs	Recognize familiar faces and voices
	Make strong likes and dislikes known
	Express feelings
	Request help
	Make needs and wants known
	Respond in an emergency
Reading, writing, and number concepts	Understand simple signs
	Use reference materials
	Follow written directions
	Understand printed material
	Print, write, and type name
	Complete forms
	Write messages
	Understand signs with numbers
	Make money transactions
	Understand units of measure
Daily planning	Tell time
	Using a phone
	Keep scheduled appointments
	Use a calendar
	Follow a map

Source: Information from American Speech-Language-Hearing Association. (1994). *Functional assessment of communicative skills for adults (FACS)*. Washington, DC: Author.

Figure 6.8 Guidelines for intervention with individuals with aphasia.

Treat the client in an age-appropriate manner.

Keep your own language simple, clear, and unambiguous and control for length and complexity.

Adjust your language and the speed of production for the processing capabilities of the client.

Use everyday items and tasks and involve the family.

Use repetition and familiar routines, situations, and responses to facilitate learning.

Structure tasks to improve performance and adjust the amount of structure just enough to support the client's efforts but not foster dependency.

Provide a context to supportive the client's language processing.

Increase the demands made on the client gradually based on the client's abilities.

Teach the client to use his or her strengths to compensate for weaknesses.

Intervention approaches reflect an SLP's theoretical position on aphasia plus a strong dose of practical knowledge regarding the most effective techniques. Each clinician must decide whether to work on underlying skills, such as memory and auditory comprehension, or to begin with specific skill deficits, such as naming. If an SLP decides that a client's brain needs help to reorganize, he or she may choose cross-modality training, such as reading aloud while tracing the letters with one's finger.

An SLP can also take advantage of cross-modality generalization in which skills trained in one modality generalize to another. For example, some individuals with agrammatism benefit from comprehension training more than production training (Jacobs & Thompson, 2000). Comprehension training seems to generalize to comprehension and production. Similarly, generalization occurs across linguistically related structures and from more complex structures to less complex ones (Thompson et al., 2003).

There is very little data on the effects of treatment during the early phases of recovery. Although the focus of early aphasia management often consists of providing support, prevention, and education rather than structured language therapy, many individuals benefit from less directive, more counseling-oriented treatment (Holland & Fridriksson, 2001).

In both initial and follow-up intervention, conversational techniques can provide language therapy and therapeutic support, especially in the early stages of intervention (Holland & Fridriksson, 2001). Within a therapeutic conversation, the client carries as much of the "communication burden" as possible. Mindful of small improvements by the client, the SLP revises the demands made of the client. In short sessions using conversation, the SLP reassures, explains what's happening to the client, and points out positive changes. As a client progresses, the SLP provides less support and provides a variety of communication contexts and experiences.

Another method of intervention is to have the client attempt to access the language in the left hemisphere by "bridging" from the right. This might be attempted by teaching the client to gesture or sign and simultaneously attempt

to say the names of familiar objects. It is reasoned that gestures or signs, being visuospatial in nature, are stored in part in the right hemisphere. Reportedly, the use of both gestures and pantomime have a positive effect on noun retrieval, although more data is needed on generalization and long-term effects (Ferguson et al., 2012). Other methods use the client's usually intact right hemisphere ability to produce intonational patterns or rhythms. The signs or intonational patterns are gradually faded as the client begins spontaneously to produce the targeted words and phrases without their aid.

As in many other areas of language intervention, unanimity on cross-hemispheric treatment methods does not exist. Many SLPs prefer to remediate language deficits by more direct multimodality stimulation of the affected cognitive processes (Peach, 2001). The goal is reactivation of speech areas in the dominant hemisphere.

Sign, gesture, or some other form of augmentative/alternative communication may become the primary communicative modality for clients who possess profoundly impaired language and/or speech disorders. Communication boards or electronic forms of communication, such as use of an iPad, may be appropriate for those who also have neuromuscular impairments. Amerind, or American Indian signs, may also be useful because many require only one hand and are easily guessable by others. See Chapter 13.

Intervention might also focus on cognitive abilities, such as memory and attention, in addition to more linguistic targets. Clinician-assisted training may also be supplemented by more minimally assisted training, such as computer-provided reading tasks, including visual matching and reading comprehension.

The adaptive capacity of the central nervous system, called *plasticity*, holds promise. Data strongly suggest that neurons and other brain cells have the ability to alter their structure and function in response to a variety of pressures, including training. Plasticity may be the key to helping damaged brains relearn lost behavior through intervention. Much more research is needed to translate from clinical research and practice (Kleim & Jones, 2008).

If a client's family is amenable, it is usually beneficial to involve them in the communication training program under the SLP's guidance. The familiar atmosphere of the home and the objects, actions, and people in it can provide a context that can facilitate a client's recovery and strengthen his or her relearned communicative behaviors. It is important for professionals to remember that the beneficial involvement of the family must not be at their emotional expense. Family members must not be made to feel guilt if the client progresses little.

Volunteers can also be trained to support the conversational attempts of individuals with aphasia (Kagan et al., 2001). These individuals need to acknowledge and respond to a client's interactive behaviors. This feedback can affect motivation and performance and is an essential part of intervention.

Augmentative/alternative communication may become the primary mode of communication or may be used as a facilitative tool to access verbal language.

Evidence-Based Practice

Although we can conclude from the myriad of studies on intervention with individuals with aphasia that intervention promotes recovery, we cannot definitively say which intervention methods are best for the various forms of aphasia (Raymer et al., 2008). What we can say is that failure to participate in intervention has an adverse effect on recovery. Other evidence-based practice (EBP) findings are presented in Box 6.1.

BOX 6.1 | Evidence-Based Practice for Individuals with Aphasia

Overall Methods of Intervention

- Individuals with aphasia significantly benefit from the services of SLPs over those who receive no intervention. At least 80% make measurable progress affecting both the quantity and quality of language.
- Behavioral intervention promotes language recovery. In general, aphasia treatment is more effective than spontaneous recovery alone.
- The most effective forms of intervention for different forms of aphasia and different language behaviors have not been thoroughly evaluated. Most evaluative studies use test performance rather than investigate the effect of aphasia treatment for functional use of communication. More research is needed in how stroke recovery factors, such as lesion size and location, age, and type of language deficit, influence treatment, especially neural reorganization.

Specific Techniques

- Although timing of intervention after an injury is critical, the optimal interval before beginning intense intervention is unknown. In general, we can say that treatment within the first 3 months is maximally beneficial but that later treatment can also improve language ability and use.
- Repetition is important for maintaining changes in brain function and physiology.
- Although more intense intervention (9 or more hours/week) yields better results, the optimal amount is unknown. In chronic aphasia, there is

modest evidence for more intensive treatment. Of particular interest is *constraint-induced language therapy* (CILT) (Pulvermuller et al., 2001). CILT involves (1) requiring the patient to use verbal language while limiting or constraining all other use channels and (2) massed practice or a high-intensity treatment schedule of 3 to 4 hours daily for 2 weeks. The effects are similar to those of other intensive treatments that do not employ the use of constraint (Cherny et al., 2008).

- Training complex language results in improvements in less complex, untrained language when the trained and untrained material are linguistically related. Training simple language has little effect on learning of more complex material.
- The results on the use of augmentative and alternative methods of communication (see Chapter 13) are inconclusive.

Generalization

- Research results on the generalization of treatment effects to untrained language behaviors are mixed.
- Generalization is most likely to occur to a language feature that is similar to one that is trained, such as generalization to untrained sentences that are syntactically related to trained sentences.

Source: Based on DeRuyter et al. (2008); Koul & Corwin (2010); Raymer et al. (2008).

Conclusion

Aphasia is a complex impairment that varies in scope and extent across individuals. In addition, clients may have other impairments, such as paralysis, as a result of their injury. Only a careful description of individual abilities and deficits in each specific modality of communication will enable an SLP to plan and carry out effective intervention. The individual variation in symptoms and severity, the team approach to intervention, and the possibility of spontaneous recovery complicate our efforts to measure intervention effectiveness and offer opportunities for those of you interested in research.

RIGHT HEMISPHERE BRAIN DAMAGE

SLPs in health care settings are increasingly involved in the assessment and management of cognitive-communication disorders in individuals with **right hemisphere brain damage (RHBD)**. The term RHBD refers to a group of deficits that result from injury to the right hemisphere of the brain, the nondominant hemisphere for nearly all language functions. RHBD has been found to result in impairments as varied as visuospatial neglect and other attention deficits; difficulties with memory and components of executive function, such as problem solving, reasoning, organization, planning, and self-awareness; and a wide range of communication impairments (ASHA, 2008; Blake, 2006; Lehman & Tompkins, 2000; Myers, 2001; Tompkins et al., 2013). Although it is estimated that 50% to 78% of individuals with RHBD exhibit one or more communication impairments, many do not receive treatment for these difficulties (Blake et al., 2002; Côté et al., 2007; Ferré et al., 2009).

Less information exists on RHBD than on damage to the left hemisphere, although approximately half the individuals who have suffered stroke have right hemisphere involvement. The communication disorders that clients with RHBD experience do not seem to be strictly language based. Rather, a combination of cognitive deficits results in the communication problem. As a result, the efficiency, effectiveness, and accuracy of communication are affected.

Although there is greater activation in the left hemisphere during both reception and production, some right hemisphere involvement also occurs (Fridriksson et al., 2009). The role of the right hemisphere in language processing has not been explored as much as that of the left. Linguistic information is processed on the left, and nonlinguistic and paralinguistic information are processed on the right. In general, the right plays a role in some aspects of pragmatics, including the perception and expression of emotion; understanding of jokes, irony, and figurative language; and production and comprehension of coherent discourse. The right hemisphere also plays a greater role in processing emotion in nonverbal contexts.

The right hemisphere also plays a role in semantic processing. Let's take a look at sentence processing for a moment. In the sentence "Ann bumped into Kathy, and she fell over," the person who fell is in doubt. If we measure brain activity using event-related potentials (ERPs), a measure of the electrical activity generated by the brain, we find that the right hemisphere is much more involved in processing sentences such as this as the brain attempts to clarify the meaning (Streb et al., 2004).

Approximately 4% of the population are either right hemisphere dominant for language or have bilateral language processing. If these individuals become aphasic as a result of left-hemisphere brain damage, they usually experience milder impairment and quicker recovery than those who are left-hemisphere dominant. The role of the right hemisphere is unclear in the recovery of left-dominant individuals with aphasia.

Characteristics

Deficits in RHBD are not as obvious as those that result from left hemisphere brain damage. The most common include the following:

- Neglect of all information from the left side
- Unrealistic denial of illness or limb involvement

- Impaired judgment and self-monitoring
- Lack of motivation
- Inattention

For a more detailed list, see Dr. McCaffrey's website.

Deficits may be very subtle but can have a great effect on everyday life. Although these deficits may seem nonlinguistic in nature, they can have a great effect on communication.

Disturbances can be grouped into attentional, visuospatial, and communicative. Attentional disturbances are characterized by a client's lack of response to information coming from the left side of the body. This phenomenon is exhibited in the drawings of individuals with mild RHBD who may omit all or provide few left-side details. Figure 6.9 shows an example of left-side neglect in a drawing. More severely impaired individuals may even refuse to look to the left side (in front of themselves).

Visuospatial deficits may include poor visual discrimination and poor scanning and tracking. The client may have difficulty recognizing familiar faces, remembering familiar routes, and reading maps. Some clients fail to recognize family members.

Data from ASHA's National Outcomes Measurement System (NOMS) reveal that individuals with RHBD resulting from stroke are treated for difficulties in swallowing (52%), memory (41%), and problem solving (40%). Intervention for disorders of expression (22%), comprehension (23%), and pragmatics (5%) occurs far less frequently (ASHA, 2008). These low percentages of treatment may be due, in part, to the difficulty in identifying right hemisphere communication impairments, to the few available assessment tools available, and to lack of clarity regarding the types of communication intervention available (Lehman Blake et al., 2013).

The communication deficits associated with RHBD affect the exchange of communicative intent through nonlinguistic and paralinguistic as well as

About half of the individuals with RHBD have communication impairments.

Figure 6.9 Drawings of an individual with mild RHBD that demonstrate left-side neglect.
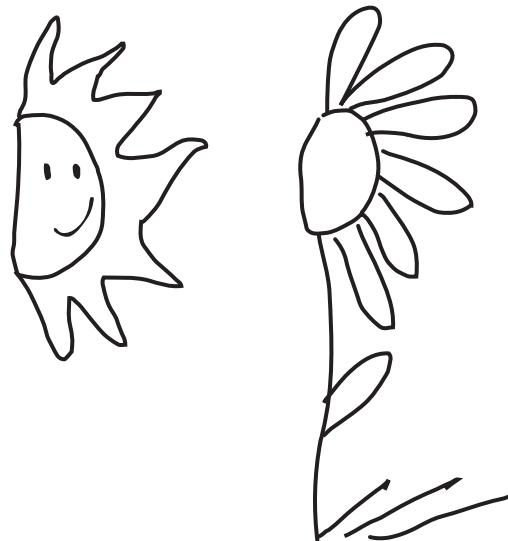
linguistic means. Facial expression, body language, and *prosody* (intonation) are all nonverbal means of conveying intent. Intent can also be conveyed by words, sentences, and *discourse*, which is two or more sentences organized to convey information.

Clients with RHBD may exhibit poor auditory and visual comprehension of complex information and limited word discrimination and visual word recognition. When we interpret a word or sentence, we activate a web of meanings and categories, some closely related to the word and others more distant. The word *banana* might activate closely related terms such as *tropical fruit* but less closely relates ones such *slippery.* The right hemisphere is important for activation of distant word and sentence meanings. It is believed that those with RHBD have reduced activation that affects their conversational (Tompkins et al., 2008, 2013).

Many words have multiple meanings. It's believed that all the multiple meanings of a word are activated when that word is heard or read but that the brain quickly inhibits meanings that do not fit the context. When we hear about a *bridal train*, we suppress meanings related to railroads. An individual with RHBD is slower in suppressing those meanings, making him or her less inefficient in interpreting conversations (Tompkins et al., 2000, 2013).

Of the various aspects of language, pragmatics, or the functional use of language in context, seems to be the most impaired (Myers, 2001). For example, topic maintenance, appreciation of the communication situation, and determination of listener needs are affected. In general, the expressive language of individuals with RHBD is characterized as tangential to the topic and more egocentric. There are also extremes of verbosity or paucity of speech (Lehman Blake, 2006). Contextual cues such as familiarity with the communication partner, social status of speaker and partner, or use of a specific speaking style, may be missed or ignored (Blake, 2007; Ferré et al., 2011).

Sentence and discourse deficits can affect efficiency and effectiveness of both comprehension and production (Myers, 2001). Discourse is frequently described as disorganized, tangential, and overpersonalized (Blake, 2006; Myers, 2001).

Comprehension deficits include misinterpretation of intended meaning, which is related to difficulties using contextual cues, and generation of inferences or links between sentences. This can also include deficits in comprehension of nonliteral language, including metaphors, idioms such as *hit the roof,* humor, sarcasm, and indirect requests such as "Is it chilly in here?" It is unclear whether such a difficulty is due to an underlying deficit in nonliteral language processing or a deficit in the use of nonlinguistic and contextual cues.

The problem may also stem from generating too many meanings and being unable to select the one appropriate for the context (Blake, 2009; Blake & Lesniewicz, 2005; Tompkins et al., 2000, 2001; 2004). A listener's failure to suppress irrelevant or inappropriate information affects comprehension (Tompkins et al., 2000).

Clients with RHBD exhibit poor judgment in determining which incoming information is important and which is not. A similar pattern of difficulty with selectivity is noted in expressive use of language. Clients may include unnecessary, irrelevant, repetitious, and unrelated information, seemingly unable to organize their language in meaningful ways or to present it efficiently. Other problem areas include naming, repetition, and writing, especially letter substitutions and omissions.

Paralinguistic deficits include difficulty comprehending and producing emotional language. The speech of individuals with RHBD lacks normal rhythm or prosody and the emphasis used to express joy or sadness, anger or delight. Called *aprosodia,* it is the reduced ability or inability to produce or comprehend affective aspects of language (Baum & Dwivedi, 2003; Pell, 2006). Speech production may sound "flat," or monotone.

For a succinct and well-informed list of the characteristics of RHBD, go to Professor Patrick McCaffrey's page at the California State University at Chico website (www.csuchico.edu/~pmccaffrey/). Click on "CMSD 636" and then scroll down to "Chapter 11," which offers a detailed description of the characteristics and diagnosis of RHBD.

Click here to check your understanding of the concepts in this section.

Assessment

As with aphasia, the assessment of individuals with RHBD is a team effort involving many of the same professionals and diagnostic tasks. An SLP is interested in visual scanning and tracking, auditory and visual comprehension of words and sentences, direction following, response to emotion, naming and describing pictures, and writing. For example, an SLP may ask a client to re-create patterns with blocks or to find two objects or pictures that are the same; to recall words or sentences heard, seen in print, or both; and to describe a picture accurately enough for the SLP to re-create it. Sampling and observational data are essential in assessing the client's pragmatic abilities in conversational contexts.

Portions of aphasia batteries, standardized tests for RHBD, and nonstandardized procedures may be used in the assessment. Nonstandard procedures include interviewing, observation, and ratings of the client's behavior, along with testing of communication.

Intervention

Intervention often begins with visual and auditory recognition. These skills are essential before progressing to more complex tasks, such as naming, describing, reading, and writing. Self-monitoring and paralinguistics are introduced, and the complexity of the content is gradually increased. Despite increasing knowledge about the deficits of individuals with RHBD, knowledge about how to treat them is limited (Lehman Blake, 2007). What we do know is presented in Box 6.2.

Because of the diffuse effects on behavior seen in RHBD, we know less about the treatment of these patients.

For clients with expressive aprosodia, SLPs may use several methods. In imitative treatment, a client repeats a sentence in unison with the SLP in response to a question. Another approach, called cognitive-linguistic treatment, uses various cues to modify the client's prosody, or the rhythm, stress, and intonation of speech. These include use of an emotion label such as happy or angry, a description of the prosodic characteristics for conveying that emotion, and a facial picture depicting the emotion. When the client is successful, the cues are systematically removed.

In order to interpret nonliteral or figurative language, such as "home is where the heart is," an individual must be able to combine the literal meaning of the words *home* and *heart* with the metaphorical sense of these words. For example, *heart* is used to signify a warm, comforting feeling, as is *home*. In a semantic intervention approach, word meanings and connotations are mapped

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BOX 6.2 | **Evidence-Based Practice for Individuals with Right Hemisphere Brain Damage**

General

- Cognitive rehabilitation intervention has positive effects on attention, functional communication, memory, and problem solving.
- Approximately 70% to 80% of clients who receive SLP intervention services make significant measurable improvements in communication.
- Communication intervention services as part of a broader interdisciplinary approach including physical, emotional, vocational, and communication, plus family education and support, resulted in greater independence in daily living and return to modified work programs.
- Despite promise, treatment studies have been few and have included a relatively small number of participants.

Specific Interventions at the Sentence and Conversational Level

- In interventions for aprosodia or difficulty expressing emotion through intonation, both imitation and cognitive-linguistic treatment show promise.

- In interventions for receptive language, techniques that provide pre-stimulation of word meanings prior to interpretation show promise, although generalization data are still lacking.
- The use of narratives to improve organization of conversations has mixed results on very limited data.
- Pragmatic intervention, whether a social skills–based treatment using a combination of videotaped feedback, modeling, coaching, and rehearsal strategies or an auditory stimulation approach to enhance attending and attentional control, has mixed results.

Source: Based on Lehman Blake et al. (2013) and Lehman Blake & Tompkins (2008).

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using spider diagrams and the two words connected in this way (Lundgren et al., 2011).

Intervention for activating meanings and for suppression of noncontextual ones can be accomplished through a technique called *contextual pre-stimulation*. In this method, still in its infancy, a client is given sentences to activate different meanings prior to being given a word. For example, the client might hear "He slipped and fell on the floor" before being asked to connect *banana* with *slippery* (Tompkins et al., 2011).

Clients are helped to respond appropriately to common communicative initiations and to track increasingly complex information in conversations. Beginning with questions from the SLP that require precise information, the client learns to make responses that come to the point. These questions become more open-ended as the client learns to make off-topic responses less frequently. Similarly, time restraints may limit conversational turns to keep the client from rambling.

Sequencing tasks and explanations of common multistep actions, such as making coffee, will be introduced to help the client organize linguistic content and make relevant contributions. Cues such as objects or pictures may be used initially to aid organization.

Finally, within conversations, an SLP will help a client synthesize these many skills. Visual and verbal cues may aid in turn-taking. Important nonlinguistic

markers such as eye contact, body language, and gestures may be targeted. Topic maintenance and relevant conversational contributions are stressed.

Thought Question

TRAUMATIC BRAIN INJURY (TBI)

A traumatic brain injury (TBI) is a disruption in the normal functioning caused by a blow or jolt to the head or a penetrating head injury. The leading causes of TBI are falls (28%), motor vehicle/traffic crashes (20%), other blows to the head, often from sports (19%), and assaults (11%) (National Center for Injury Prevention and Control, 2009). Falls mostly affect the very young and the very old. The two age groups at highest risk for TBI are 0- to 4-year-olds and 15- to 19-year-olds. The increase in use of motor vehicles, motorcycles, and off-road vehicles is directly related to the increase in TBI among teens and young adults. Another disturbing increase is the rise in attempted homicides and gun-related injuries, especially in urban areas. The authors have seen adult clients with TBI resulting from automobile, motorcycle, and bicycle collisions; falls; violent crime; and failed suicide attempts involving firearms.

Annually, approximately 1.4 million people sustain TBI in the United States (National Center for Injury Prevention and Control, 2009). Most are treated in emergency rooms and released, but 50,000 die, and 235,000 require longer hospitalization. Motor vehicle accidents result in the greatest number of hospitalizations. The number of people with TBI who do not seek medical treatment or care is unknown. It's estimated that as a result of TBI, at least 5.3 million Americans—approximately 2% of the U.S. population—currently have a long-term or lifelong need for help performing daily living activities. Males are about twice as likely as females to sustain a TBI.

The statistics tell a chilling story but do not begin to explain the pain and suffering or the long struggle to recover. Case Study 6.3 presents the personal story of one young man with TBI. For further information it is suggested that you check the National Institute of Neurological Disorders and Stroke website.

You will recall from our discussion of language disorders in children that, unlike stroke, which injures a specific area of the brain, TBI is a diffuse injury to the entire brain; it is nonfocused. Damage may result from:

- Bruising and laceration of the brain caused by forceful contact with the relatively rough inner surfaces of the skull
- Secondary **edema**, or swelling due to increased fluid, which can lead to increased pressure
- Infection
- Hypoxia (oxygen deprivation)
- Intracranial pressure from tissue swelling
- **Infarction**, or death of tissue deprived of blood supply
- **Hematoma**, or focal bleeding

Aphasia-like symptoms are rare, but linguistic impairments related to cognitive damage are not. In addition, an individual with TBI may have sensory, motor, behavioral, and affective disabilities. Neuromuscular impairments may include seizures, hemisensory impairment, and hemiparesis or hemiplegia. The symptoms and the life changes that result can be profound.

CASE STUDY 6.3

Personal Story of a Young Man with TBI

His family called him Felipe, but he preferred to use the more Americanized nickname "Chip" that his friends had given him. He was excited to be leaving home for college. Thoughts of being on his own thrilled him with endless possibilities. Even though he was only a freshman, he planned to live with some older friends in their off-campus apartment.

A few weeks after school began, Felipe decided to hitchhike home to surprise his mother, who missed him a great deal. He stuck out his thumb early on Friday afternoon but never made it home. After his first ride, he bought a soda and began to thumb anew. Shortly afterward, he was struck in the head by the mirror on a pickup truck. Luckily, Felipe was carrying identification in his backpack, and his family was alerted shortly after he was admitted to the hospital.

When he regained consciousness, a few hours after the accident, Felipe was extremely disoriented. He made no attempt to speak and was very lethargic. Although he seemed to recognize his family, he made no attempt to communicate with them. Over the next few weeks, his condition slowly stabilized. Physicians were initially concerned about swelling in the area of the injury. There was evidence of some internal bleeding, but it was not a major problem.

Once the swelling began to recede, Felipe's abilities slowly returned. He began to recall the names of family members and common objects. Walking was extremely difficult because of paralysis on the right side of his body. He dropped out of college and remained at home, where he received intervention services. As an outpatient, he was seen by a speech-language pathologist, a physical therapist, and an occupational therapist.

After a year's absence from school, Felipe returned and was able to be successful with some adaptations, such as the use of a tape recorder and extra time for completing written tests. He retains a slight limp in his right leg and some minimal weakness in his right arm. His language and speech skills have returned, although he has some mild word-finding difficulties. His cognitive abilities are more concrete than those he had before the accident, and problem-solving tasks require greater effort. All indications are that he will be successful in his academic pursuits, although his physical and cognitive limitations will continue to affect him.

Characteristics

Adults with TBI are a heterogeneous group with a diverse collection of physical, cognitive, communicative, and psychosocial deficits. Usually, the most devastating aspect is an inability to resume interests and daily living tasks to the level that existed before the injury. Some clients exhibit nearly total dependence on others. Cognitive difficulties may be evident in orientation, memory, attention, reasoning and problem solving, and executive function, which is the planning, execution, and self-monitoring of goal-directed behavior.

Language is affected in three of four individuals with TBI. The two most commonly reported symptoms for TBI are anomia and impaired comprehension.

As with children, the most disturbed language area and that with the most pervasive problems is pragmatics. Most published tests target language form and content and may miss pragmatic deficits that are evident in conversation. Pragmatic impairments result from the inability to inhibit behavior and from errors of judgment. The result may be rambling speech and incoherence, as manifested by off-topic and irrelevant comments and inability to maintain a topic, as well as by poor turn-taking skills, such as frequent interruption of others. In addition, communication may be marked by poor affective or emotional language abilities and inappropriate laughter and swearing.

Deficits are not limited to language and may include speech, voice, and swallowing difficulties. Approximately a third of all individuals with TBI exhibit dysarthria, a disorder resulting from weakness or incoordination of the muscles that control speech production (see Chapter 10). Language deficits reflect underlying disruptions in information-processing, problem-solving, and reasoning abilities. In addition, psychosocial and personality changes may include disinhibition or impulsivity, poor organization and social judgment, and either withdrawal or aggressiveness. Physical signs may include difficulty walking, poor coordination, and vision problems. A more complete list of the possible outcomes of TBI is presented in Figure 6.10.

Severity seems to be related to initial levels of consciousness and posttraumatic amnesia. Consciousness levels can be classified along a continuum from extended states of unconsciousness or coma, in which the body responds only minimally to external stimuli, to consciousness with disorientation, stupor, and lethargy. Amnesia, or memory loss, is a frequent result of TBI. The duration of both coma and amnesia has been used successfully, but not infallibly, as predictors of severity and prognosis. In general, the shorter both are, the less severe the resultant deficits of TBI and the better the potential outcome.

Lifespan Issues

Most adults with TBI are young and have experienced an auto or motorcycle accident. Imagine that you, a college student, are riding in a friend's car. The next thing you remember is waking in the hospital, dazed, disoriented, and unaware

Figure 6.10 Possible outcomes of TBI.

Cognition	*Emotion/Personality*
Inattentive	Aggression/withdrawal
Disoriented	Apathy and indifference
Poor memory	Denial
Poor problem-solving abilities	Depression
Language, Speech, and Oral Mechanism	Disinhibition and impulsivity
Dysphagia	Impatience
Dysarthria	Phobias
Possible mutism	Socially inappropriate behavior and comments
Pragmatic difficulties (talks better than can communicate)	Suspiciousness and anxiety
Confused language—irrelevance, confabulation or casual unfocused chatting, circumlocution, off-topic comments, lack of logical sequencing, and misnaming	

of your surroundings. You may have language or other impairments that will change your life forever or at least for the immediate future.

Several stages of recovery exist, and clinical intervention varies with each. Most individuals will not reach full recovery, and some residual deficits will most likely remain. Initially, the individual may be nonresponsive to stimuli and may need total assistance in a hospital setting.

When the individual does begin to respond, his or her behavior may not reflect the varying nature of the stimuli. In other words, the patient may persist with a response although the situation has changed. Responses may be delayed. Vocalizations may seem purposeless.

Gradually, the individual begins to respond differently to different stimuli and to recognize familiar individuals. Response to commands is still often inconsistent.

As the client becomes more alert, he or she may seem confused or agitated. Short-term memory and goal-directed behaviors may be poor. Although the client is able to sit and walk, these behaviors are performed without purpose. The client may be subject to mood swings and may have incoherent, inappropriate, or emotional language. Although the individual still needs rehabilitative hospital care, he or she has recovered enough to move from intensive care.

As agitation fades and language continues to return, the individual can remain alert for short periods of time and hold brief conversations if strong external cues, such as pictures or objects, are used. There are still periods of nonpurposeful behavior. Short-term memory is still severely impaired. With structure, the patient can perform learned tasks but is still unable to learn new behaviors.

As the individual continues to improve, he or she needs less assistance. Able to attend for up to 30 minutes with redirection, the individual is aware of the appropriate responses to self, family, and basic needs, which become more goal directed. Relearned tasks exhibit some carryover to other situations, although new learning does not. Language is used appropriately only in highly familiar contexts.

Gradually, the individual becomes oriented to persons and place. Time is still confusing, and the individual demonstrates only superficial understanding of his or her condition. Usually in outpatient status, the individual is able to learn and carry over this learning to other tasks and to monitor his or her own behavior with minimal assistance. Still unable to recognize inappropriate social behavior, the client is often uncooperative, unrealistic in his or her expectations, and unaware of the needs and feelings of others.

As the individual gains more of an understanding of his or her condition and is able to plan and initiate routine tasks, frustration may build, and he or she may become depressed, argumentative, irritable, or overly dependent or independent. Living at home and possibly having returned to work, the individual may be able to concentrate for an hour even with distractions, to recall past and present events, and to learn new tasks with only minimal assistance.

Increasing abilities may not reduce the individual's low tolerance for frustration, although behavioral responses may be less. In the later stages of recovery, the individual can shift between tasks for up to 2 hours and initiate and carry out familiar tasks. Able to acknowledge his or her impairment, the client is able to consider the consequences of his or her actions and to recognize the needs and feeling of others.

Finally, the individual may be able to consistently act in a socially appropriate manner, to respond appropriately to others, and to plan, initiate, and complete both familiar and unfamiliar tasks. Periodic depression may occur, and irritability may reappear with illness, inability to perform a task, and in emotional situations.

An individual with TBI may face a long period of rehabilitation. Even those who have made a nearly full recovery will have some lingering deficits, especially in pragmatics. The authors have worked with college students with TBI who were able to gain their degrees with only minimal adaptations.

Before we move to a discussion of assessment and intervention, you might want to check out the National Institute of Neurological Disorders and Stroke website (www.ninds.nih.gov/index.htm) for a description of traumatic brain injury and links to several other useful sites. Click on "Disorders A-Z" at the left, click "T," and then scroll down to and select "Traumatic Brain Injury."

Assessment

An SLP is a member of an interdisciplinary team of rehabilitation specialists who collaborate in assessment of and intervention with persons with TBI. As such, the SLP is responsible for assessing all aspects of communication, cognitive-communicative functioning, and swallowing.

Unlike individuals with aphasia, those with TBI progress through recognizable stages of recovery. Assessment must be ongoing and varies with each stage. Neurological, psychiatric, and psychological reports will aid in the planning of both assessment and intervention. Observation can aid the SLP in deciding which areas to probe, especially in determining pragmatic deficits that may be missed in formal testing.

To date, few comprehensive tools exist for assessment of language skills in individuals with TBI. Many SLPs working with this population have compiled a series of individual tests for aspects of both language and cognition. These tests are often portions of larger test batteries. Language testing must be comprehensive. Tests that emphasize language form and content may fail to adequately assess pragmatics, thus underestimating the extent of the language impairment.

Sampling is essential because pragmatic behavior that varies across communicative contexts cannot be adequately assessed in a testing context alone. Sampling contexts should include functional activities, such as talking on the phone or grocery shopping, in natural environments, such as the home. Sampling should occur within a discourse unit, a series of related linguistic units that convey a message.

Intervention

With or without intervention, the pattern of recovery for individuals with TBI is predictable. Unlike those with focal damage such as a stroke, who progress smoothly, those with TBI recover in a plateau fashion characterized by periods of little or no change interspersed with periods of rapid improvement. After a period of unconsciousness, the person often responds indiscriminately and seemingly without purpose. Attention may be fleeting, and overall level of arousal may

fluctuate. The client is often hyperresponsive to stimuli and easily irritated and agitated. Clients may become very emotional and exhibit shouting, emotional language, and, in some cases, repetitive, stereotypic movements such as rocking. With recovery, a client's behavior becomes more purposeful, although restlessness and irritability may persist.

As the client becomes more oriented in place and time, he or she is better able to respond to simple requests, although attention span is short and distractibility high. Memory and abstract reasoning may continue to be a problem even as the client becomes better able to manage daily living and to begin to function independently.

Intervention for cognitive-communicative deficits with individuals with TBI is called **cognitive rehabilitation**, a treatment regimen designed to increase functional abilities for everyday life by improving the capacity to process incoming information. The two primary approaches are restorative and compensatory. The restorative approach attempts to rebuild neural circuitry and function through repetitive activities, while the compensatory approach concedes that some functions will not be recovered and develops alternatives. Restorative techniques might include classification tasks and word associations. In contrast, compensatory strategies to improve memory might include focused attending and rehearsal of new information. Traditionally, restorative strategies are attempted first and may include rehearsal and encoding strategies and the use of memory aids. Compensatory methods are typically used when restorative attempts have failed. Slowly, professionals are recognizing that compensatory strategies aid in restorative development, and both methods are being used simultaneously.

> Cognitive rehabilitation promotes independent functioning in daily life by focusing on specific cognitive processes such as memory and language processing.

An SLP is responsible for designing and implementing treatment programs to decrease the effects of impairment. Evidence-based practices are presented in Box 6.3. In addition to providing direct intervention, an SLP helps to identify functional supports, such as memory logs, and work adjustments that aid in successful independent living.

Intervention programs vary depending on the stage of recovery. During the early stages, intervention focuses on orientation, sensorimotor stimulation, and recognition of familiar people and common objects and events. Early intervention results in shorter rehabilitation and higher levels of cognitive functioning.

BOX 6.3 | **Evidence-Based Practice for Individuals with Traumatic Brain Injury**

General

- The most effective interventions are those that are tailored to the individual client's unique needs and situation. Those receiving communication intervention make gains in cognitive communication, activities, and social participation.
- Those receiving communication services are discharged with higher levels of cognitive functioning and in greater percentages to home versus long-term care.
- More than 80% of clients with TBI make significant measureable gains in memory, attention, and pragmatics.

Source: Based on Coelho et al. (2008).

In the middle stages, training becomes more structured and formal. The goals are to reduce confusion and improve memory and goal-directed behavior. Much of the training involves increasing the client's orientation to the everyday world. Consistency and routines are important in orientation training. An SLP may target active listening and auditory comprehension and following directions with increasingly more complex information. Word definitions, descriptions of entities and events, and classification of objects and words are also targeted. Conversational speech training is also attempted. For example, one SLP, recognizing that the act of taking a conversational turn is too difficult for some clients, begins by using an object that is passed back and forth to signal turn changes. Over time, the object is replaced with subtle nonverbal signals, such as eye contact.

During the late stages of recovery, the goal is client independence. Targets include comprehension of complex information and directions and conversational and social skills. An SLP helps a client to explore alternative strategies for word recall, memory, and problem solving. Conversational problem-solving tasks are also targeted, along with self-inhibition and self-monitoring. Real-world contexts are emphasized, especially those that are potentially confusing or emotional.

DEMENTIA

We live in a youth-oriented culture. Commercial images lead to the stereotype of older people with deteriorated bodies and minds. Although physical decline with age is inevitable, intellectual capacity is frequently unimpaired. Fewer than 15% of elderly people experience dementia, and as many as 20% of these positively respond to treatment (Shekim, 1990). The incidence of dementia is increasing rapidly as the percentage of the U.S. population over age 65 increases. It is estimated that as many as 48% of new admissions to long-term care facilities have a diagnosis of dementia (Magaziner et al., 2000).

Dementia is an impairment of intellect and cognition.

Dementia is an umbrella term for a group of both pathological conditions and syndromes that result in declining of memory and at least one other cognitive ability that is significant enough to interfere with daily life activities (American Psychiatric Association [DSM-4], 1994). It is acquired and is characterized by intellectual decline due to neurogenic causes. Memory, as mentioned, is the most obvious function affected. Additional deficits include poor reasoning or judgment, impaired abstract thinking, inability to attend to relevant information, impaired communication, and personality changes. Irreversible dementia is most frequently caused by Alzheimer's disease (AD), vascular dementia, or a combination of both, referred to as mixed dementia (Ritchie & Lovenstone, 2002).

Dementia can be divided into cortical and subcortical types, based on patterns of neurophysiological impairment. The characteristics of cortical dementias, such as Alzheimer's and Pick's diseases, resemble those of focal impairments such as aphasia and RHBD. These include visuospatial deficits, memory problems, judgment and abstract thinking disturbances, and language deficits in naming, reading and writing, and auditory comprehension. Alzheimer's disease accounts for 60% to 80% of all dementia cases, or 5.3 million adults in the United States (Alzheimer's Association, 2009).

Subcortical dementias may accompany multiple sclerosis, AIDS-related encephalopathy, and Parkinson's and Huntington's diseases. A slow, progressive

deterioration of cognitive functioning occurs with deficits in memory, problem solving, language, and neuromuscular control. Disorders that involve neuromuscular functioning, such as Parkinson's, will be discussed in Chapter 7 and Chapter 10.

The language functions that most depend on memory seem to be primarily affected by dementia. Communication disorders associated with dementia progress over time and include anomia, discourse production and comprehension deficits, and, eventually, the inability to express one's self via speech and language (Bourgeois & Hickey, 2009).

A significant decline is noted in naming and word retrieval. Language form—phonology, morphology, and syntax—is generally less disordered, although syntax may be less coherent than before, as the client struggles with anomia. As a result, conversations may lack coherence and may be filled with repetitions, stereotypic utterances, false starts, verbal repairs, jargon, neologisms, and the use of phrases such as *that one* and *you know* (Shekim & LaPointe, 1984). A client would repeat "I know" several times.

For an SLP working in a health care setting, a large proportion of the caseload is individuals with dementia. Only individuals with dysphagia and aphasia are a larger portions of the caseload (ASHA, 2008).

Alzheimer's Disease

Alzheimer's is characterized by microscopic changes in the neurons of the cerebral cortex.

Alzheimer's disease (AD) is a cortical pathology that affects approximately 13% of individuals over age 65 and possibly as many as 50% of those over age 85, or approximately 4.1 million individuals in the United States (Alzheimer's Association, 2009). Given the aging U.S. population, the prevalence of Alzheimer's disease will increase 50% by 2030 unless science finds a way to slow the progression of the disease or prevent it. Although cancer and heart disease result in more direct deaths, Alzheimer's is the most expensive disease in the United States, costing families and society around $200 billion annually, most of this total spent on long-term care (Associated Press, 2013). Individuals with AD are a heterogeneous population and may be primarily impaired in memory, language, or visuospatial skills. AD is twice as common in women as in men, primarily because women tend to live longer.

The cause of AD is unknown but may be a combination of genetic and environmental factors. The neuropathology is characterized by the presence of twisted neurofilaments in the cytoplasm of neurons that deteriorate cell functioning. These tangles are most pronounced in the temporal lobe and in associational areas of the brain (see Figure 6.11). Nerve fibers degenerate, resulting in brain atrophy that may decrease brain weight as much as 20%, especially in the temporal, frontal, and parietal lobes. Other physical changes include extensive damage to the hippocampus, located on the interior portion of the temporal lobes (interior to the ears), and formation of senile plaques within the cortex that affect nerve cell interactive functioning. A variation of the APOE gene found in all humans greatly increases the likelihood of developing AD. Environmental risk factors include head trauma, heart and circulatory problems, poor overall health, and diabetes.

Mild dementia may be characterized by name recall difficulties, occasional disorientation, and memory loss. Memory problems are the most obvious

Area of atrophy and
brain weight loss

Left temporal lobe

Hippocampus
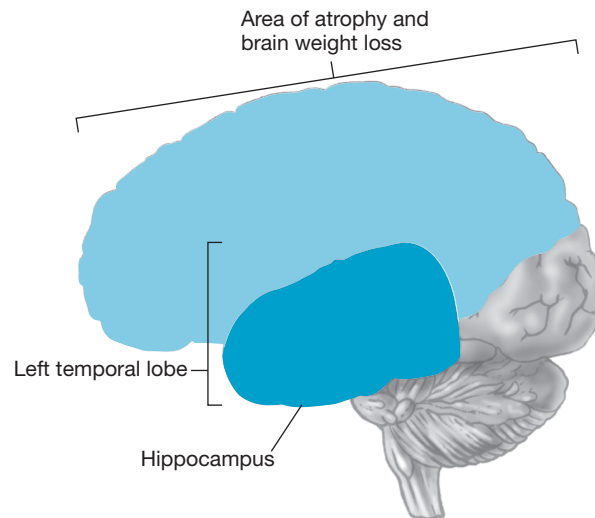
changes. Retention of newly learned information is most impaired. Long-term memory is unimpaired initially but deteriorates as the disease progresses.

Language is not affected in all individuals initially. Early problems involve word finding, off-topic comments, and comprehension. At these early stages, deficits are mostly pragmatic and semantic-conceptual in nature, and syntax is relatively unaffected compared to that of elderly individuals not affected by AD (Kavé & Levy, 2003).

Later characteristics include paraphasia (word substitution) and delayed responding. In more severe stages, expressive and receptive vocabulary and complex sentence production become reduced; pronoun confusion, topic digression, and inability to return to and to shift topic are more pronounced; and writing and reading errors occur. In the most severe form of AD, the language of individuals is characterized by naming errors and the use of generic words (*this, that*), syntactic errors, minimal comprehension, jargon, echolalia, or mutism. As might be expected, increased severity results in more conversational breakdowns.

All areas of communication, including writing, are affected. Writing impairment may arise at several different steps in the process, including planning, sequencing, and organization at the letter, word, sentence, and narrative levels (Neils-Strunjas et al., 2006). Deficits may include misspelling, poor narrative organization, content word errors, perseveration (or repetition of words or ideas), grammatical errors, and reduced syntactic complexity. Problems with writing reflect general language deficits as well as deficits in working memory, attention, and motor control.

Lifespan Issues

AD is a genetic disorder that lies in hiding, although early screening is possible in some cases. Often the person who will be afflicted with the disease is unaware and/or ignores early signs. At present there are no cures, but some early drug therapies seem to lessen the effects.

In the early stages of AD, the individual experiences memory loss, especially of new information. The individual experiences word retrieval problems and some difficulty with higher language functions, such as humor and analogies. The individual may seem indifferent and may initiate little communication. Able to live at home, the individual can become an increasing burden on an elderly spouse or on adult children who may have families of their own.

As the disease progresses, memory loss increases, with the effect that vocabulary decreases. Comprehension is reduced. Language production may be reduced to ritualistic or high-usage phrases accompanied by poor topic maintenance and repair of errors, frequent repetition and word retrieval problems, and insensitivity to conversational partners. Irritability and restlessness may increase. The individual may be able to live at home with visiting nurse care to help with daily living routines.

In the most advanced stages of the disease, all intellectual functions including memory are severely impaired, and almost all individuals reside in nursing homes. Language may be meaningless, or the individual may be mute or echolalic. Most clients cannot recall the names of loved ones and may undergo radical personality changes. Motor function is also severely impaired, and the individual needs total care.

Thought Question

Assessment

Definitive diagnosis of AD is difficult in the early stages of the disease. Use of neuroimaging techniques may help in early identification, especially for specific protein buildup in the brain (DeKosky, 2008). Pupil dilation tests may also indicate the presence of the disease in the early stages. Finally, computer-based assessments, such as the Computerized Assessment of Mild Cognitive Impairment (CAMCI), are being developed and tested. These measures usually test attention, recognition, and recall of both words and pictures.

Working as a member of a diagnostic team, an SLP usually helps identify changes in language performance that may signal intellectual deterioration and aspects of behavior amenable to change (Hopper, 2005). The results of this assessment may help differentiate AD from other neuropathologies.

Genetic history and general and neurological health data are important elements in the assessment process. Observation of the individual in different communication environments is also important. In the early stages, dementia may be confused with other disorders, such as depression. The progressive nature of the disorder makes it imperative that the SLP remain current on the changing condition and learning ability of a client.

Few language tests for this population exist. Of importance are assessment of retrieval, perceptual, and linguistic deficits and the client's ability to participate in the give-and-take of daily communication in a number of areas.

Writing assessment is important because decline in written language may precede other cognitive and spoken language deficits (Kavrie & Neils-Strunjas, 2002). Functional writing tasks, such as writing a letter, are one of the earliest affected areas of linguistic performance.

Several scales exist for rating the severity of a client's loss. Of particular importance are memory deficits. In addition, many assessment batteries that are used with individuals with aphasia can be helpful in evaluating the communication skills of persons with dementia. Detailed understanding of a client's

With dementia, language is affected by deficits in memory.

strengths and weaknesses is essential for helping family members choose the most effective communicative strategies.

Intervention

Intervention with those with progressive disorders can sometimes feel like trying to hold back the tide. Decline is inevitable, given the present state of our knowledge. However, this does not mean that we do nothing. Quite the contrary: Clinical intervention by an SLP can help maintain the client at her or his highest level of performance and help others maximize the client's participation in conversational interactions. It is imperative, therefore, that an SLP emphasize the use of intact cognitive abilities to compensate for deficient ones (Hopper, 2005). The ASHA website defines the role of the SLP with clients with dementia (go to ASHA website and type "dementia" into the search box).

Various professionals use three general approaches with individuals with dementia. In *cognitive rehabilitation*, the client, health professionals, and families develop individualized goals and implement strategies based on those goals. Goals may be very basic, such as appropriately recalling a family member's name, or, in less impaired clients, reading a book to grandchildren. A second approach, *cognitive training*, is used to denote structured practice to improve specific cognitive functions, such as attention, memory, and executive functions. Tasks might include memorizing a grocery list or attending to a prerecorded conversation for a short period. Finally, a third intervention method, called *cognitive stimulation*, is less direct. Usually conducted in groups, cognitive stimulation is concerned with general enhancement of cognitive and social functioning and might involve relaxation exercises or music therapy.

With no cure for dementia on the immediate horizon, much research and intervention has focused on nonpharmacological therapies to lessen the symptoms of dementia and to improve the quality of life for individuals with dementia and for their caregivers. A wide range of nonpharmacological therapies are used to treat dementia or mild cognitive impairment (MCI). These include direct interventions focused on the person with dementia, such as computer-assisted cognitive interventions, Montessori-based interventions, reminiscence therapy, errorless learning (EL), simulated presence therapy, Spaced-Retrieval (SR), and vanishing cues (VC), as well as indirect interventions for use with caregivers, such as caregiver-administered cognitive stimulation and caregiver education in communication strategies (Olazarán et al., 2010). While it isn't possible to discuss all these methods in detail, we'll try to give you a taste of many of them. Today's best evidence on effectiveness in presented in Box 6.4.

Many intervention methods involve the use of cues or prompts to elicit the correct behavior, such as a request for a desired item or for assistance, names, and events. In errorless learning (EL), a memory intervention technique, SLPs use cues or instructions to prevent or reduce the likelihood of individuals making mistakes (Clare & Jones, 2008). In this way, desired information is accessed and, presumably, the neural pathway to that information is enhanced. As a client progresses, the SLP may use vanishing cues (VC), a technique in which cues or prompts are gradually decreased one at a time, following each successful recall trial. In a variation of VC, cues may be withheld and then added one at a time following an incorrect response. When a correct response is achieved, the cues are faded (Sohlberg et al., 2005). Finally, with spaced-retrieval (SR), the prompted recall of a response occurs at spaced or delayed intervals.

BOX 6.4 | **Evidence-Based Practice for Individuals with Dementia**

Guidelines

- Although evidence is limited for individuals with moderately severe and severe dementia, those with mild and mildly moderate to moderate cognitive decline may be able to learn and relearn facts and procedures using specific cognitive intervention strategies.
- Spaced Retrieval, errorless learning, vanishing cues, and specific cueing are promising techniques, although more research is needed.
- Intervention tasks should be as functional as possible and should include ecologically valid facts and procedures.

- Although improvement on trained items may be expected, carryover and long-term maintenance of facts and procedures may be limited unless there is additional intervention.
- Improvement in general cognitive functioning should not be expected from intervention on specific cognitive tasks and information.
- SLPs should consider ethnic, cultural, linguistic, and educational factors when making prognostic statements about learning outcomes.

Source: Information taken from Hopper et al. (2013).

Appropriate and effective intervention requires that the SLP understand what the family of the client is experiencing.

Intervention is not undertaken in isolation. As in the other disorders discussed in this chapter, an SLP is a member of a team. Professionals consult with one another and with the client and family on the best course of action.

An SLP may target memory or word retrieval by working on word associations and categories; auditory attending and comprehension in conversational contexts; coherent verbal responses; and formation of longer, more complex utterances with the help of memory aids. Family members can help to keep conversations focused on the present, to validate the client's comments, to reduce distractions and limit the number of participants, and to foster comprehension and participation by slowing the rate and decreasing the complexity of their utterances, using nonlinguistic cues and yes/no response questions (Small & Perry, 2005). Interactive strategies that result in the least communication breakdown include eliminating distractions, speaking in simple sentences, and using yes/no questions. Relatively intact reading and visual memory can be used to facilitate verbal memory (Hopper, 2005).

New drug and gene therapies and bioengineering techniques hold the promise that many of the diseases that cause dementia may one day be controllable. At present, intervention that stimulates cognitive processes combined with pharmacological approaches that increase certain neural chemicals important for memory is best. Stem cells may also be used to someday regenerate brain tissue.

✔ Click here to check your understanding of the concepts in this section.

SUMMARY

Aphasia, right hemisphere brain damage (RHBD), traumatic brain damage (TBI), and dementia result in very different types of language impairment. Aphasia, which results from a focal brain injury, most likely a stroke, may result in a wide

variety of impairments that may affect one or more modalities of communication; comprehension, speech, and naming are usually impaired. Stroke is also the primary cause of RHBD. Comprehension and production of paralinguistics and complex linguistic structures are affected. Pragmatics is the most affected aspect of language. This is also true for traumatic brain injury, which, in contrast to aphasia and RHBD, is a diffuse injury rather than a focal injury. Finally, dementia, particularly dementia caused by Alzheimer's disease, is a degenerative disease. Word-finding difficulties, off-topic comments, and comprehension deficits are the most common characteristics.

In the adult language impairments discussed, a speech-language pathologist (SLP) functions as a member of a multidisciplinary collaborative team. The role of the SLP includes assessment of communicative abilities and the implications of other cognitive deficits, swallowing, and associated neurological disorders. SLP responsibilities include treatment planning and programming, direct intervention services, interdisciplinary consultation, and family training and counseling. Intervention usually focuses on retrieval of language skills and on compensatory strategies.

SUGGESTED READINGS

Brookshire, R. H. (2007). *Introduction to neurogenic communication disorders* (7th ed.). Boston: Elsevier.

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7

Stuttered Speech

CHAPTER LEARNING GOALS

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

- Describe differences between fluent and stuttered speech

- Describe the onset and development of stuttering

- Describe the major etiological theories and conceptual models of stuttering

- Describe the important components involved in the evaluation of stuttering

- Describe evidence-based treatment approaches and techniques that are effective for children and adults who stutter

F luent speech is the consistent ability to move the speech production apparatus in an effortless, smooth, and rapid manner, resulting in a continuous, uninterrupted forward flow of speech. Several conditions that adversely affect speech and language production can also disrupt the fluency of speech. Dysarthria, apraxia, cerebral palsy, and some forms of aphasia affect the fluency of speech. These disorders and their effects on speech and language production are discussed in Chapters 6 and 10 of this book. The focus of this chapter is on a disorder of speech called *developmental stuttering*. Developmental stuttering, or simply *stuttering,* primarily influences the speaker's ability to produce fluent speech. Stuttered speech is characterized by involuntary repetitions of sounds and syllables (e.g., *b-b-b-ball*), sound prolongations (e.g., *mmmmm-mommy*), and broken words (e.g., *b—oy*). All three of these interruptions are considered to be stuttering behaviors, and they have a negative impact on a speaker's ability to produce fluent speech. Case Study 7.1 provides an example of a young child with developmental stuttering.

In this chapter, we define stuttering and discuss how stuttering begins and develops as a disorder, paying particular attention to how stuttered speech differs from fluent speech. Consideration is given to some of the major theories

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CASE STUDY 7.1

Case Study of a Child with Stuttering: Tamara

Mrs. Fisher brought her 4-year-old daughter, Tamara, to the speech and hearing clinic at a nearby university. In an interview with the clinic's director, Mrs. Fisher explained that when Tamara was about 3½ years old, she had trouble starting to speak because she repeated the first sounds and syllables at the beginning of each utterance, like *C-c-c-can I have some ice cream?* or *Ba-ba-ba-ba-baseball is boring*. This difficulty lasted about 2 weeks, and then it went away as abruptly as it had begun. Tamara's speech was free of such disruptions for the next 6 months. Mrs. Fisher further explained that about 2 weeks prior to her visit to the clinic, Tamara's speech interruptions reappeared. She showed great concern when she told the clinic director that in addition to repeating sounds and syllables at the beginning of utterances, she was holding or prolonging sounds at numerous places in her utterances, like *I-l-l-l want to sssssssssit over there*.

The clinic director observed Mrs. Fisher and her daughter interacting with one another in an adjoining room via a one-way mirror. The clinic director observed that Mrs. Fisher spoke at a very rapid rate and that she tended to use complex sentence structures when she spoke to her daughter. A formal evaluation of Tamara's speech revealed that she produced an average of 15 instances of stuttering per 100 words spoken, she would frequently lose eye contact with the examiner, and she scored 30 points on the Stuttering Prediction Instrument. Based on these findings, it was recommended that Tamara be seen for direct treatment two times per week and that Mrs. Fisher be given instruction regarding reducing her speaking rate and sentence complexity.

Following 4 months of the start of direct intervention and parental instruction, Tamara's disfluent behaviors were markedly reduced, falling well within the average range. In addition, Tamara's mother had learned to slow her speaking rate and speak in relatively simple sentence structure when she conversed with her daughter.

As you read this chapter, think about:

- The nature of the speech interruptions Tamara had developed
- The developmental course of Tamara's disfluent behaviors
- Why the clinic director recommended direct intervention for Tamara and instruction for her mother to reduce her speaking rate and linguistic complexity

regarding stuttering, the clinical diagnosis of stuttering, and, finally, evidence-based treatment practices.

The cause of stuttering remains elusive, and our understanding of stuttering is incomplete, despite its long and diverse history. Stuttering has been part of the human condition for all recorded time. Clay tablets found in Mesopotamia dating from centuries before the birth of Christ record the disorder, hieroglyphics from the 20th century B.C. depict stuttering, and poems written in China more than 2,500 years ago allude to stuttering (Van Riper, 1992). Stuttering affects people worldwide. Physicist Sir Isaac Newton, author W. Somerset Maugham (*Of Human Bondage*), and statesman Winston Churchill stuttered. Performers James Earl Jones, Carly Simon, Marilyn Monroe, and Bruce Willis stuttered. Stuttering is insensitive to race, creed, color, intellect, and virtually any other attribute that could be used to distinguish one human being from another.

The number of adults who report that they have stuttered at some time in their life is 5% (Andrews et al., 1983; Conture & Guitar, 1993). However, this 5% incidence rate includes the high percentage of children who naturally recover from the disorder before the age of 6 (Conture, 1996). Relatively new information indicates that 65% to 75% of children will recover from stuttering within the first 2 years after its onset, and 85% will recover within the next few years. Given a recovery rate of about 85% (i.e., more than 4 of 5 children), the 5% lifetime incidence percentage reduces down to about a 1% incidence (Conture, 1996; Yairi & Ambrose, 1992a, 2004; Yairi et al., 1993). It is not well understood why some children naturally recover from stuttering and others do not. For example, females appear to recover from stuttering more frequently than males.

The prevalence of stuttering is determined by ascertaining the number of cases in a given population (usually school-age children) during a given period of time. Research findings of many studies conducted in various regions around the United States suggest an average prevalence rate of 0.97% for school-age children (Bloodstein, 1995). This figure is consistent with the 1% incidence estimate and with prevalence estimates from European and Middle Eastern countries. The prevalence of stuttering is stable from first grade to the ninth grade, with a precipitous decline in stuttering during grades 10, 11, and 12.

Stuttering affects more males than females, the reported sex ratio differences ranging from 2.3 to 1 to 3.0 to 1. This difference has been attributed to differences in the physical maturation rates of boys and girls and to differences in speech and language development, but genetic factors may also be involved.

Stuttering has a high degree of familial incidence. Fifty percent of people who stutter report that they have a relative who stuttered at some time in his or her life. Fifteen percent of first-degree relatives (parents, sisters, and brothers) of people who stutter are current or recovered stutterers. This threefold increase over the reported 5% lifetime incidence for the general population is genetically significant (Felsenfeld, 1997; Felsenfeld et al., 2000; Kidd, 1984). In addition, if one twin stutters, there is a high probability that the other twin will stutter, and the rate of concordance (both twins exhibiting the disorder) is higher for monozygotic twins (genetically identical) than for dizygotic (fraternal) twins.

Recent genetic research has indicated that stuttering may be linked to genetic mutations on chromosomes 3 and 12 (Rowden-Racette, 2012). Continued genetic research will ultimately play a role in our understanding of stuttering and may potentially impact the way speech-language pathologists (SLPs) treat stuttering.

FLUENT SPEECH VS. STUTTERING

Anyone who has listened carefully to a young child speak can attest to the fact that the flow of most children's speech is not continuously forward and uninterrupted. Children exhibit many hesitations, revisions, and interruptions in their utterances. Children are not born as fluent speakers. Fluency requires some degree of physical maturation and language experience, but it does not develop linearly as the child matures. Longitudinal research indicates that children around 25 months of age are more fluent than they will be at 29 months and at 37 months of age (Yairi, 1981, 1982). There is a gradual increase in disfluent speech behaviors beginning around 2 years of age that peaks around the third birthday. Fluency then improves after age 3, and the types of disfluency change.

Normal Disfluencies

The type of disfluency exhibited by a normally developing child changes between the ages of 25 and 37 months. At approximately 2 years of age, typical disfluencies are whole-word repetitions (*I-I-I want a cookie*), interjections (*Can we-uhm-go now?*), and syllable repetitions (*I like ba-baseball*). Revisions such as *He can't–he won't play baseball* are the dominant disfluency type when the child is approximately 3 years old (Yairi, 1982). Normal disfluencies persist throughout the course of one's life, but they do not tend to adversely affect the continuous forward flow of speech. Normally fluent speakers frequently interrupt the forward flow of speech by repeating whole multisyllablic words (*I really-really like hockey*), interjecting a word or phrase (*He will, uhhhhh, you know, not like that idea*), repeating a phrase (*Will you, will you please stop that*), or revising a sentence (*She can't–She didn't do that*).

Stuttered Disfluencies

What is stuttering? How is it different from normally fluent and normally disfluent speech? These are not simple questions, and there are no simple answers. Consider the words of English literary genius Samuel Johnson (1709–1784), when he mused about poetry: "Sir, what is poetry? Why, sir, it is much easier to say what it is not" (Gregory, 1981, p. 416). We might say the same about stuttering.

The issue of what stuttering is and how to define it lies at the center of some unresolved issues (Ingham & Cordes, 1997). Can clinicians determine reliably whether and when stuttering has occurred? Do normal disfluencies and stuttered disfluencies lie along the same continuum, or are they categorically different behavioral events? There are no absolute answers to these questions. At present, no universally accepted definition of stuttering exists. However, a reasonable framework from which one can begin to distinguish between normal disfluencies and those that are likely to be regarded as stuttered disfluencies has been proposed.

Specifically, stuttering or stuttered speech involves audible or silent repetitions and prolongations (Andrews et al., 1983). Tense pauses and hesitations within and between words may also be regarded as stuttering. Within-word and some between-word disfluencies are believed to be the cardinal, universal features

of stuttering (see Table 7.1 for specific examples). Visit the Stuttering Foundation website (www.stutteringhelp.org) to see videos of children and adolescence who stutter. Type "videos" into the search engine at the bottom of this webpage to access a complete list of available videos.

In young children, there continues to be some debate about when speech disfluencies constitute stuttering behaviors. Some studies have shown that children who are considered to be stutterers produce many more part-word repetitions and prolongations than do children who are considered to be nonstutterers. Other studies have found that children presenting with the same type and severity of disfluencies were considered to be nonstutterers. These conflicting findings may relate to the notion of a "perceptual threshold" for stuttering (Martin & Haroldson, 1981). Disfluencies that are likely to be regarded as instances of stuttering include monosyllabic whole-word repetitions (*he-he-he-he-hit me*), sound repetitions (*p-p-p-p-p*ail), syllable repetitions (*ba-ba-ba-ba-baseball*), audible prolongations (*sssssss-snow*), and inaudible prolongations (*g----irl*).

More than one type of within-word disfluency may be present in a given disruption that interferes with the forward flow of speech. Consider the following disfluent production of the word *mommy* that contains elements of both sound repetition and an audible prolongation: *m-m-m-mmmommy* (Yaruss, 1997). Such productions, called "clustered disfluencies," are quite common in the speech of young children who stutter. Some researchers have suggested that the presence of clustered disfluencies may indicate incipient stuttering (stuttering that is just beginning) and that these disfluencies may help to differentiate children who stutter from children who do not stutter.

TABLE 7.1

Types of within-word (stuttered) and between-word (normal) speech disfluencies

Disfluency Type	Within-Word	Between-Word	Examples
Sound/syllable repetitions	X		*He's a b-b-b-boy.* *G-g-g-g-go away.* *Yes, puh-puh-please.*
Sound prolongation	X		*Sssssssee me swing!* *T—oronto is cool.*
Broken word	X		*Base-(pause)-ball.*
Monosyllablic whole-word repetitions	X	X	*I-I-I-hit the ball.* *It's my-my-my-turn.*
Multisyllabic whole-word repetitions		X	*I'm going-going home.*
Phrase repetition/ interjection		X	*She hit–she hit me.*
			I like, uh, ya know, big boats.
Revisions		X	*He went, he came back.*

Source: Based on Conture (1990b).

Other behaviors may accompany instances of speech disfluency. Such behaviors that occur concomitantly with stuttered disfluencies are called *secondary characteristics,* or accessory behaviors, and are widely varied and idiosyncratic. Some common secondary characteristics include blinking of the eyes; facial grimacing; facial tension; and exaggerated movements of the head, shoulders, and arms. Interjected speech fragments that are superfluous to the utterance are also considered to be secondary characteristics, particularly when they occur in conjunction with a moment of disfluency. An example of an interjected speech fragment is the superfluous phrase *that is to say* in the utterance *I met her in T-T-T-T, that is to say, I met her in Toronto.*

The speaker may have adopted these behaviors in an effort to reduce instances of stuttering (Bloodstein, 1995). The person who stutters discovers through trial and error that some action (e.g., bodily movements) momentarily distracts from the act of speaking and that action appears to help terminate or avoid an instance of stuttering. Behaviors such as eye blinking, however, soon lose their apparent power to reduce stuttering, and the individual is forced to replace the ineffective behavior with a new behavior, such as shrugging the shoulders, to reduce stuttering. Unfortunately, the eye blinking behavior may have become so strongly habituated that it will remain permanently associated with a person's stuttering. How do these cardinal stuttering behaviors and secondary characteristics develop and how do they change over the course of an individual's life?

THE ONSET AND DEVELOPMENT OF STUTTERING THROUGH THE LIFESPAN

Although stuttering can develop at any age, the most common form of stuttering begins in the preschool years and is called **developmental stuttering**. Developmental stuttering is contrasted with another form of stuttering, called **neurogenic stuttering**, which is typically associated with neurological disease or trauma. Neurogenic stuttering differs from the more common developmental stuttering in several ways.

Disfluencies associated with developmental stuttering usually occur on content words (e.g., nouns, verbs), whereas disfluencies associated with neurogenic stuttering can occur on function words (e.g., conjunctions, prepositions) and content words. People who have developmental stuttering frequently exhibit secondary characteristics and anxiety about speaking, whereas neurogenic stutterers do not. Also, developmental stuttering tends to occur on the initial syllables of words, whereas neurogenic stuttering can be more widely dispersed throughout an utterance (Ringo & Dietrich, 1995). Unlike with developmental stuttering, with neurogenic stuttering there are no clear differences in stuttering frequency across speaking tasks (i.e., word imitation vs. connected speech). Finally, neurogenic stutterers do not improve (i.e., adapt) with repeated readings or singing, as do developmental stutterers (Duffy, 2013). We will focus primarily on developmental stuttering at this point.

It is generally accepted that the onset of developmental stuttering occurs between the ages of 2 and 5 and that 75% of the risk of developing stuttering occurs before the child is 3½ years old (Yairi, 1983, 2004; Yairi & Ambrose, 1992a, 1992b, 2004). The onset of stuttering is gradual for the majority of

children who develop the condition, with stuttering severity increasing as the child grows older. When stuttering develops in a gradual manner, some general trends regarding stuttering behaviors, reactions to stuttering, and conditions that seem to promote stuttering can be observed. We will outline some of these developmental trends (Bloodstein, 1995). Not all children exactly follow this developmental framework of stuttering, but it generally does capture the onset and progression of the disorder. This developmental framework is divided into four phases that have a sequential relationship to each other.

Phase 1 corresponds to the preschool years, roughly between the ages of 2 and 6. During phase 1, periods of stuttering are followed by periods of relative fluency. The episodic nature of stuttering is an indication that stuttering is in its most rudimentary form. The child may stutter for weeks at a time between long interludes of normally fluent speech. The child tends to stutter most when he or she is upset or excited, and in conditions of communicative pressure, such as when a parent forces a child to recite in front of friends or relatives. Sound and syllable repetitions are the dominant feature, but there is also a tendency to repeat whole words. Stuttering tends to occur at the beginnings of sentences, clauses, and phrases on both content words (e.g., nouns, verbs) and function words (e.g., articles, prepositions, etc.), unlike with more advanced forms of stuttering, in which disfluencies are generally confined to content words. Finally, during phase 1, most children are unaware of the interruptions in their speech or are not bothered by them.

Phase 2 represents a progression of the disorder and is associated with children of elementary school age. In phase 2, stuttering is essentially chronic, or habitual, with few intervals of fluent speech. The child has developed a self-concept as a person who stutters and will refer to himself or herself in that way. Stuttering in phase 2 occurs primarily on content words, with much less tendency to stutter only on the initial words of sentences and phrases. Stuttering is more widely dispersed throughout the child's utterances. Stuttering in phase 2 also increases under conditions of excitement.

Phase 3 is associated with individuals who can range in age from about 8 years to young adulthood. Stuttering in phase 3 seems to be in response to specific situations such as speaking to strangers, speaking in front of groups, or talking on the telephone. Certain words are regarded as more difficult than others, and the person who stutters attempts to avoid such words by using word substitutions and circumlocutions. An example of a word substitution is *I want a ni-ni-ni–five cents*; the individual substitutes *five cents* for the originally intended word *nickel*. Circumlocutions are roundabout or indirect ways of speaking. A circumlocution used to avoid the term *fire truck* in a child's request for a toy might take on the following form *I want a—ya know—red thing—sirens and ladders—truck for my birthday*. Despite the individual's awareness of stuttering, he or she will generally present little evidence of fear or embarrassment and will not avoid specific speaking situations.

In phase 4, the apex of development, stuttering is in its most advanced form. A primary characteristic of phase 4 is vivid and fearful anticipation of stuttering. In phase 4, the person who stutters avoids certain sounds, words, and speaking situations; frequently makes word substitutions and uses circumlocutions, and is embarrassed by his or her stuttering. Stuttered words may have associated audible vocal tension and rising pitch. These phases are summarized in Table 7.2.

TABLE 7.2

Summary of Bloodstein's four phases of the onset and development of stuttering

Phase	Age	Highlights
1	2–6 years	Stuttering is episodic.
		Most stuttering occurs when the child is upset or excited.
		Sound/syllable repetitions are the dominant speech feature.
		Child seems unaware of the stuttering.
2	Elementary school age	Stuttering is chronic.
		Stuttering occurs on content words (nouns, verbs).
		Child regards himself or herself as a stutterer.
3	8 years to adulthood	Stuttering is situational (speaking on the telephone, speaking to large groups).
		Certain words are regarded as more difficult than others.
		Circumlocutions and word substitutions are frequent.
4	8 years to adulthood	Stuttering is at its apex of development.
		There is fearful anticipation of stuttering.
		Certain sounds, words, and speaking situations are avoided.
		Increased circumlocutions and word substitutions are present.

See Case Study 7.2 for the personal story of a young man whose fear of speaking prevented him from eating his favorite food.

Stuttering does not always develop gradually. For some individuals, when stuttering is first diagnosed in young children, the symptoms appear to be very advanced, and secondary characteristics may be present (Van Riper, 1982; Yairi, 2004; Yairi & Ambrose, 1992a, 1992b, 2004; Yairi et al., 1993). The onset may be a distinct and sudden event for as many as 36% of children, and the stuttering behaviors may be considered to be moderate to severe (Yairi & Ambrose, 1992a). More research is needed on the onset and development of stuttering and the factors that underlie persistence and natural recovery.

Thought Question

THE EFFECTS OF STUTTERING THROUGH THE LIFESPAN

Stuttering almost always has its onset in early childhood. Research conducted at the University of Illinois indicates that in 68% of the children studied, stuttering onset occurred by 36 months of age and in 95% of the children studied by 48 months of age (Yairi, 2004; Yairi & Ambrose, 2004). Although the

Personal Story of a Young Man with Stuttering

Geoff was a teenage boy who was first seen at the speech and hearing clinic on his 13th birthday. His parents explained, during an initial interview, that Geoff had begun stuttering when he was around 3 years old. They further explained that the stuttering would come and go, and he would sometimes have fluent periods that lasted 2 months. Although the parents were concerned about Geoff's stuttering behaviors, they thought that he would outgrow the stuttering. This belief was reinforced by his long periods of fluency.

An SLP evaluated Geoff. Formal tests of stuttering placed him as a severe stutterer, most of his stuttering behaviors taking the form of long sound prolongations. Geoff told the SLP that his grades in school were falling because he would not speak in class and that he didn't like to interact with his classmates because they "always make fun of the way I talk." He also reported that there were certain words that he could not say without stuttering severely.

The SLP recommended that Geoff enroll in treatment twice a week for a trial period of 6 months.

The parents and Geoff agreed. He made good progress during this trial period and stayed in treatment for an additional 4 months. At the end of 10 months of treatment, he was dismissed, exhibiting good control over his stuttering.

Two months later, he and his mother came back to the clinic for a reevaluation of his fluency skills. During the reevaluation, Geoff told the SLP that he was happy with his new speech because he could say any word he wanted without stuttering. He told the SLP that he loved to go to McDonald's or Burger King to eat cheeseburgers and french fries. But before treatment, if he had to place his own order, he wouldn't order the french fries because he knew he would stutter on the word "french." He went without the fries more times than he cared to recall. Nowadays, Geoff is enjoying his cheeseburgers *with* the french fries that he orders himself. According to Geoff, that makes him the "happiest kid on the planet."

prevalence of stuttering (the number of persons in the population who stutter) is 1%, research indicates that "the magnitude of the problem is much larger among young children" (Yairi & Ambrose, 2004, p. 5). To put the effects of stuttering throughout the lifespan in perspective, however, we briefly discuss the model developed by the World Health Organization.

From within the context of this model, stuttering is considered to be a *disability* or a *disabling condition*. Specifically, a disability comprises "the disadvantages that result from reactions to the audible and visible events of a person's stuttering, including those of the person who stutters" (Conture, 1996, p. S20). Both informal and formal observations suggest that stuttering has a negative effect on a wide variety of daily life activities, especially in three main venues of life, school, work, and social interactions. Children may withdraw and refuse to communicate orally in school, adults may select professions that require little or no oral communication, and both children and adults may avoid social contact because of a fear of speaking.

Let us first consider the negative impact stuttering can have on a child's school performance. Stutterers, on the whole, are poorer in educational adjustment than typical speakers. This conclusion is based on the amount of retention in grades at school. On average, children who stutter are delayed about half a year or half a grade level. School children who stutter are older than their classmates who do not stutter, a finding suggesting that children who stutter are

more likely to be held back in school. If so, timely and appropriate treatment should be expected to improve the academic performance of children who stutter (Bloodstein, 1995; Conture, 1996). An additional concern is children's vulnerability to being bullied. School-age children who stutter are significantly more likely to be bullied and/or teased than their peers who do not stutter (Blood & Blood, 2004).

The educational and personal disadvantages stuttering may impose on a young person do not end when the child leaves school. Stuttering can also have a negative impact in the workplace and is a vocationally disabling condition because employers view it as a disorder that decreases employability and opportunities for promotion (Hurst & Cooper, 1983). Despite this view, when an employee who stutters seeks treatment, there is an attendant improvement in the employer's perception of the employee (Craig & Calvert, 1991). This enhanced perception is reflected by increased numbers of job promotions among employees who sought treatment and were successful in maintaining fluency following treatment.

Stuttering's potential effects on an individual's social interactions and quality of life are not well understood. Clinical observations suggest that successfully treated individuals, particularly adults, experience an improvement in their social interactions, but the nature and significance of these changes in social behavior are not well documented (Conture, 1996). However, considerable research has indicated that people who stutter do not as a group exhibit consistent, recognized patterns of psychoneurotic disturbance, but mild forms of social maladjustment are frequently reported (Bloodstein, 1995). Further research is needed to determine whether and to what extent stuttering treatment influences psychosocial adjustment (Conture, 1996).

Click here to check your understanding of the concepts in this section.

THEORIES AND CONCEPTUALIZATIONS OF STUTTERING

An examination of some of the most prominent etiological theories of stuttering will provide you with an appreciation of the various models that have influenced stuttering research and treatment for over 80 years. In addition, various aspects of some of the theories we consider are implicitly present in contemporary stuttering research and treatment. Etiological theories of stuttering can be classified into three categories: organic, behavioral, and psychological.

Organic Theory

Organic theories propose an actual physical cause for stuttering. Speculations about a physical cause for stuttering date back to the writings of Aristotle, who suggested that stuttering is a disconnection between the mind and the body and that the muscles of the tongue cannot follow the commands of the brain (Rieber & Wollock, 1977). Many organic theories have been proposed since Aristotle's writings, but they have all failed in one manner or another to explain stuttering satisfactorily. For example, the *theory of cerebral dominance,* or the "handedness theory," proposed by Samuel Orton and Lee Travis in the 1930s (Bloodstein, 1995) assumed that when neither cerebral hemisphere is dominant, both send competing neural impulses to their respective muscles of speech, resulting in a discoordination between the right and left halves of the speech musculature. They believed that this discoordination results in stuttering. A renewed interest

in this theory has come about due to recent findings from brain-imaging studies that have revealed structural and functional differences in the brains of adults with chronic developmental stuttering.

Current brain-imaging research may facilitate the development of a comprehensive neurophysiological model for both fluent and stuttered speech that could lead to new stuttering prevention and treatment methods (Brown et al., 2005; c.f., Ingham et al., 2003).

Behavioral Theory

Behavioral theories assert that stuttering is a learned response to conditions external to the individual. Wendell Johnson developed a prominent behavioral theory, the *diagnosogenic* theory, during the 1940s and 1950s. According to this theory, stuttering began in the parent's ear, not in the child's mouth. Overly concerned parents would react to the child's normal speech hesitations and repetitions with negative statements, admonishing the child to speak more slowly and not to stutter. Such parental behaviors made the child anxious about speaking, and the child's anxiety fostered further hesitations and repetitions.

Not only is there no evidence to support this theory, there is evidence to the contrary. Studies have shown that the process of natural recovery may actually be due in part to parents explicitly telling their child to slow down, stop and start again, or think before speaking when their child is stuttering (e.g., Langford & Cooper, 1974; Martin & Lindamood, 1986).

Thought Question

Psychological Theory

Psychological theory contends that stuttering is a neurotic symptom with ties to unconscious needs and internal conflicts, treated most appropriately by psychotherapy. Some psychological theories regard people who stutter as individuals with neuroses; other theories regard stuttering as a phobic manifestation. Some people who stutter may indeed have neuroses, but psychological theory has yet to provide a cogent explanation for the underlying cause of stuttering or its onset and development.

Current Conceptual Models of Stuttering

The *covert repair hypothesis,* based on a language production model, assumes that stuttering is a reaction to some flaw in the speech production plan (Postma & Kolk, 1993). Speakers have the capability of monitoring their speech as it is being formulated and detecting errors in the speech plan. People who stutter have poorly developed phonological encoding skills that cause them to introduce errors into their speech plan. If there are more errors in the speech plan, there will be more occasions for error correction. Stuttering is not the error. Rather, stuttering is a "normal" repair reaction to an abnormal phonetic plan.

Another conceptualization of stuttering is the *demands and capacities model* (*DCM*) (Starkweather, 1987, 1997). This model asserts that stuttering develops when the environmental demands placed on a child to produce fluent speech exceed the child's physical and learned capacities. The child's capacity for fluent speech depends on a balance of motor skills, language production skills,

emotional maturity, and cognitive development. Children who stutter presumably lack one or more of these capacities for fluent speech. Parents of a child who lacks the required motor skills for fluency might talk rapidly; rapid rates of speech may put time pressure on the child that exceeds his or her motoric ability to respond. Other parents might insist on the use of advanced language structures that are in excess of the child's language development. In every case of stuttering within the DCM, there is an imbalance between the environmental demands that are placed on the child and the child's capacity for fluent speech.

The DCM is not a theory of stuttering, and it does not suggest a cause for stuttering. Rather, the DCM is a useful tool that helps clinicians understand the dynamics of forces that contribute to the development of stuttering. Therapeutically, the DCM provides useful guidelines for understanding what capacities a child may lack for fluent speech production and the elements of the child's environment that may be challenging those capacities.

One more theoretical construct regarding stuttering is worthy of mention. The EXPLAN model (Howell, 2004) is an account of the production of spontaneous speech that applies to both fluent speakers and speakers who stutter. In this model, speech planning (PLAN) is the linguistic process of language formulation, and execution (EX) is the motor activity related to production of the language formulation. Although some theoretical accounts of stuttering have placed the primary site of disruption in the language formulation phase and other accounts have placed the primary site at the instructions sent to the motor system, the EXPLAN model posits that stuttering results from a failure in normal interactions between the PLAN and EX processes (Howell, 2004). Fluency failures occur when linguistic plans are sent too slowly to the motor system.

Alternatively, computer simulation models of speech production have been programmed to simulate stuttering, providing evidence for a disrupted speech motor control system in individuals who stutter (c.f. Max et al., 2004). These scientifically sophisticated models may further our understanding of the basic nature of stuttering and of stuttering treatment.

THERAPEUTIC TECHNIQUES USED WITH YOUNG CHILDREN

When parents are concerned that a child is stuttering, it is an SLP's responsibility to determine whether there should be concern and, if so, to plan an appropriate course of action. Two important components of the evaluation of a child suspected of stuttering are observations of the child speaking and a detailed parental interview (see Figure 7.1 for some common questions for parents with a disfluent child).

The Evaluation of Stuttering

The primary component of a stuttering evaluation is a detailed analysis of the child's speech behaviors. The SLP determines the average number of each type of disfluency the child produces (e.g., within-word repetitions, sound

Figure 7.1 Common questions for parents of a disfluent child.

Introduction

Why are you here today?

Tell us (me) about your child's problem.

General Development

Tell us (me) about your child's development from birth to present

How does this compare with his or her siblings?

Family History

Do any other family members have speech, hearing, or language problems?

Did they receive speech intervention?

Speech/Language Development

When did your child say his or her first words?

When did your child say his or her first phrases and sentences?

History/Description of the Problem

Describe your child's speaking problems.

When did the problem start?

What was your reaction? Did you bring the problem to your child's attention?

Can you describe your child's stuttering when it first began?

Has it changed over time?

Does your child lose eye contact when talking to you?

Does your child have excessive body movements when talking?

Does he or she avoid speaking situations?

Have you done anything to help your child stop stuttering?

Family Interactions

What do you and your child do when you spend time together?

What kind of things do you do as a family?

How do you handle sibling hostilities?

Wrap Up

If you could wish for three things for your child, what would you wish for?

Source: Based on Conture (1990b).

prolongations). Three or more within-word disfluencies per 100 words spoken may indicate that the child has a fluency problem (Conture, 1990b). The percentage of the total disfluency that each type of disfluency contributes is another important evaluative measure. For example, if a child produces 10 disfluencies per 100 words spoken and 6 of them are sound prolongations, then 60% of all the disfluencies are sound prolongations. A high percentage of sound prolongations may indicate a chronic fluency problem. The SLP will also measure the duration of several disfluencies. Longer durations and/or multiple sound or syllable repetitions may represent an increase in the severity of the stuttering problem.

Standardized tests such as the Stuttering Prediction Instrument (SPI) (Riley & Riley, 1981) and the Stuttering Severity Instrument–Fourth Edition (SSI-4) (Riley, 2009) may also be used in a fluency evaluation. The SPI is specifically for young children ages 3–8 years of age. It yields a numerical score based on a number of stuttering-related behaviors, such as the duration of disfluencies and stuttering frequency. The numerical score is converted to a verbal stuttering severity rating. The SSI-4 may be used with children or adults. This test determines frequency of stuttering measured in percent of syllables stuttered, duration of stuttering moments, and secondary behaviors. An SLP will also record the types of

secondary symptoms. A wide assortment of secondary symptoms may indicate a progression of the disorder.

An SLP's decision to recommend treatment is not based on any single behavior or test result. Treatment may be recommended if two or more of the following behaviors are observed:

- Sound prolongations constitute more than 25% of the total disfluencies produced by the child
- Instances of sound or syllable repetitions or sound prolongations on the first syllables of words during iterative speech tasks (e.g., iterative productions of *pa-ta-ka, pa-ta-ka, pa-ta-ka*)
- Loss of eye contact on more than 50% of the child's utterances
- A score of 18 or more on the SPI (Conture, 1990b)
- At least one adult expressing concern about the child's speech fluency skills (Chang et al., 2002)

Indirect and Direct Stuttering Intervention

If an SLP determines that a child has a stuttering problem or a high probability of developing stuttering, therapeutic intervention is indicated. In general, two broad intervention strategies can be used with young children who stutter: indirect treatment and direct treatment. Indirect approaches are considered viable for children who are just beginning to stutter and whose stuttering is fairly mild. Direct approaches are typically reserved for children who have been stuttering for at least a year and whose stuttering is moderate to severe.

An indirect approach does not explicitly try to modify or change a child's speech fluency; it focuses instead on the child, the child's parents, and the child's environment. Important aspects of indirect treatment are sharing information and teaching parents to provide a slow, relaxed speech model for the child. Play-oriented activities that encourage slow and relaxed speech are the central component of such intervention. There is no explicit discussion about the child's fluent or stuttering speaking behaviors. The goal of indirect treatment is to facilitate fluency through environmental manipulation.

Direct approaches involve explicit and direct attempts to modify the child's speech and speech-related behaviors. In direct treatment, concepts such as "hard" and "easy" speech are introduced. Hard speech is rapid and relatively tense (such as a tense sound prolongation of /s/ in *sssssssssss-snake*), whereas easy speech is slow and relaxed. The terms "hard" and "easy" are simple and carry little negative connotation for the child. Children are taught to identify both types of speech by first monitoring their recorded utterances and later by identifying these types of speech in their ongoing productions. Once the child is able to identify hard and easy speech segments accurately and reliably, the SLP teaches the child strategies that will help him or her increase easy speech and change from hard speech to easy speech when required. The therapeutic sequence of identification followed by identification/modification forms the core elements of many strategies for children and adults.

✔ Click here to check your understanding of the concepts in this section.

THERAPEUTIC TECHNIQUES USED WITH OLDER CHILDREN AND ADULTS WHO STUTTER

Individuals who continue to stutter into their teenage years and beyond will likely have many negative reactions to speaking situations that may affect their social lives and vocational goals. Many of these individuals will have had previous unsuccessful speech treatment and perhaps other forms of remediation to combat the fluency problem. An adult who stutters "brings a complexity of attitudes, experiences, and coping attempts to the therapeutic process, and these must be dealt with directly or indirectly" (Gelfer, 1996, p. 160).

The primary focus of this section is on therapeutic techniques used to manage adulthood stuttering. In particular, we explore direct techniques that are used to establish fluency. Changing certain aspects of one's speaking behavior is of fundamental importance in stuttering intervention and is often a source of confusion among clinicians who treat adults who stutter (Sommers & Caruso, 1995).

Therapeutic techniques designed to modify stuttering behaviors are classified generally into two broad categories: *fluency-shaping techniques* and *stuttering modification techniques.* When used properly, both techniques have a powerful effect in reducing stuttering. Fluency-shaping techniques involve changing the overall speech timing patterns of the individual in an effort to reduce or eliminate stuttering. This is typically accomplished by lengthening the duration of sounds and words and greatly slowing down the overall rate of speech. Stuttering modification techniques involve changing only the stuttering behaviors. This is typically accomplished by lengthening the duration of or in some way modifying only the speech segment on which the stuttering is occurring. Treatment programs for stuttering often combine these two approaches (Guitar, 2006). See Prins and Ingham (2009) for a historical, evidence-based perspective of fluency-shaping and stuttering modification treatments.

Fluency-Shaping Techniques

Reducing speech rate, known as **prolonged speech**, is one of the most powerful ways to reduce or eliminate stuttering. Prolonged speech may be a specific therapeutic goal, or it may involve use of various techniques that serve to reduce speaking rate and increase fluency. The term *prolonged speech* arose from research conducted in the 1960s regarding the effects of delayed auditory feedback (DAF) on speech production. DAF is a condition in which a speaker hears his or her own speech after an instrumental delay of some finite period of time, such as 250 or 500 milliseconds. When a person speaks under DAF, his or her speech is slowed involuntarily because the duration of syllables is prolonged. For example, when people who stutter speak under conditions of DAF, speaking rates decrease dramatically and the longer the delay, the slower the speech. This slowing of speech rate under DAF conditions is accompanied by a substantial decrease in stuttering.

When DAF is used clinically to prolong speech, the feedback delay is set to promote speaking rates of about 30 to 60 syllables per minute. During this initial phase, the person who stutters is taught to prolong the duration of each syllable but not to increase the duration of pauses between syllables (Boburg & Kully, 1995; Max & Caruso, 1997). This prolonged speech pattern is systematically

Delayed auditory feedback systems use a microphone and earphones. A person wearing the earphones speaks into the microphone, which transmits the speech to a device that electronically delays sending the speech to the earphones. If the delay were set at 250 milliseconds (or ¼ second), the speaker would hear his or her utterance ¼ of a second after it was uttered. Delaying the auditory feedback causes the speaker to reduce the rate of speaking.

altered over the course of intervention by adjusting the DAF times to reduce the magnitude of syllable prolongation while maintaining fluent speech. Speech rates ranging from 120 to 200 syllables per minute are typical targets for the termination of treatment.

Behavioral techniques that serve not only to reduce speech rate but also reduce physical tension in the speech musculature before and during occurrences of stuttering, promoting smooth speech, are *light articulatory contacts* and *gentle voicing onsets* (*GVOs*). The therapeutic use of light articulatory contacts involves instructing the speaker to use less tension in the articulators, particularly during production of stop consonants (/p/, /b/, /t/, /d/, /k/, and /g/) that involve a complete constriction of the vocal tract (Max & Caruso, 1997).

Reducing articulatory tension is believed to prevent occurrence of prolonged articulatory postures that interfere with smooth articulatory transitions from sound to sound. Light touches promote continuity and ease of articulation by preventing excessive pressure and tension in the articulators (Boburg & Kully, 1995).

Gentle voicing onsets are a cardinal feature of many treatment programs, and they are known by many different names, such as Fluency Initiation of Gestures (FIGS) (Cooper, 1984). The basic characteristic of GVOs is a tension-free onset of voicing that gradually builds in intensity. One can appreciate the dynamics of this technique by initiating production of the vowel /a/ in a whisper, gradually engaging the vocal folds such that the vowel is produced with a breathy voice quality, and finally increasing the vowel's intensity. GVOs are typically learned in a hierarchical fashion beginning with vowel production, followed by syllable productions, and then word productions.

Another clinical rate reduction technique that has an ameliorative effect on stuttering is called *pausing/phrasing,* and it is designed to lengthen naturally occurring pauses (clause and sentence boundaries) and to add pauses between other words or phrases. In addition, pausing/phrasing techniques may attempt to limit utterance length to two to five syllables. A formal stuttering treatment known as the *Gradual Increase in Length and Complexity of Utterance (GILCO)* program (Ryan, 1974) capitalizes on the underlying principles of pausing/phrasing techniques and has been found to be effective in reducing or eliminating stuttering, particularly in school-age children.

Another powerful fluency-shaping therapeutic intervention consistently found to reduce or eliminate stuttering is response-contingent stimulation (RCS). RCS procedures have their origins in learning theory and are based on B. F. Skinner's behavioral (operant) conditioning paradigm. Operant conditioning results in the association between a behavior (response) and the stimulus that follows (consequence) and thus determines the future occurrence of that behavior.

Skinner's system of behavioral modification is the basis for response-contingent time-out from speaking (RCTO), which requires the individual to pause briefly from speaking after a stuttering behavior has occurred. This pause or cessation from speaking serves as the consequence for stuttering. Research has consistently shown its positive effects on reducing stuttering frequency to zero or nearly zero levels. Adolescents and adults who stutter have also been taught to self-administer a time-out from speaking immediately after a self-identified instance of stuttering (Hewat et al., 2006; James, 1981b). The mechanism underlying the success of RCTO remains elusive, however.

People who stutter frequently use excessive articulator pressure when producing sounds. They may, for example, press the tongue very hard on the roof of the mouth during the production of /t/ and /d/ sounds. Teaching the individual to reduce such pressure, or make light articulatory contacts, promotes fluency.

Well-controlled experimental investigations over the past 30 years have consistently demonstrated the robust and immediate effects of behavioral modification techniques such as rewarding fluent speech and correcting stuttered speech.

Response-contingent procedures have been especially effective as a behavioral treatment for young children who stutter when administered by parents in the child's everyday environment. In long-term treatment outcome trials, the *Lidcombe program* has been shown to be highly effective in decreasing stuttering to zero or nearly zero levels for 2 to 7 years following treatment (Lincoln & Onslow, 1997; Nye et al., 2012). The Lidcombe program is a parent-administered treatment in which positive reinforcement is provided to the child for stutter-free speech, and a correction is used following stuttering (i.e., the child is asked to repeat the stuttered word(s) correctly). Parents provide praise and reinforcement for fluent speech five times more often than they request correction of stuttered speech. Learn more about the Lidcombe program at http://sydney.edu.au /health-sciences/asrc/docs/lidcombe_program_guide_2011.pdf.

Stuttering Modification Techniques

Unlike the fluency-shaping approach that seeks to reduce or eliminate stuttering by teaching the individual who stutters to speak in a way that prevents stuttering, the stuttering modification approach teaches the person who stutters to react to his or her stuttering calmly, without unnecessary effort or struggle (Prins & Ingham, 2009). Stuttering modification procedures were born out of Charles Van Riper's conceptualization of stuttering as a disruption in speech timing, causing fluency breakdowns, as well as the triggering of negative reactions to such breakdowns.

> Dr. Charles Van Riper was a distinguished professor of SLP for many years at Western Michigan University. Dr. Van Riper learned to control his stuttering and spent most of his life searching for the cause and cure of stuttering. Intervention techniques that he developed are still in use today.

As such, three techniques developed by Van Riper work to not only modify speech timing but also to modify abnormal reactions to stuttering (Prins & Ingham, 2009). They are known as *cancellations, pull-outs,* and *preparatory sets*.

These three techniques are introduced therapeutically in sequential order, beginning with stuttering cancellation. During the cancellation phase of treatment, an individual is required to complete the word that was stuttered and pause deliberately following the production of that stuttered word. The individual pauses for a minimum of 3 seconds and then reproduces the stuttered word in slow motion. This ostensibly provides practice with the motoric integration and speech timing movements that are required for a fluent production of that word. When the individual reaches a criterion level of cancellation proficiency, he or she will move to the second technique, known as pull-outs.

During the pull-out phase of treatment, the individual does not wait until after the stuttered word is completed to correct the inappropriate behavior. Rather, the individual modifies the stuttered word during the actual occurrence of the stuttering. This modification involves slowing down the sequential movements of the syllable or word when stuttering occurs, in a fashion similar to the slowed and exaggerated movements used in the cancellation phase of treatment. In essence, the individual is modifying the stuttering online, "pulling out" of the stuttering behavior and completing it with a more fluent production of the intended word. Once again, when the individual reaches a criterion level of proficiency, he or she will move to the last stage, known as preparatory sets.

The preparatory sets stage involves using the slow-motion speech strategies that were learned during the first two phases of treatment, not as a response to an occurrence of stuttering, but in anticipation of stuttering. A person who stutters typically knows when and on what word a stuttering moment will occur.

When an individual anticipates stuttering, he or she starts preparing to use the newly learned fluency-producing strategies before the word is attempted. The goal of this phase of treatment is to initiate the word in a more fluent manner, even though the individual is producing consecutive speech movements and transitions in a slowed manner.

Selecting Intervention Techniques

An SLP's selection of a specific management technique depends on many factors, including the severity of the stuttering problem, the motivation and specific needs of the person who stutters, and the SLP's knowledge of the specific techniques available. Careful and detailed observation of an individual's stuttering behaviors before initiating treatment and during the treatment process is an essential component of successful clinical management. Such observation will assist the SLP in "selecting, combining, and modifying available techniques in order to teach the client how to alter timing and tension aspects of his or her speech movements" (Max & Caruso, 1997, p. 50). In short, a one-size-fits-all clinical program does not and should not exist. Inherent differences among individuals within the stuttering population prohibit the use of inflexible clinical protocols that cannot be modified to meet the individual's needs.

THE EFFECTIVENESS OF STUTTERING INTERVENTION THROUGH THE LIFESPAN

Determining the effectiveness of stuttering treatment depends largely on how *effectiveness* is defined. This is a complex issue. However, a "treatment for stuttering might be considered *effective* if it resulted in the individual's being able to speak with disfluencies within normal limits whenever and to whomever he or she chose, without undue concern or worry about speaking" (Conture, 1996, p. S20). The treatment of stuttering differs across an individual's lifespan in terms of frequency and nature, as well as rates of recovery. Therefore, the review of treatment efficacy is probably best considered relative to four age groups: preschoolers, school-age children, teenagers, and adults. Review of the published research in stuttering intervention provides support for use of several treatment approaches and/or techniques. These are briefly reviewed in Box 7.1.

Efficacy of Intervention with Preschool-Age Children

In general, the findings of most recent studies are quite encouraging and indicate the potential benefits of early diagnosis and treatment of stuttering. As many as 91% of preschool children who had been in a stuttering treatment program maintained their fluent speech 5 years after their initial evaluation (Fosnot, 1993). Among preschool-age children enrolled in a parent-conducted intervention program, all maintained their fluent speech 7 years after dismissal from treatment (Lincoln & Onslow, 1997). In another study, 100% of 45 preschool-age children who stuttered had maintained fluent speech 2 years following dismissal from treatment (Gottwald & Starkweather, 1995).

BOX 7.1 | **Evidence-Based Practices for Individuals with Stuttering**

General

- Individuals who stutter can benefit from intervention by an SLP at any time during their life.
- Treatments with the greatest efficacy for reducing stuttering in older children and adults include those that change the rate of speech and tension during speaking.
- Comprehensive approaches focusing on the individual's attitude toward speaking and on addressing the negative impact of stuttering on one's life are reported by clients as being of more benefit than approaches that focus on speech alone.
- Between 60% and 80% of clients who participate in stuttering treatment make significant improvement.

Specific Behavioral Treatment Approaches or Techniques

- The long-term effectiveness of the parent-administered behavioral intervention the Lidcombe program is well established, particularly for preschool children. Parents are taught to praise their child's fluent speech by saying, "Good job, that was nice and smooth" and to correct stuttered speech by saying, "Oops, that was bumpy, can you say _____ again" in a 5:1 ratio of positive reinforcement to stuttering correction.

- A program of gradual increase in length and complexity of utterances, called GILCO, in which a child progresses from one-word stutter-free responses to 5 minutes of stutter-free speech during reading, monologue speaking, and conversation has been found to be highly effective with older children.
- Prolonged speech techniques (e.g., light articulatory contacts, gentle voicing onsets) have been found to be highly effective with older children and adults, particularly when taught in the context of a structured program with opportunities for daily practice. No one technique has been found to be effective on its own, however.
- RCTO from speaking is based on behavioral (operant) conditioning and involves the individual pausing briefly from speaking immediately after a stuttering event. This procedure is highly effective in reducing stuttering in adolescents and adults. Usually, the SLP tells the individual to stop speaking after an instance of stuttering; however, individuals can be taught to self-deliver a time-out from speaking following a self-identified stuttering moment.

Source: Based on Bothe et al. (2006); Conture & Yaruss (2009); Craig et al. (1996); Hewat et al. (2006); James (1981b); Nye et al. (2013); Onslow et al. (2003); Ryan (1974).

Efficacy of Intervention with School-Age Children

One noteworthy study of stuttering treatment effectiveness used four different treatment approaches with school-age children and reported an average 60% posttreatment improvement (Ryan & Van Kirk Ryan, 1983). Even better results were found in another study, in which 96% of the school-age children enrolled in two treatment programs maintained fluent speech 14 months after treatment (Ryan & Van Kirk Ryan, 1995).

The findings of nine investigations of the effectiveness of stuttering treatment involving 160 school-age children are mildly encouraging. The findings of these studies indicated a 61% average (range of 33% to over 90%) decrease in stuttering frequency and/or stuttering severity across the nine studies. As with the stuttering treatment efficacy findings among preschool-age children, these studies suggest cautious optimism (Conture, 1996).

Efficacy of Intervention with Adolescents and Adults

Teenagers who stutter can be difficult to manage clinically, and little information is available regarding specific intervention programs for this age group (Daly et al., 1995; Schwartz, 1993). In sharp contrast, many reports of treatment outcomes for adults who stutter are available. A wide variety of adult stuttering treatment techniques have been investigated, ranging from operant conditioning techniques to drug therapies. Collectively, these studies suggest a 60% to 80% improvement rate, regardless of the therapeutic technique used.

In summary, stuttering intervention across all age groups results in an average improvement for about 70% of all cases, with preschool-age children improving more quickly and easily than people who have a longer history with stuttering. The clinical research that we have considered indicates that effective treatment of stuttering is increasingly able to improve the daily life of people who stutter by increasing their ability to communicate whenever and with whomever they choose without undue concern about speaking.

✔ Click here to check your understanding of the concepts in this section.

SUMMARY

Stuttering is a disabling condition primarily characterized by sound and syllable repetitions and sound prolongations that interrupt the smooth forward flow of speech. Stuttering is a universal problem that affects males more than females. In most cases, stuttering appears between the ages of 2 to 4 years, and as the disorder progresses, it increases in severity. Stuttering can adversely affect an individual's school performance, employment, and social interactions. The treatment of stuttering is most effective when it is initiated in early childhood, although treatment at any age can reduce stuttering.

A number of theories—organic, behavioral, and psychological—attempt to account for the onset and development of stuttering, but its cause is unknown. Solving the riddle of stuttering will undoubtedly require expertise from many specialists, including speech-language pathologists, neurolinguists, geneticists, and medical specialists.

SUGGESTED READINGS

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8

Voice and Resonance Disorders

CHAPTER LEARNING GOALS

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

- Explain the normal processes of phonation and resonance

- Describe the perceptual signs of voice and resonance disorders

- Describe voice disorders that are associated with vocal misuse or abuse, medical or physical conditions, and psychological or stress conditions

- Discuss the primary components of a voice and resonance evaluation

- Describe the major goals of voice and resonance treatment, and effective voice and resonance treatment approaches and techniques

V oice is our primary means of expression and is an essential feature of the uniquely human attribute known as speech (Boone & McFarlane, 2000; Colton & Casper, 1996; Titze, 1994). Your voice reflects gender, personality, personal habits, age, and the general condition of your health. Research has shown that certain characteristics of the voice reflect various personality dimensions, and these vocal characteristics correlate well with standardized tests of personality (Colton & Casper, 1990; Markel et al., 1964). Your voice is an emotional outlet that mirrors your moods, attitudes, and general feelings. You can express anger by shouting and express affection by speaking softly; these types of vocal expression have great potential to evoke emotional responses from a listener.

Resonance refers to the quality of the voice that is produced from sound vibrations in the pharyngeal, oral, and nasal cavities. Recall from Chapter 3 that sound energy produced by the vibrating vocal folds travels through the vocal tract, an acoustic resonator that serves to enhance or reduce particular frequencies of that sound. Thus, the size and shape of the pharynx, oral cavity, and nasal cavity will directly affect the perceived sound, or quality, of your voice. In addition, the velopharyngeal mechanism, responsible for coupling and decoupling the oral and nasal cavities during speech and swallowing, regulates sound energy and air pressure in the oral and nasal cavities (Kummer & Lee, 1996). Recall that the production of most speech sounds requires the velum to be elevated to prevent air from escaping through the nose and also to ensure adequate air pressure buildup in the oral cavity to produce high-pressure consonants (e.g., /p/, b/, /s/). Failure of the velopharyngeal mechanism to separate the oral and nasal cavities during speech production and swallowing is called **velopharyngeal inadequacy (VPI)**. VPI is a frequent result of malformations of the hard and soft palate early in embryonic development.

In this chapter, we will extend some of the basic concepts related to normal voice and resonance, as well as discuss disorders of voice associated with vocal misuse and hyperfunction, abnormal medical and physical conditions, and psychological and stress conditions. We will also discuss disorders of resonance related to **craniofacial anomalies**, or congenital malformations involving the head and face (i.e., cleft palate). Finally, we will discuss assessment, treatment, treatment efficacy issues, and evidence-based practices as they pertain to voice and resonance.

NORMAL VOICE AND RESONANCE PRODUCTION

Vocal Pitch

During one complete vibratory cycle of vocal fold vibration, the vocal folds move from a closed or adducted position to an open or abducted position and back to the closed position.

Recall from Chapter 3 that speech production begins with phonation, or sound produced by vocal fold vibration. Fundamental frequency is associated with the speed of vocal fold vibration and is measured in **hertz (Hz)**, or the number of complete vibrations per second.

The perceptual correlate of fundamental frequency is *pitch*. For example, on average, adult men have fundamental frequencies of around 125 Hz (the vocal folds open and close 125 times per second), whereas adult women have fundamental frequencies around 250 Hz. Therefore, the perceived pitch of male voices is, on average, lower than the perceived pitch of female voices. The fundamental

TABLE 8.1

Summary of laryngeal development and fundamental frequency characteristics through the lifespan

Time	Structural Development	Fundamental Frequency
Birth	Larynx positioned high in the neck; vocal fold length is 3 mm	Average is about 400 Hz; unstable
4 years	Little sex difference in vocal fold length until about 10 years	Stable from 4 to 10 years with little sex influence
Puberty	10 mm increase in vocal fold length for males; 4 mm increase for females	One octave decrease for males; decreases three musical tones for females
Adulthood	Vocal fold length is 20 mm in men; vocal fold length is 17 mm in women	Males' average is 125 Hz; females' average is 250 Hz

Source: Based on Kent (1997).

frequency of young children's voices can be as high as 500 Hz, resulting in a very high-pitched voice. The difference in vocal fundamental frequency (and resulting vocal pitch) among men, women, and children is due largely to the structure of the vocal folds themselves. The structural changes of the vocal folds and the relationship to vocal fundamental frequency through the lifespan are summarized in Table 8.1.

Although individuals have a habitual speaking frequency (average pitch), the frequency of the voice constantly varies during speech production. A monotonous or **monotone** voice is the result of not varying the habitual speaking frequency during speech production. People who use a monotone voice are not terribly interesting to listen to, and listeners quickly lose interest in what is being said. Varying the pitch of the voice also has linguistic significance. Consider these two sentences:

Tom has a dog.

Tom has a dog?

The words in these two sentences are identical, but the sentences' meanings are quite different. "Tom has a dog" is a statement of fact (a declarative), whereas "Tom has a dog?" is a question (an interrogative). Say those two sentences out loud, paying particular attention to what happens to your pitch at the end of each sentence. For the declarative, the pitch of your voice will decrease or fall off as you are saying the word *dog*. In contrast, for the interrogative, the pitch of your voice will increase when you are saying the word *dog*. How does one change the pitch of the voice? Modifications in the length and tension of the vocal folds are necessary to produce pitch change.

Vocal Loudness

Like changing the pitch of the voice, changing vocal loudness is also necessary for adequate communication. Vocal loudness is the perceptual correlate of intensity, which is measured in **decibels (dB)**. In general, as vocal intensity increases, the perceived loudness of the voice increases. The loudness of normal conversational speech, such as conversations at the dinner table, averages around 60 dB.

Changes in vocal intensity require the vocal folds to stay together longer during the closed phase of vibration, but alveolar pressure is the major determinant of vocal intensity (Kent, 1997; Zemlin, 1998). As discussed in Chapter 3, alveolar pressure is the pressure placed on the vocal folds by the lungs. Every time alveolar pressure doubles, there is an 8 to 12 dB increase in vocal intensity. The *Guinness Book of World Records* reports that the loudest scream ever recorded was produced at 123.2 dB, and a man named Anthony Fieldhouse won the World Shouting Contest with a yell that was registered at 112.4 dB (Kent, 1997). Unless you are a record seeker, this kind of behavior is not recommended, as we see later in this chapter. Check out the National Center for Voice & Speech website www.ncvs.org and type "tutorials" into the search bar for an in-depth look at pitch and loudness control.

Thought Question

Resonance

Normal resonance is largely determined by the velopharyngeal structures and the adequacy of their function. Structures of the velopharyngeal mechanism include the velum (soft palate), the lateral pharyngeal walls, and the posterior pharyngeal wall. Velopharyngeal closure is achieved by the combined action of velar elevation in a flap-like fashion and movement of the lateral pharyngeal walls and posterior pharyngeal wall in a sphincter-like fashion. The velopharyngeal port remains open most of the time to allow for nasal breathing. It is also open for production of the nasal consonants (i.e., *m, n, ng*) but must achieve complete or nearly complete closure for production of oral speech sounds (Hixon et al., 2014).

It is important to note that velopharyngeal closure patterns vary among individuals and can change over time with age. For instance, young children with enlarged adenoids may achieve velopharyngeal closure via elevation of the velum against the adenoid mass. If an adenoidectomy is performed, the child may experience hypernasal-sounding speech, or speech that sounds like it is resonating through the nasal cavity, following the surgery. Luckily, most children undergo a natural reorganization of their systems during development such that velopharyngeal closure patterns slowly begin to involve movement of the pharyngeal walls to accommodate for the lack of adenoid tissue (Hixon et al., 2014).

Click here to check your understanding of the concepts in this section.

VOICE DISORDERS

Disordered voice production involves deviations in voice quality, pitch, loudness, and flexibility that may signify illness and/or interfere with communication (Aronson, 1990). Voice disorders can affect people of any age. It is estimated that approximately 3% to 6% of school-age children and 3% to 9% of adults in the United States have a voice disorder. In the adult population, men are more commonly affected than women (Ramig & Verdolini, 1998).

Data from the National Center for Voice and Speech (Ramig & Verdolini, 1998) suggest that approximately 3% of the working population in the United States have occupations (e.g., police, air, traffic controllers, pilots) in which use of their voice is necessary for public safety. More recently, data have shown that "approximately 10 percent of the workforce in the United States would be classified as heavy occupational voice users" (Roy, 2005, p. 8). For example, school-teachers have a higher prevalence of voice disorders than do nonteaching adults

(11.0% vs. 6.2%) (Roy et al., 2004); it is clear from the data that the occurrence of voice disorders in adults is problematic from a health care perspective.

Unlike voice disorders in children, which are usually related to vocal misuse or abuse and in most cases are temporary, adult voice disorders are quite varied. Perceptual signs of a voice disorder are related to specific characteristics of a person's voice and can be evaluated by a speech-language pathologist (SLP). Clinically, perceptual signs in conjunction with a person's case history serve as the initial benchmarks in the differential diagnosis of a voice disorder. Perceptual signs of voice can be divided into five broad categories: pitch, loudness, quality, nonphonatory behaviors, and aphonia, or the absence of phonation (Colton & Casper, 1996).

Disorders of Vocal Pitch

As stated earlier in this chapter, pitch is the perceptual correlate of fundamental frequency. Three aspects of pitch may suggest a voice disorder. The first is **monopitch**. A monopitch voice lacks normal inflectional variation and, in some instances, the ability to change pitch voluntarily. Monopitch may be a sign of a neurological impairment or a psychiatric disability, or it may simply reflect the person's personality. **Inappropriate pitch** refers to a voice that is judged to be outside the normal range of pitch for age and/or sex. A vocal pitch that is too high may indicate underdevelopment of the larynx, whereas a vocal pitch that is excessively low may be related to endocrinological problems such as hypothyroidism. It is also possible that a vocal pitch that is excessively high or low may be related to personal preference or habit.

Pitch breaks are sudden uncontrolled upward or downward changes in pitch. Pitch breaks are common among young men who are going through puberty, but this condition usually resolves over time. Certain types of laryngeal pathologies and/or abnormal neurological conditions can be related to pitch breaks.

Disorders of Vocal Loudness

Loudness is the perceptual correlate of vocal intensity. Two aspects related to vocal loudness may indicate a voice disorder. The first is **monoloudness**. A monoloud voice lacks normal variations of intensity that occur during speech, and there may be an inability to change vocal loudness voluntarily. Monoloudness may be a reflection of neurological impairment or psychiatric disability or merely a habit associated with the person's personality. **Loudness variations** are extreme variations in vocal intensity in which the voice is either too soft or too loud for the particular speaking situation. The inability to control vocal loudness may reflect a loss of neural control of the respiratory or laryngeal mechanism. Psychological problems may also contribute to abnormal variations in vocal loudness.

Disorders of Vocal Quality

Several perceptual characteristics of the voice are related to vocal quality. *Hoarseness/roughness* is the first. A hoarse/rough voice lacks clarity, and the voice is noisy. Pathologies that affect vocal fold vibration can result in a hoarse/rough vocal quality. Some of these pathologies are discussed later in this chapter. A hoarse/rough voice can also be a temporary condition that results from minor forms of vocal misuse or abuse that produces vocal fold swelling called edema.

Breathiness is the perception of audible air escaping through the glottis during phonation. Excessive airflow through the glottis usually indicates inadequate glottal closure during vocal fold vibration. The inability to close the glottis during vocal fold vibration may be related to the presence of a lesion on the vocal folds that prevents closure or reflects some form of neurological impairment.

Tremor involves variations in the pitch and loudness of the voice that are not under voluntary control. **Vocal tremor** is usually an indication of a loss of central nervous system control over the laryngeal mechanism. **Strain and struggle** behaviors are related to difficulties initiating and maintaining voice. During speech production, the voice fades in and out, and actual voice stoppages may occur. Strain and struggle behaviors are usually related to neurological impairment, but psychological problems may also cause them.

Nonphonatory Vocal Disorders

Stridor is noisy breathing or involuntary sound that accompanies inspiration and expiration. Stridor is indicative of a narrowing somewhere in the airway. Stridor is always abnormal and serious because its presence represents a blockage of the airway.

Excessive throat clearing, a frequent accompaniment to many voice disorders, is an attempt to clear mucus from the vocal folds. Although throat clearing is a typical behavior, it is considered abnormal when it occurs with excessive frequency.

Consistent aphonia is the persistent absence of voice and perceived as whispering. Aphonia may be related to vocal fold paralysis, disorders of the central nervous system, or psychological problems.

Episodic aphonia is uncontrolled, unpredictable aphonic breaks in voice that can last for a fraction of a second or longer. Central nervous system disorders and psychological problems can contribute to episodic aphonia. The perceptual signs of voice disorders are summarized in Figure 8.1.

Figure 8.1 **Perceptual signs of voice disorders.**

I. Pitch
   A. Monopitch
   B. Inappropriate pitch
   C. Pitch breaks
II. Loudness
   A. Monoloudness
   B. Inappropriate loudness (soft, loud, uncontrolled)
III. Quality
   A. Hoarseness/roughness
   B. Breathiness
   C. Tremor
   D. Strain/struggle
IV. Nonphonatory Behaviors
   A. Stridor
   B. Excessive throat clearing
V. Aphonia
   A. Consistent
   B. Episodic

Source: Based on Colton & Casper (1990).

Before we turn our attention to specific voice disorders, note that many of the perceptual signs of voice disorders can be objectively quantified with clinical instruments that are readily available to the SLP (Behrman & Orlikoff, 1997). Briefly, quantitative assessments of the voice are easily made by using specially designed computer hardware and software. Kay Elemetrics, for example, manufactures a computer-based instrument called the VisiPitch (see Figure 8.2). It is a user-friendly instrument that permits numerous objective assessments of the physical correlates of pitch, loudness, and hoarseness/roughness. Objective assessments are valuable for diagnostic purposes as well as for monitoring improvements during voice intervention.

Instruments are also available that measure airflow and air volume exchanges during phonation that can be used to objectively assess vocal breathiness. These instruments can be interfaced with specially designed computer hardware and software for vocal assessment. Normative data exist for many objective correlates that are related to the perceptual signs of voice disorders (see, e.g., Baken & Orlikoff, 2000).

Three general etiologies of voice disorders are vocal misuse or abuse (functional) conditions, medical or physical (organic) conditions, and psychological or stress conditions (Ramig, 1994). The exact etiology of a specific voice disorder is not always easy to determine, and some voice disorders may have multiple causes. With this caution in mind, we use these three general etiologies to examine some of the most common disorders of voice.

Voice Disorders Associated with Vocal Misuse or Abuse

Vocal misuse and abuse are frequently said to contribute to structural damage of vocal fold tissue, which in turn affects vocal fold vibratory behavior. Although there is a fine distinction between vocal misuse and abuse, vocal abuse is considered to be the harsher of the two, with a greater risk of injuring vocal fold tissue (Colton & Casper, 1996). Conditions and behaviors that are considered to be vocal misuse and abuse are listed in Table 8.2 and discussed thereafter.

Figure 8.2 Kay Elemetrics VisiPitch.

Source: Kim Farinella

TABLE 8.2

Common conditions and behaviors considered to be misuse or abuse of the voice

Misuse	Abuse
Abrupt voicing onsets	Screaming or yelling
High laryngeal position	Excessive use of alcohol
Lack of pitch variability	Excessive throat clearing and coughing

Source: Based on Colton & Casper (1990).

Vocal nodules are a common vocal fold pathology that is secondary to vocal misuse/abuse. Nodules are localized growths on the vocal folds that result from frequent, hard vocal fold collisions that occur, for example, during yelling or shouting (Colton & Casper, 1996; Gray et al., 1987). They are generally bilateral (appearing on both vocal folds), although they can appear on only one vocal fold (see Figure 8.3). Nodules are soft and pliable early in their formation. Over time, however, they become hard and fibrous, interfering greatly with vocal fold vibration. Nodules usually appear at the juncture of the anterior one third and posterior two thirds of the vocal folds, where contact is greatest. Nodules occur most frequently in adult women, particularly those between 20 and 50 years of age. However, children who are prone to excessive loud talking or screaming may also develop vocal nodules; in this age group, they are more likely to develop in boys (Colton & Casper, 1996).

The primary perceptual voice symptoms of vocal nodules are hoarseness and breathiness. People who have vocal nodules may complain of soreness in the throat and an inability to use the upper third of their pitch range.

Newly formed nodules are often treated with vocal rest (no talking). To prevent their return, however, people with vocal nodules need to alter the vocal

As you watch this **video,** note the hoarseness and breathiness in this young man's voice.

Figure 8.3 Unilateral vocal fold nodule. (Photograph courtesy of Robert Orlikoff, Ph.D., Memorial Sloan-Kettering Cancer Center, New York, NY)
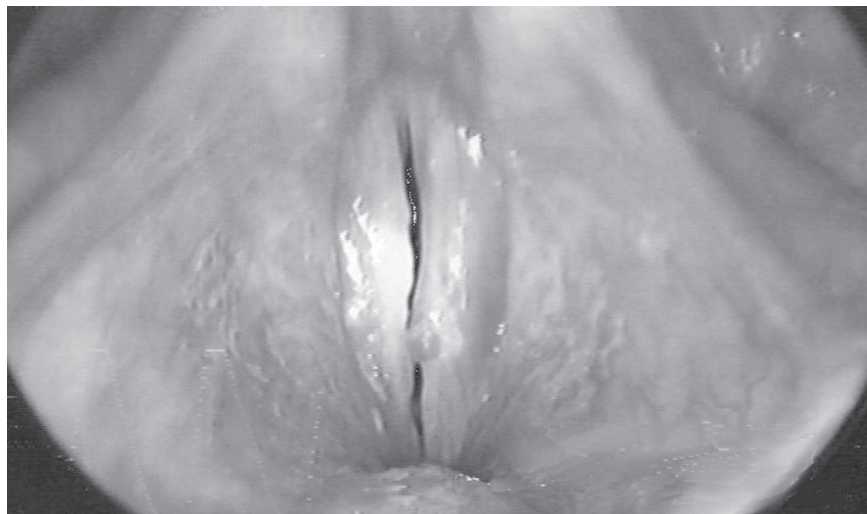
behaviors that produced the nodules. Consulting an SLP for voice intervention and education is usually recommended. Longstanding nodules may require surgical removal followed by voice intervention designed to eliminate vocally abusive behaviors. See Case Study 8.1 for the personal story of a college music student with nodules that were effectively treated with intervention and vocal rest.

Contact ulcers are reddened ulcerations that develop on the posterior surface of the vocal folds, in the region of the arytenoid cartilages. Contact ulcers, like vocal nodules, are usually bilateral, but unlike nodules, they can be painful. Pain is usually unilateral, and it may radiate into the ear. It was once believed that contact ulcers, which occur predominantly in men older than 40 years, resulted from forceful and aggressive speaking behaviors (Colton & Casper, 1996; Titze, 1994). Contemporary thought, however, suggests that the regurgitation of stomach acids into the esophagus and throat (gastric reflux) during sleep may be an important predisposing condition for the development of contact ulcers. Stomach acids irritate vocal fold tissue, promoting excessive throat clearing, which is abusive to the tissue and causes the ulcerations (Colton & Casper, 1996).

The primary voice symptoms of contact ulcers are vocal hoarseness and breathiness. Throat clearing and vocal fatigue accompany the disorder. Although some individuals claim that contact ulcers can be treated effectively with voice intervention (e.g., Boone & McFarlane, 2000), others suggest that successful

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CASE STUDY 8.1

Personal Story of a College Woman with Vocal Nodules

Jessica, a voice major, decided to pledge a sorority in the fall semester of her sophomore year. A talented vocal performer, Jessica had aspirations to teach singing and to perform professionally. During the fall semester, her course work was demanding, requiring several vocal performances and long hours of rehearsal. Pledging turned out to be demanding vocally also. Jessica was talking excessively all day long and well into the night, in addition to shouting loudly at sorority events.

During the fifth week of the semester, Jessica noted that her voice fatigued easily, she sounded hoarse, and she could not reach some of the high notes required in her singing. Her voice teacher suggested that she be evaluated at the university's speech and hearing clinic, in an effort to determine the cause of her diminished vocal capacity. A perceptual and instrumental evaluation of Jessica's voice was performed by two graduate students enrolled in the university's communication sciences and disorders program. The findings of this evaluation suggested the possibility of vocal nodules. During the consultation after the evaluation, the supervising professor and

the two graduate students explained their findings to Jessica and told her that she needed to be examined by an otolaryngologist before they could proceed further. Otolaryngologic examination is required to confirm or disconfirm the presence of nodules, and SLPs are required ethically to ensure that such an examination has been performed before they initiate treatment.

The otolaryngologic examination confirmed the presence of newly formed bilateral vocal nodules. Her physician prescribed complete vocal rest for a week, followed by voice intervention. Jessica enrolled in voice treatment at the university for 6 weeks. Vocal hygiene was stressed during treatment sessions. Jessica was examined by her otolaryngologist at the end of week 6 of treatment. Her vocal nodules were significantly reduced in size and were no longer adversely affecting her voice.

Jessica completed her academic semester and sorority pledging successfully, graduated 2 years later, and went on to graduate school at the Juilliard School of Music in New York City. She maintains contact with the university's speech clinic and reports that she continues to practice good vocal hygiene.

treatment is questionable and not well documented. Quite frequently, contact ulcers reappear after surgical removal; therefore, managing gastric reflux with medication prior to surgical intervention has been suggested (Catten et al., 1998).

Vocal polyps, like vocal nodules, are caused by trauma to the vocal folds associated with vocal misuse or abuse. Polyps develop when blood vessels in the vocal folds rupture and swell, developing fluid-filled lesions. Polyps tend to be unilateral, larger than nodules, vascular, and prone to hemorrhage (Colton & Casper, 1996). Unlike vocal nodules, polyps can result from a single traumatic incident such as yelling at a sporting event.

Two general types of polyps have been identified: sessile and pedunculated (Colton & Casper, 1996; Titze, 1994). A **sessile** (closely adhering or attached to vocal fold tissue) **polyp** (see Figure 8.4) can cover up to two thirds of the vocal fold. A **pedunculated polyp** appears to be attached to the vocal fold by means of a stalk and can be found on the free margins of the vocal folds as well as on the upper and lower surfaces of the folds.

Hoarseness, breathiness, and roughness are the typical vocal symptoms, and individuals who have a vocal polyp may report the sensation of something in the throat. The combination of surgical removal of the polyp and voice intervention to eliminate vocal misuse or abuse is effective in treating this condition (Ramig, 1994).

Acute laryngitis and **chronic laryngitis** are inflammation of the vocal folds that can result from exposure to noxious agents (tobacco smoke, alcohol, etc.), allergies, or vocal abuse (Colton & Casper, 1996). Acute laryngitis is a temporary swelling of the vocal folds that can result in vocal hoarseness.

Chronic laryngitis is a result of vocal abuse during periods of acute laryngitis, and it can lead to serious deterioration of vocal fold tissue. The vocal folds appear thickened, swollen, and reddened because of excessive fluid retention and dilated blood vessels in the vocal folds. If chronic laryngitis persists, a marked atrophy (wasting away of tissue) of the vocal folds will occur. The vocal folds become dry and sticky, resulting in a persistent cough, and the individual reports frequent throat aches (Boone & McFarlane, 2000). The voice symptoms of chronic laryngitis range from mild hoarseness to near aphonia. Surgery and subsequent voice treatment are usually both necessary to treat chronic laryngitis effectively.

Figure 8.4 Sessile polyp. (Photograph courtesy of Robert Orlikoff, Ph.D., Memorial Sloan-Kettering Cancer Center, New York, NY)

Voice Disorders Associated with Medical or Physical Conditions

The second major group of voice disorders is that caused by central nervous system (CNS) disorders, organic disease, or laryngeal trauma.

A number of the conditions discussed in this section of the chapter have a general deleterious impact on overall health and wellness. We focus primarily on how these conditions affect voice production.

Disorders of the CNS can result in speech and voice disorders that are characterized by muscle weakness, discoordination, tremor, or paralysis. Most of these disorders, generally called *dysarthrias* (discussed further in Chapter 10), involve generalized neurological damage resulting in complex patterns of speech and voice symptoms. It is useful to broadly separate CNS disorders that affect the voice into two categories: those that result in **hypoadduction**, or reduced vocal adduction, and those that result in **hyperadduction**, or increased adduction (Ramig, 1994).[1] These categories are related generally to the anatomical location of CNS lesions or disease. CNS disorders are discussed in more detail in Chapter 10.

Voice Disorders Associated with Hypoadduction

Parkinson disease is a CNS disease that results in vocal fold hypoadduction. Muscle rigidity, tremor, and an overall slowness of movement, or hypokinesia, are characteristics of Parkinson disease (Aronson, 1990; Colton & Casper, 1996). Facial appearance is unemotional and sometimes referred to as masklike. The voice symptoms associated with Parkinson disease include monopitch, monoloudness, harshness, and breathiness (Duffy, 2013).

Parkinson disease is a serious medical condition that is typically treated aggressively with a variety of drugs. Although such neuropharmacological treatments have a positive effect on limb movement, speech and voice symptoms are not consistently improved. Intensive voice treatment aimed at improving vocal fold adduction has been successful in improving vocal loudness and speech intelligibility (e.g., Ramig et al., 2001).

Unilateral and bilateral **vocal fold paralysis** is another common hypoadductory disorder that can result from CNS damage. The **recurrent branch** of the 10th cranial nerve (vagus) is the nerve supply for most of the laryngeal muscles associated with voice production. This nerve leaves the brain stem and travels down into the chest cavity, loops around the heart's aorta, and then courses upward, inserting into the larynx from below. Damage to this nerve can occur through injuries to the head, neck, or chest; from viral infections; and sometimes during neck or chest surgery.

If the recurrent laryngeal nerve is damaged on one side, unilateral vocal fold paralysis results. If it is damaged on both sides, bilateral vocal fold paralysis results.

The voice symptoms of unilateral vocal fold paralysis include a hoarse, weak, and breathy voice quality.

The paralyzed vocal fold is flaccid (limp or weak) in comparison to the non-paralyzed vocal fold. Therefore, the two vocal folds vibrate at different speeds,

The recurrent branch of the vagus nerve was frequently severed in the early days of open heart surgery, resulting in postoperative aphonia. Improved surgical procedures have minimized this problem, although the risk still exists.

In this **video**, note how the right vocal fold remains in the para-median position during vocal fold vibration.

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[1]Ramig (1994) also proposes a third category, called *phonatory instability,* which is characterized by involuntary variations of pitch and loudness.

resulting in **diplophonia**, the perception of two vocal frequencies. The voice is very weak or totally absent in cases of bilateral vocal fold paralysis. If nerve regeneration and improved function are not observed within 6 months after the injury, surgical treatment may be required to facilitate vocal fold closure. Collagen or Teflon can sometimes be injected surgically into a paralyzed vocal fold to build up its mass. Vocal fold implantation helps promote vocal fold contact. Voice treatment following surgery aims to increase vocal fold closure and vocal loudness.

Voice Disorders Associated with Hyperadduction

Spastic dysarthria is a neurological motor speech disturbance that results in vocal fold hyperadduction. It is caused by bilateral damage to the brain, usually as a result of strokes, brain injuries, or multiple sclerosis. People with bilateral damage who have spastic dysarthria also have great difficulty swallowing and speaking. These individuals may also exhibit emotional lability or may break into fits of crying or laughing for no apparent reason. Such behaviors appear to be uncontrolled. Prominent voice symptoms of spastic dysarthria include harshness, pitch breaks, and a strained or strangled voice quality (Duffy, 2013). These symptoms are all characteristic of vocal fold hyperadduction. Spastic dysarthria is discussed in further detail in Chapter 10.

Another neurological disorder associated with hyperadduction of the vocal folds is called **spasmodic dysphonia (SD)**. SD occurs with equal incidence in men and women, and the average age of onset is 45 to 50 years of age. For years, SD was believed to be a psychological voice disturbance resulting from stress, anxiety, or emotional trauma. We know now that SD can be neurological, psychological, or idiopathic (of unknown etiology). Psychological, or **psychogenic**, voice disturbances are discussed later in this chapter. SD of neurological origin results from an abnormal adductor laryngospasm that causes a strained, effortful, tight voice and intermittent voice stoppages. SD is often associated with voice tremor that is best heard during prolongation of the /a/ vowel. Botulinum toxin injection into specific laryngeal muscles to cause incomplete paralysis is the preferred method of treatment for neurological or idiopathic SD (Duffy, 2013).

Other Conditions That Affect Voice Production

A number of other conditions unrelated to CNS disorders can affect the larynx and, in turn, voice production. **Laryngeal papillomas** are small wart-like growths that cover the vocal folds and the interior aspects of the larynx. These lesions are caused by a papovavirus and are common in children younger than 6 years (Boone & McFarlane, 2000; Colton & Casper, 1996). Papillomas are noncancerous, but they can obstruct the airway, hindering breathing. Children with the disorder exhibit stridor during inhalation and may be aphonic (Wilson, 1987). Papillomas must be surgically removed, but they have a strong tendency to reappear, requiring multiple operations that may damage vocal fold tissue.

Congenital laryngeal webbing may be present at birth. Congenital webs typically form on the anterior aspects of the vocal folds and can interfere with breathing. Laryngeal webbing must be removed surgically. Webs may produce a high-pitched, hoarse voice quality.

Laryngeal cancer is the most serious organic disorder of the voice; it has been linked to cigarette smoking and excessive use of alcohol. One of the early

Botulinum toxin (Botox) is one of the most poisonous substances known. It is produced by bacteria found in contaminated meat products. When ingested, it causes paralysis of muscles in the body, including the respiratory muscles that regulate breathing, and can lead to death. However, in small doses injected into localized areas, Botox has been found to be a safe and effective way to weaken or paralyze selected muscles temporarily for medical and cosmetic reasons, including reducing abnormal muscle contractions, managing pain, and reducing the appearance of wrinkles.

signs of laryngeal cancer is persistent hoarseness in the absence of colds or allergies (Ramig, 1994). Once cancer is diagnosed, it is frequently necessary to remove the entire larynx to prevent the spread of the cancer to other parts of the body. When the larynx is removed surgically, the trachea is repositioned to form a stoma (mouthlike opening) on the anterior aspect of the throat for breathing purposes.

Removal of the larynx requires alternate methods of producing voice. Some alaryngeal (without larynx) speakers use a technique called **esophageal speech**, which uses the esophagus as a vibratory source. Essentially, these individuals learn to speak using "burps" as a substitute for actual voice production. Some individuals are incapable of producing esophageal speech. Several prosthetic devices are available to produce an alternative form of voicing for these alaryngeal speakers. One such device is a battery-powered **electrolarynx**. The electrolarynx has a vibrating diaphragm that is placed on the lateral aspects of the neck. This vibration excites the air in the vocal tract and thus serves as an alternate form of voicing. Some alaryngeal speakers may be candidates for devices that are inserted through a surgical opening in the throat. A device called a **tracheoesophageal puncture (TEP) or tracheoesophageal shunt** directs air from the trachea into the esophagus, allowing the speaker to use respiratory air and a muscle of the esophagus, the cricopharyngeous muscle, for voice production (Ramig, 1994). This device enhances esophageal speech. Other augmentative and alternative communication systems are available (see Chapter 13).

Trauma can damage the nerve supply to the larynx or cause structural damage to laryngeal cartilages and vocal folds. For example, a condition associated with surgical intubation of the larynx (respiratory tube placed between the vocal folds) is called **granuloma** (see Figure 8.5).

> More than 75% of people who are diagnosed with cancer of the larynx are or were heavy cigarette smokers. Particles in tobacco smoke are a major irritant to vocal fold tissue.

Figure 8.5 Granuloma. (Photograph courtesy of Robert Orlikoff, Ph.D., Memorial Sloan-Kettering Cancer Center, New York, NY)
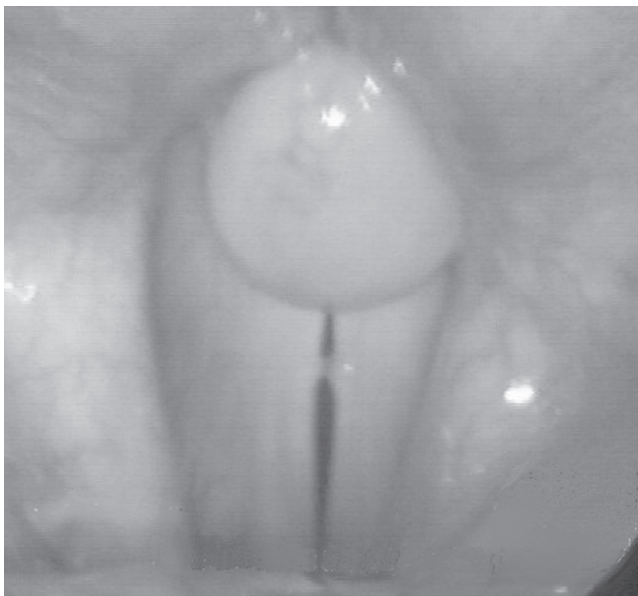
The severity of this condition is directly related to the size of the tube and the length of time it is in place between the vocal folds (Titze, 1994). Granulomas are ruptured capillaries covered with epithelial tissue (Colton & Casper, 1996). The preferred treatment for granuloma is surgical removal followed by voice treatment.

Voice Disorders Associated with Psychological or Stress Conditions

Your voice involuntarily responds to emotional changes. Strong emotional reactions such as extreme sadness, fear, anger, or happiness are reflected by your voice. When experiencing strong emotions, you might not be able to control your voice.

Strong emotions, when they are suppressed, can cause *psychogenic* voice disorders. Psychogenic voice disorders that result from psychological suppression of emotion are called **conversion disorders** because the person is converting emotional conflicts into physical symptoms. In these cases, the vocal folds are structurally normal, and they function normally for nonspeech behaviors. One type of vocal conversion disorder is called **conversion aphonia**. People who suffer from conversion aphonia whisper to produce voice. Although these individuals are capable of coughing and clearing the throat, indicating the capability of glottal closure, they do not approximate the vocal folds for speech production. In many cases, people with conversion aphonia believe they have a physical condition that prevents them from using their voice (Duffy, 2013).

It is believed that conversion aphonias develop out of a desire to avoid some type of personal conflict or unpleasant situation in the person's life (Duffy, 2013). Conversion aphonia is not a common condition, and it will likely persist until the person is willing to resolve the emotional conflict. People with deeply rooted psychological problems may require psychotherapy or psychiatric treatment.

RESONANCE DISORDERS

Resonance disorders result when there is any disruption to the normal balance of oral and nasal resonance. They can be caused by a number of structural abnormalities, including clefts of the palate. A cleft is an abnormal opening in an anatomical structure (Shprintzen, 1995) caused by failure of structures to fuse or merge correctly early in embryonic development. Alternatively, a resonance disorder may develop when there is a blockage in the nasopharynx that impedes sound energy from traveling through the nose for production of nasal sounds (Kummer & Lee, 1996).

Thought Question

When the velopharyngeal mechanism fails to decouple the oral and nasal cavities, **hypernasality** secondary to VPI occurs. VPI is a frequent result of palatal clefts and is associated with velar soft tissue and muscle tissue deficiencies. People with VPI are said to have a hypernasal voice quality; however, hypernasality is not a problem associated with phonation. Rather, it is a result of not partitioning the oral and nasal cavities by actions of the velopharyngeal mechanism. Hypernasality is a resonance problem created by the nasal cavity acting inappropriately as a second "filter," coupled to the oral cavity. Addition of this second

filter alters the vocal tract's output in such a way that it sounds as though the individual is talking through the nose.

VPI can also result in **audible nasal emission**, particularly during production of high-pressure consonants (e.g., /p/, /b/, /s/, *sh, ch, j*). When an individual with VPI attempts to build up the necessary air pressure in the oral cavity for production of high-pressure sounds, the air pressure subsequently escapes through the nasal cavity. This may be heard as a very loud, turbulent sound called a *nasal rustle,* or *nasal turbulence,* believed to be a friction noise caused by a large amount of air moving through a small velopharyngeal opening (Kummer & Lee, 1996; Peterson-Falzone et al., 2006). Visit www.cleft.org for stories by families with children born with cleft lip and/or cleft palate.

When there is an insufficient amount of nasal resonance as is needed during production of the nasal sounds /m/, /n/, and *ng,* speech may sound hyponasal. Your voice may have a hyponasal quality when you experience a bad head cold. **Hyponasality** occurs when there is a partial blockage somewhere in the nasopharynx or nasal cavity. When there is a complete blockage, denasality occurs, resulting in a more severe resonance disorder where nasal sounds are imperceptible from oral consonants produced with the same place of articulation (Peterson-Falzone et al., 2006).

> Click here to check your understanding of the concepts in this section.

EVALUATION AND MANAGEMENT OF VOICE AND RESONANCE DISORDERS

Evaluation and management of voice and resonance disorders requires a multidisciplinary team approach. The specific nature and cause of a disorder determines the precise composition of the team. At a minimum, a voice evaluation requires an otolaryngologist and an SLP. For evaluation of resonance disorders, particularly of VPI secondary to cleft palate, a cleft palate or craniofacial team comprising but not limited to surgeons, SLPs, dental specialists, audiologists, and social workers is necessary for effective clinical management of this population.

The Voice Evaluation

The first step in the evaluation of any suspected voice disorder is an examination performed by an otolaryngologist. The otolaryngologic examination provides information about vocal fold tissue damage, presence of nodules, polyps, or other abnormal growths. A direct examination of the vocal folds and other laryngeal structures is essential to determine whether the voice disorder has an organic basis. The otolaryngologist makes direct observation of the laryngeal structures using laryngeal mirrors (similar to the mirror used by a dentist) or with an **endoscope**. An endoscope (see Figure 8.6) is basically a lens coupled with a light source. The light source[2] illuminates the larynx, and laryngeal structures are viewed through the lens. Biopsies of vocal fold tissue may be taken if laryngeal cancer is suspected.

> Optical fibers are specially constructed flexible, tubular-shaped rods of glass that conduct light in only one direction. In an endoscope, small optical fibers transmit light from a source to illuminate an object, and a larger optical fiber transmits light from the illuminated object to a camera lens or viewing instrument.

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[2]The light source can be a stroboscopic light that flashes light rapidly in synchrony with vocal fold vibration.

Figure 8.6 An endoscope. (KPG Payless/Shutterstock)

An SLP involved in a voice evaluation typically begins by obtaining a thorough case history. Information regarding the nature of the voice disorder, how it affects daily life activities, the developmental history and duration of the disorder, the person's social and vocational use of the voice, and his or her overall physical and psychological condition are important areas of interest in taking a case history (Colton & Casper, 1996).

The SLP also conducts a perceptual evaluation to describe the pitch, loudness, and voice quality characteristics of the voice. In some clinical situations, detailed acoustic and physiological data regarding vocal function are collected and compared to normative data. The data obtained by the otolaryngologist and the SLP are considered collectively, and a therapeutic plan is recommended.

The Resonance Evaluation

There are a number of standardized rating scales for assessing vocal resonance. Rating scales permit the assignment of numbers to express increasing severity of the disorder. In general, such rating scales are reliable and valid. Two such rating scales are presented in Figure 8.7.

Figure 8.7 Two examples of scales used to rate the degree of resonance disorders: (a) a 7-point scale emphasizing hypernasality and (b) an 8-point scale for rating nasal resonance.

(a)

	Hypernasality		
Normal	Mild	Moderate	Severe
1	2	3	4	5	6	7

(b)

	Hypernasality		
Hypo-nasality	Normal	Mild	Moderate	Severe
−1	0	1	2	3	4	5	6

Source: Based on McWilliams et al. (1990).

Noninstrumental procedures to assess velopharyngeal functioning are the mirror test and the nostril-pinching test. To determine the presence of nasal airflow during speech production, a small dental mirror can be is placed under the nose while the client produces words or sentences containing high-pressure consonants (e.g., *Buy Bobby a puppy*). If the mirror fogs during this task, then air may be escaping from the nose. It is important to place the mirror under the nose at the right time because normal air leakage can occur just before the start of the utterance and again right at the end (Kuehn & Henne, 2003).

To assess abnormal nasal flow during speech using the nostril-pinching test, have the client produce nonnasal words first while pinching the nostrils and then again with the nostrils open. The perceived resonance and quality should sound the same; if there is a perceptual difference, it may suggest that the velopharyngeal port is open (Kuehn & Henne, 2003).

Specially designed instruments are also available to assess resonance disorders. One such instrument, manufactured by Kay Elemetrics, is called a **nasometer**. A nasometer measures simultaneously the relative amplitude of acoustic energy being emitted through the nose and mouth during phonation. A numerical value, the **nasalance score**, is computed to reflect the magnitude of hypernasality. Nasalance scores correlate well with rating scales and with the actual degree of velopharyngeal opening (Dalston, 1995, 2004; Dalston & Seaver, 1990). Nasometry can also be used as an effective therapeutic feedback technique.

The definitive procedure for assessing velopharyngeal function is **multiview videofluoroscopy**. Videofluoroscopy is motion picture X-rays recorded on DVD. Multiview videofluoroscopy permits the imaging of velopharyngeal function from three different perspectives: from the front, from the side, and from beneath. These images provide a complete picture of velopharyngeal closure or the lack thereof.

Intervention for Voice Disorders Associated with Vocal Misuse or Abuse

Treatment of any voice disorder may involve behavioral voice intervention, surgical intervention, psychological or psychiatric counseling, drug treatments, or various combinations of these. Treatment protocol decisions are based on the specific needs of the individual and the established clinical efficacy of the treatment (Ramig, 1994). Voice intervention is frequently the clinical method of choice for voice disorders that have resulted from vocal misuse or abuse.

When voice intervention is the primary treatment method, an SLP works toward several goals: (1) restore the vocal fold tissue to a healthy condition, (2) regain clear and full vocal function, (3) identify and eliminate behaviors that are abusive to the voice, and (4) establish improved vocal habits (Colton & Casper, 1996). Figure 8.8 lists some suggestions for good **vocal hygiene** that an SLP might recommend during a counseling session. When voice intervention is a secondary treatment method, as after the surgical removal of vocal nodules or polyps, the SLP works toward these goals: (1) restore healthy vocal function, (2) help the individual discover the "best" voice of which he or she is capable, and (3) make environmental changes as necessary (Colton & Casper, 1996).

An SLP uses a number of therapeutic techniques in an effort to reach the goals just outlined: breathing and relaxation exercises, soft glottal attacks (initiation of voice with a whisper), reduction of vocal loudness, and a variety of other techniques that facilitate healthy use of the voice. The therapeutic process may also involve discussions regarding personal concerns, and it is important that the SLP listen in a nonjudgmental fashion. It is also essential that the SLP provide support and encouragement to help the individual accept a changed or restored voice (Colton & Casper, 1996).

Thought Question

Intervention for Voice Disorders Associated with Medical or Physical Conditions

Treatment of voice disorders associated with disease processes does not focus on elimination of the disorder (e.g., reducing the size of a nodule) or on precipitating conditions (e.g., frequent yelling at sporting events) but rather on assisting

Figure 8.8 Behaviors that promote good vocal hygiene.

Drink plenty of fluids, especially water.

Limit the intake of caffeine.

Limit the intake of alcoholic beverages.

Avoid tobacco products.

Avoid yelling and screaming.

Speak at a comfortable loudness level; don't "push" your voice.

Avoid loud, dry, or smoky environments.

Do not use "unnatural" voices, such as imitating cartoon characters.

Practice vocal rest.

Avoid excessive throat clearing and coughing.

the individual achieve the best voice possible or on establishing alternative manners to produce voice. For example, voice disorders associated with neurological problems are usually not the primary disability. Therefore, direct treatment of voice disorders associated with certain types of neurological disease may be a secondary concern to the SLP's treatment of related disabilities, such as apraxia, aphasia, or dysphagia (Colton & Casper, 1996).

If voice intervention is indicated, the overriding therapeutic goal is to assist the individual to produce the best voice possible to remain communicatively functional in vocational and social settings. In addition, the SLP can be helpful in assessing the effects of medications or surgery on voice production. Some of the specific techniques that the SLP uses to establish the best voice possible include increasing respiratory function for speech, changing speaking rate, and changing the overall prosody of speech. It is essential that the SLP recognize the limitations of voice intervention for certain medical or physical conditions and help the individual to achieve the best possible means of communication (Colton & Casper, 1996).

Intervention for Voice Disorders Associated with Psychological or Stress Conditions

Treatment of voice disorders associated with psychological or stress conditions can be effective if an SLP succeeds in convincing the individual that there is nothing wrong physically with his or her voice. Individuals who have recognized conditions of stress or emotional conflict in their life and the relationship of that stress to their voice problem are the best candidates for voice intervention. These individuals want the ability to use their voice again, and the SLP can help them see how their psychosocial history may have contributed to the voice problem (Duffy, 2013).

A recommended therapeutic technique for voice disorders associated with psychological or stress conditions (conversion aphonia) begins by having the individual initiate voice from a grunt to a sigh to a prolonged sound, then to a syllable or word (e.g., *uh-huh*). Such techniques provide solid evidence to the individual that he or she is physically capable of normal voice production (Boone & McFarlane, 2000; Duffy, 2013).

For many individuals with conversion aphonia or dysphonia, voice can return to normal in minutes or over several sessions with the help of an SLP. For these individuals, in fact, psychiatric referral is often not needed after successful treatment by an SLP (c.f. Duffy, 2013).

Elective Voice Intervention for Transgender/Transsexual Clients

Some individuals will seek the help of an SLP to assist in changing various aspects of their voice and communication style following transgender reassignment. This is most typical in male-to-female transgender individuals. For females transitioning to males, hormone replacement often serves to lower pitch to an appropriate level, and thus, these individuals do not often seek voice intervention (Van Borsel et al., 2000). On the other hand, individuals transitioning from male to female often need assistance in raising vocal pitch to be perceived as female. Recall that women have a fundamental frequency of about 250 Hz, while men have a fundamental frequency of about 125 Hz. Research has shown that for biological males to be perceived as females, they must raise their fundamental

frequency to 155–165 Hz (Gelfer & Schofield, 2000) and, in some cases, as high as 180 Hz (Gorham-Rowan & Morris, 2006). In addition to raising fundamental frequency, it is also necessary to alter vocal tract resonance in order to achieve a perceptually feminine voice. SLPs can work to train individuals to place their tongue more anteriorly in their mouth when speaking, thereby achieving a more "forward" resonance believed to be characteristic of the female voice (Hancock & Helenius, 2012).

Treatment of Resonance Disorders

Medical Management

Treatment of hypernasality secondary to VPI in individuals with cleft palate typically begins with surgical intervention. Normal velopharyngeal function cannot be achieved without structural integrity of the velopharyngeal mechanism. Therefore, children born with palatal clefts undergo surgical closure of the cleft between 9 and 12 months of age. If a child also has a cleft of the lip, surgery to repair the cleft lip frequently occurs before 3 months of age (Kuehn & Henne, 2003).

Prosthetic Management

Following early surgical repair of a cleft palate, it is possible for a *fistula,* or an open hole between the nasal and oral cavities to open spontaneously (Peterson-Falzone et al., 2010). A **palatal obturator**, which is a prosthetic device similar to a dental retainer, can be used to cover a defect until further surgery is warranted. Obturators are made of acrylic material and custom built to conform to the general configuration of an individual's oral cavity. An obturator is held in place by clasps that anchor it to the teeth.

Prosthetic devices can also be considered when other anatomical limitations exist, such as when the velum is too short to contact the posterior pharyngeal wall, or for a velum that is completely immobile due to neurological disease. For a velum that is too short, a **speech bulb obturator** can be used. The bulb serves to fill the space between the velum and pharyngeal walls and thus, reduce perceived hypernasality during speech (Kummer & Lee, 1996). For a velum that is immobile due to paralysis secondary to neurological disease, a **palatal lift** can be considered. A palatal lift works to either elevate the velum into full contact with the posterior pharyngeal wall or positions the velum such that pharyngeal wall movement is sufficient to achieve closure (Peterson-Falzone et al., 2006).

Behavioral Management

While surgery is effective in improving the structure of the velopharyngeal mechanism in individuals with cleft palate, it does not serve to improve function. As such, speech-language treatment is typically warranted (Kummer & Lee, 1996). In individuals with VPI resulting in a mild degree of hypernasality following surgical repair of a cleft palate, the cleft palate team may determine that behavioral management is appropriate.

One approach that an SLP may use to treat VPI is a resistance exercise treatment program called continuous positive airway pressure (CPAP). CPAP

treatment is an 8-week muscle resistance home-training program designed to strengthen the muscles of the soft palate. A CPAP device, like the one used for patients with obstructive sleep apnea, generates continuous positive air pressure that is delivered through a nose mask. Treatment involves production of 50 specified words and 6 sentences while pressure is delivered through the nose. The amount of pressure delivered and the amount of practice time each week progressively increases (Kuehn, 1991; Peterson-Falzone et al., 2010).

CPAP treatment is based on the exercise physiology principle of progressive resistance training. Progressive resistance training asserts that when muscles are subjected systematically to weights greater than those to which they are accustomed, they adapt by adding muscle tissue, and strength is increased. To continue building muscle tissue, weights are increased systematically until the desired muscle strength is achieved.

The CPAP procedure attempts to strengthen the muscles of the velopharyngeal mechanism by having the velar musculature work against systematic increases of weight. Because it would be quite impractical and probably impossible to use miniature free weights, CPAP uses air pressure in the nasal cavity as a substitute. Heightened air pressure in the nasal cavity is the "weight" that the velopharyngeal mechanism works against (Tomes et al., 1997).

During treatment, the velum works against the increased air pressure in the nasal cavity while producing syllables that contain nasal consonants such as /n/ or /m/, vowels, and nonnasal consonants. The velum is lowered during production of a nasal consonant and elevated during vowel and nonnasal consonant productions. Nasal air pressure is increased systematically during velar elevation associated with production of the nonnasal consonant.

Treatment of Articulation Disorders Secondary to VPI

Individuals with clefts are also at high risk for disordered articulation. Direct intervention by an SLP for speech-sound development should begin prior to the first palatal surgery, and as early as 5 to 6 months of age, just before the onset of babbling (Peterson-Falzone et al., 2006). Early speech-language intervention should focus on increasing the child's consonant inventory, especially pressure consonants, and on increasing oral airflow (Hardin-Jones et al., 2006). The behavioral treatment approaches and techniques described in Chapter 9 for children with articulation and phonological disorders also apply to the treatment of the cleft population. The procedures and techniques used in bottom-up drill approaches may be particularly useful for treating habituated, compensatory misarticulations.

Teaching the difference between nasal and oral sounds, as well as how to direct the air stream through the mouth, might also be useful. This can be accomplished using swimmers' nose clips to prevent nasal air escape and helping the child learn how airflow feels when it is directed through the mouth during speech production (Peterson-Falzone et al., 2006).

For children who continue to substitute glottal stops (i.e., production of a grunt-like sound in the glottis or throat) for high-pressure consonants such as stops, fricatives, or affricates even after surgical correction of the cleft, direct speech treatment should begin as soon as possible. Glottal stops are far easier to eliminate early on than later, and specific treatment procedures are available (c.f., Kuehn & Henne, 2003; Peterson-Falzone et al., 2006).

A promising technique for speech sound production training is **electropalatography (EPG)**. This technique uses an artificial palatal plate containing electrodes that are connected to a computer. The palatal plate is fitted in the client's mouth, and when the tongue contacts these electrodes during speech production, the articulatory patterns can be seen on the computer screen. Children with cleft palate can learn correct placement of the articulators for speech-sound production using EPG.

Treatment of Voice Disorders Secondary to VPI

The treatment techniques and approaches described previously to reduce or eliminate vocal hyperfunction are applicable here as well. An additional goal of voice treatment is elimination of **hard glottal attacks**. A hard glottal attack occurs when a client initiates speech using hyperadducted vocal folds.

To eliminate hard glottal attacks, the individual is trained to initiate speech beginning with vowels using a gentle onset of voice. An SLP teaches this strategy by having the client begin producing a prolonged /h/ and then gradually moving into the initial vowel in the word. This breathy, relaxed voicing onset can be felt and heard, and the client is taught to sense the relaxed phonation. Initiating words with the /h/ is gradually phased out, and treatment progresses into two-word combinations, sentences, and finally conversational speech.

An SLP works to habituate a client's new voice in two phases: limited habituation and overall habituation (McWilliams et al., 1990). Limited habituation involves having the client use his or her new voice only in the presence of the SLP and then in highly controlled situations outside the clinic. Overall habituation involves using the new voice during an entire treatment session, then in specific classes in school, and then during certain hours at home. Treatment is terminated when the client and his or her caregivers or significant others report a consistent use of the new voice.

Efficacy of Voice and Resonance Treatment

Assessing the efficacy of treatment for voice and resonance disorders is complex because of the variety of conditions that produce voice and resonance disorders, the varying severity levels of the specific types of these disorders, the variety and combinations of behavioral and medical treatments available, and the manner in which treatment efficacy is defined. Despite these complexities, clinical and experimental data suggest general clinical effectiveness. For voice disorders, particularly those associated with vocal misuse and abuse, including those with structural tissue damage, and for some voice disorders associated with neurological conditions like Parkinson disease, and voice disorders associated with psychological or stress conditions, treatment has shown to be reasonably effective. Similarly, individuals born with cleft palate who receive medical and behavioral treatment earlier in their life generally speak normally by the time they are adolescents (Peterson-Falzone et al., 2010). Box 8.1 briefly summarizes specific approaches and techniques that have been shown to be effective in treating voice and resonance disorders.

In addition, it's important for an SLP to help clients who have voice or resonance disorders comply with specific treatment techniques by being patient and encouraging during treatment sessions. Changing habituated behaviors that

BOX 8.1 | Evidence-Based Practices for Individuals with Voice and Resonance Disorders

General Intervention with Laryngeal-Based Voice Disorders

- SLP-administered voice intervention is effective when medical intervention, such as surgery, is not warranted.
- For some types of laryngeal pathology, SLP voice intervention may be as effective as or more effective than medical intervention.
- In general, treatment pre- and postsurgery results in better outcomes than surgery alone.

Specific Behavioral Treatment Approaches or Techniques

- Systematic programs of vocal rest, such as the *Voice Use Reduction Program,* provide specific guidelines on when and how much the voice can be used during a particular day or week, and in which communicative situations, with voice use progressively increasing as the voice improves. Such programs are effective in improving voice disorders associated with vocal abuse and misuse.
- Vocal function exercises (e.g., pitch glides, sustained low or high pitches) are effective in treating psychogenic voice disorders, as well as voice disorders associated with laryngeal hyperfunction by lowering the larynx and facilitating production of a more relaxed voice.
- The *Yawn–Sigh* technique also effectively lowers the larynx and opens the glottis, thereby decreasing laryngeal strain and facilitating ease of phonation. This technique is suggested for individuals with laryngeal pathology associated with vocal hyperfunction (e.g., vocal nodules).
- Vocal hygiene programs that involve educating individuals about voice production and identifying and providing alternatives to vocally abusive behaviors (e.g., yelling, excessive throat clearing) are somewhat effective in eliminating or preventing the behaviors that can often lead to laryngeal pathology. Patient adherence is a critical variable, however. Classroom-based vocal hygiene programs may also prove useful for young children but require age-appropriate materials and teaching aids.
- An intensive treatment focused on increasing loudness, the *Lee Silverman Voice Treatment* (*LSVT*), has repeatedly shown to improve voice production in both children and adults with neurological diseases (e.g., cerebral palsy, Parkinson disease, multiple sclerosis). Treatment entails practicing using a louder voice while saying /a/, producing functional sentences, and producing utterances of increasing complexity four times per week for 4 weeks.

Surgical Intervention for Cleft Palate

- Although about 90% of children with nonsyndromic clefts are expected to have good velopharyngeal function after the first surgery, speech treatment may still be needed. As structures of the head and face grow, velopharyngeal function may deteriorate.
- The type of secondary surgical procedure used in some children (i.e., secondary palatal surgery and/or pharyngeal flap surgery) depends on the severity of velopharyngeal inadequacy. Following secondary surgery, speech treatment is often needed to eliminate habituated compensatory misarticulations and nasal air emission during production of pressure consonants.

Specific Behavioral Treatment Approaches or Techniques for Resonance Disorders

- *CPAP* treatment is best suited for individuals with a small velopharyngeal gap (less than 2 mm) and a movable velum, and it has been found to be effective in some patients with mild to moderate hypernasality.
- *Electropalatography* (*EPG*) provides visual feedback on the location and timing of tongue–palate contacts and continues to show promise for remediation of speech-sound disorders in the cleft palate population. EPG is effective in teaching correct production of /s/ in preschool children with cleft palate.
- Bottom-up articulation drill procedures that focus on phonetic placement and sound shaping are recommended for children with repaired clefts, and they may be effective for sounds that are often difficult for this population. For instance, to teach the production of /s/ without nasal emission, have a child produce /t/ with the teeth closed. Then have the child prolong this sound,

contribute to vocal misuse or abuse is hard work and takes time. As an SLP, your dedication to your clients through your hard work and your enthusiasm about even small gains in progress can be overwhelmingly motivating to clients.

SLPs specialize in *communicating,* which we often equate with *talking,* but it is sometimes more important to compassionately listen to our clients and their caregivers. This is particularly the case for parents who have children with cleft palate, which can cause significant anxiety for caregivers about their child's future. While you as an SLP will probably not have specific answers or be able to make any reliable inferences about prognoses for speech and language development, you can listen attentively, acknowledge caregivers' concerns and fears, and act in a caring and empathetic fashion at all times. Your success as an SLP will depend on your ability to build trusting relationships with clients and caregivers, and these relationships will not only contribute to your effectiveness as a clinician but also serve to add genuine meaningfulness to your career and to your life overall.

Click here to check your understanding of the concepts in this section.

SUMMARY

The human larynx is a versatile instrument that, in addition to its primary biological function of protecting the lower airways from invasion of foreign substances, serves as the primary sound generator for spoken communication. The human voice reflects one's personality, general state of health and age, and emotional condition. The human vocal tract, made up of the pharyngeal, oral, and nasal cavities, acts as a filter, changing in size and shape to alter the sound generated by the larynx, thus contributing to the resonance, or quality, of the voice. Closure of the velopharyngeal mechanism is necessary to produce the majority of speech sounds in the English language, and inadequate closure due to structural abnormalities such as cleft palate results in the perception of hypernasality, or sound energy inappropriately resonating through the nasal cavity.

Disorders of voice and resonance affect a substantial number of people and vary in both etiology and severity. Voice and resonance disorders can range from relatively uncomplicated abnormalities such as vocal hoarseness resulting from

yelling excessively at a sporting event, or hyponasal-sounding speech due to an upper respiratory infection, to cancer of the larynx or bilateral cleft of the lip and palate. The specific method of treatment is largely dictated by the etiology and severity of the disorder.

SLPs play a pivotal role in the treatment of voice and resonance disorders, but effective and ethical management requires a team approach. In many instances, surgical intervention followed by behavioral treatment is the standard protocol. In other instances, medical intervention alone, as in the case of a nasal block-age, or behavioral treatment alone, as is sometimes the case for individuals with vocal nodules, is sufficient. Dealing effectively with individuals with voice and resonance disorders requires detailed and specific knowledge about normal and abnormal function of the laryngeal and velopharyngeal mechanisms. Many voice and resonance disorders respond well to techniques used by SLPs, and working with such disorders can be a rewarding and exciting clinical endeavor.

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9

Disorders of Articulation and Phonology

CHAPTER LEARNING GOALS

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

- Describe the nature of speech sounds and the relationship between phonology and articulation

- Describe the correlates and causes of disorders of articulation and phonology

- Explain the procedures for assessing speech-sound disorders

- Describe the approaches and techniques for treatment of articulatory and phonological disorders and the supporting evidence available

A lthough the written alphabet we use contains 26 letters, spoken English has 41 to 43 different speech sounds. In this chapter, we are concerned primarily with speech sounds, or phonemes, which are combined to form spoken words, phrases, and sentences. For example, the word *cat* contains three phonemes [kæt]. Note that phonemes and letters are not the same. The word *that* also has three phonemes [ðæt]. Phonemes are generally written between two slashes, as in /p/; transcribed phonemic combinations such as words are often transcribed between brackets, as in [ðæt]. Some phonemes are universal and found in all languages; other phonemes are used in only a few languages. For example, the tongue clicks used in some African languages are not used as phonemes in English. In general, the more phonemes two languages have in common, the more similar the languages sound. The phonemic symbols for standard American English speech sounds are shown in Table 9.1.

In addition to phonemes, which are the building blocks of speech, *phonotactic* rules exist that specify acceptable sequences and locations. For example, the "ks" combination is never used at the beginning of an English word, but it is fine at the end, in words such as *books* [bʊks]. Many Polish and Russian names are difficult for English speakers to pronounce because these Slavic languages permit consonant combinations that are not found in English.

Allophonic variations contribute to regional and foreign dialects. The examples given in the text do not apply to all English speakers.

Each phoneme is really a family of related sounds and may be said with some variation but still be considered that particular phoneme. These variations are called **allophones**. Compare the *p* in the words *pot* and *spot*. When *p* is at the beginning of a word and followed by a vowel, it is pronounced with a little puff of air (**aspiration**), but in most regions of the United States, when *p* is immediately preceded by *s*, it is not aspirated. Still, we recognize both as /p/. If the wrong allophone is used, the spoken words do not sound right.

We begin our discussion of articulation and phonology with information about how sounds are produced and classified. We examine the distinction

TABLE 9.1

Phonemic symbols for standard American English speech sounds

Consonants				Vowels			
Phoneme	**Example**	**Phoneme**	**Example**	**Phoneme**	**Example**	**Phoneme**	**Example**
/p/	pan	/ʃ/	shed	/i/	eat	/ɔ/	sauce
/b/	boot	/ʒ/	measure	/ɪ/	pit	/ɑ/	father
/t/	tall	/h/	high	/e/	cake		
/d/	down	/tʃ/	chop	/ɛ/	bed		*Diphthongs*
/k/	kite	/dʒ/	jump	/æ/	at	*Phoneme*	*Example*
/g/	go	/m/	mat	/ʌ/	cup	/aɪ/	ice
/f/	fan	/n/	noon	/ə/	above	/aʊ/	cow
/v/	vase	/ŋ/	ring	/ɝ/	bird	/ɔɪ/	toy
/θ/	thumb	/l/	lamb	/ɚ/	paper		
/ð/	then	/w/	wit	/u/	you		
/s/	sun	/j/	yellow	/ʊ/	would		
/z/	zoo	/r/	rod	/o/	no		

Case Study of a Child with an Articulation Disorder: Kee

Although his grandparents are somewhat recent immigrants, Kee was born in the United States and speaks only English. Thoroughly acculturated, he loves baseball and pizza. Now in fifth grade, Kee has no remnants of the articulation problem he experienced as a younger child.

Kee's parents became concerned about his speech when he was a preschooler. Unsure who to ask, they inquired of the family physician, who told them that it was not unusual for children to have speech-sound problems, and they shouldn't worry. Reassured, they made no further inquiries.

In kindergarten, the school identified Kee as a child with a possible speech problem, and his parents agreed to further testing by the speech-language pathologist (SLP). He determined that Kee had difficulty with both the "s" and "sh" sounds and, to a lesser extent, with "z," demonstrating a frontal lisp on all three. Prognosis was good because Kee produced the "s" and "sh" correctly 12% and 19% of the time, respectively, and the "z" 42% of the time.

Kee received speech-language pathology services in school twice per week beginning in kindergarten. In the middle of second grade, he was dismissed from therapy because of satisfactory progress.

As you read the chapter, think about:

- Possible explanations for Kee's difficulties
- Possible ways Kee's SLP may have gathered diagnostic data
- Possible intervention methods that may have contributed to Kee's progress

between articulation and phonology and then describe the development of speech and speech-sound impairments that may be related to articulatory and phonological disorders. The second half of the chapter is devoted to assessment and treatment. Case Study 9.1 describes a child diagnosed with impaired speech sound production skills who was successfully treated by a speech-language pathologist (SLP).

UNDERSTANDING SPEECH SOUNDS

Phonemes are often categorized as either **vowel** or **consonant**. Very generally, vowels are produced with a relatively open or unobstructed vocal tract, and consonants are made with some degree of constriction.

Consonant phonemes may be classified according to which articulators are used (place of articulation), how the sound is made (manner of production), and whether they occur with laryngeal vibration (voicing). Vowels are normally described according to tongue and lip position and relative degree of tension in these articulators. In addition, the concept of **distinctive features** is sometimes used to describe both vowels and consonants. These methods of characterizing phonemes are described in the next few pages.

All spoken languages have vowels and consonants. The intelligibility of an utterance is determined largely by the consonants, whereas the sound energy comes primarily from the vowels.

Classification of Consonants by Place and Manner

As we mentioned, consonants are characterized by constriction somewhere along the vocal tract. This point of contact or constriction is used to classify consonants. Consonants in which constriction is made with both lips are called

bilabial, meaning "two lips." **Labiodental** consonants are made with the bottom lip and upper teeth in contact. **Interdental** consonants are produced with the tongue between the teeth and are sometimes called **linguadental**. **Alveolar** sounds are made when the tongue tip is touching the alveolar or upper gum ridge. In **palatal** consonants, the center of the tongue is near the hard palate. The rear of the tongue approaches the velum or soft palate in the production of **velar** consonants. When the constriction occurs at the level of the vocal folds, the phonemes produced are called **glottal**.

Consonants may be *voiced or voiceless*—that is, produced with or without laryngeal vibration. **Obstruents**, in which airflow is blocked or obstructed, include stops (e.g., /p/, /b/), fricatives (e.g., /f/, /v/), and affricates ("ch", and "j"). In the production of **stops**, air pressure is built up behind the point of constriction, momentarily stopped, and then released, as in the /p/ sound. **Fricatives** are nonresonants that are made with a narrow passageway for the air to pass through, creating a frictionlike sound. **Affricates** begin as stops and then are released as fricatives. **Resonants** are the **nasals** and **approximants**. The special characteristic of nasals is that they are produced with resonance in the nasal cavity. Approximants include **glides** and **liquids**. Glides occur when the articulatory posture changes gradually from consonant to vowel. Liquids include /l/ and /r/.

Classification of Vowels by Tongue and Lip Position and Tension

Vowels are produced by resonating the exhaled air within the oral cavity. The exact sound that is made depends on which part of the tongue is elevated (front, center, or back), its relative height (high, mid, or low), and the amount of tension (tense or lax) in the articulators. Whether the lips are rounded (pursed) or retracted (pulled back into a sort of smile) also influences the sound that is produced. Figure 9.1 is a diagram of American English vowels. In the figure, the higher vowel of the front and back paired vowels and /ɝ/ are relatively tense; all other vowels are lax. High and mid back vowels and the back central vowels are produced with the lips somewhat rounded. All other English vowels are unrounded. All English vowels are normally voiced and not nasal. Exceptions occur when you whisper and when nasal resonance occurs for any number of reasons including proximity to a nasal phoneme, such as /m/ or /n/.

Figure 9.1 Classification of American English vowels by height and frontness/backness of tongue.

Source: Adapted from Shriberg & Kent (1995) and Yavas (1998).

When two vowels are said in close proximity, they produce a special type of phoneme called a **diphthong**. In English, the vowels in the words *sigh, now*, and *boy* are diphthongs. *Sigh* contains /aɪ/, *now* contains /aʊ/, and *boy* contains /ɔɪ/.

Distinctive Feature Analysis

In an attempt to provide a system for describing phonemes found in all languages, linguists identified the components of individual sounds and called them distinctive features. Each phoneme can then be theoretically identified by the presence or absence of each of these features (Chomsky & Halle, 1968). For example, three English phonemes (/m/, /n/, and /ŋ /) are produced with nasal resonance. They are considered + nasal. All other English phonemes are − nasal. To further distinguish among the nasal phonemes, we might note that /m/ and /n/ are produced with obstruction in the front portion of the mouth; they are + anterior, whereas /ŋ/ is − anterior. The phonemes /m/ and /n/ can be differentiated on the basis of the distinctive feature "distributed." If the constriction extends for some distance along the direction of the airflow, it is + distributed. In the example we are using, /m/ is considered + distributed; /n/ is − distributed.

The concept of distinctive feature analysis has been helpful in finding patterns of speech-sound errors and thereby facilitating their correction. Figure 9.2 contains brief definitions and examples of some of the most commonly used distinctive features.

SPEECH-SOUND DEVELOPMENT THROUGH THE LIFESPAN

Although you gained early control of most of the muscles needed for speech, it took you longer to perfect their movement and to learn to produce all the sounds of American English. Even so, most children can produce English speech sounds by early elementary school.

Pre-Speech

Although newborns produce predominantly reflexive sounds, such as fussing and crying, and vegetative sounds, such as burping and swallowing, these sounds decrease with maturation. This disappearance is related to the rapid rate of brain growth and to myelination. **Myelination** is the development of a protective myelin sheath or sleeve around the cranial nerves. Myelination is not completed until adulthood.

Initially, newborns cry on both inhalation and exhalation. The expiration phase—a more efficient sound production source—gradually increases. Crying helps children to become accustomed to air flow across the vocal folds and to modifying their breathing patterns. Because speech sounds originate at the level of the larynx, this early stimulation is necessary. However, noncrying vocalizations are far more important in the development of speech.

Noncrying sounds usually accompany feeding or are produced in response to smiling or talking by the caregivers. These noncrying vowellike sounds contain some *phonation* or vibration at the larynx, but the child has insufficient ability to produce full speech sounds.

Figure 9.2 Definitions and examples of some common distinctive features.

Anterior:	Sounds produced with an obstruction in the front portion of the mouth—specifically, labials, dentals, and alveolars
	Examples of + anterior: /m, p, b, f, v, θ, ð, n, t, d/
Consonantal:	Sounds produced with obstruction in the oral cavity—specifically, obstruents and nasals
	Examples of + consonantal: /s, z, t, d, m, n, r, l/
	Examples of − consonantal: /æ, i, e, o, u/
Continuant:	Sounds in which the air may flow without interruption—specifically, fricatives, glides, liquids, vowels.
	Examples of + continuant: /f, v, s, z, h, j, r, l, i, e, o, u/
	Examples of − continuant: /p, t, k, b, d, g/
Distributed:	Consonants produced with a constriction that extends a relatively long distance along the direction of airflow
	Examples of + distributed: /m, p, b, ʃ, ʒ, tʃ, dʒ/
Nasal:	Phonemes produced with a lowered soft palate
	Examples of + nasal: /m, n, ŋ/
Sonorant:	Sounds produced with a relatively open vocal tract, such that spontaneous voicing is possible—specifically, vowels, nasals, liquids, glides
	Examples of + sonorant: /æ, o, m, n, l, r, w, j/
	Examples of – sonorant: /p, b, t, d, k, g, ʃ, tʃ
Strident:	Sounds in which the airstream is constricted in such a way as to produce a high-intensity noise
	Examples of + strident: /s, z, f, v/
	Examples of − strident /p, b, i, e, o/
Syllabic:	Sounds that serve as the nucleus of a syllable—specifically vowels, syllabic liquids, syllabic nasals
	Examples of + syllabic: [bʌ tn̩] as in "button"
	Examples of − syllabic: the /b/ and /t/ in "button."
Voiced:	Sounds produced with vocal fold vibration—specifically all vowels, nasals, glides, voiced consonants
	Examples of + voice: /i, e, o, m, n, j, w, b, d, g, z, v/
	Examples of − voice: /p, t, k, s, f/

Source: Based on Chomsky & Halle (1968).

By 2 months of age, infants develop nondistress sounds called either "gooing" or "cooing." During gooing, infants produce back consonant sounds similar to /g/ and /k/ and middle and back vowel sounds, such as /ʌ/ and /ʊ/, with incomplete resonance.

By 3 months of age, infants vocalize in response to the speech of others. Infants are most responsive if their caregivers respond to them.

At 5 months, infants are able to imitate the tone and pitch signals of their caregivers. Most infant imitative and nonimitative vocalizations are single-syllable units of consonant-vowel (CV) or vowel-consonant (VC) construction. These sound units that begin around 4 months are called **babbling**.

With maturity, longer sequences and prolonged individual sounds evolve. Children produce increasingly more complex combinations. Sounds are now more like adult speech sounds. As muscle control moves to the front of the oral cavity, we see strong tongue projection in 4- to 6-month-olds. Initially, back consonants predominate in babbling, but by 6 months, labial or lip sounds, such as /m/ and /p/, are produced more frequently.

Babbling is random sound play, and even deaf infants babble. During babbling, infants experiment with sound production. With age, children's babbling increasingly reflects the syllable structure and intonation of the caregivers' speech.

At about 6 or 7 months, infants' babbling begins to change to **reduplicated babbling**, which contains strings of consonant-vowel syllable repetitions or self-imitations (CV-CV-CV), such as *ma-ma-ma*. Hearing ability appears to be very important. Children with deafness continue to babble, but the range of consonants decreases, and few reduplicated strings are produced.

> The consonant-vowel (CV) syllable becomes one of the predominant building blocks in first words.

In contrast to babbling, reduplicated babbling more closely approximates mature speech in its resonant quality and timing. The child is beginning to adapt the speech patterns of the environment. Regardless of the language, infants' vocalizations and later first words have similar phonological patterns. For example, stops (/p, b, t, d, k, g/), nasals (/m, n, ŋ/), and approximants (/w, j/) constitute approximately 80% of the consonants in infant vocalizations and in the first 50 words of Spanish-, Korean-, and English-speaking children.

The period from 8 to 12 months has been called the *echolalic* stage. **Echolalia** is speech that is an imitation of some other speaker. At first, children imitate only sounds they have produced spontaneously on their own.

Gradually, infants begin to use imitation to expand and modify their repertoire of speech sounds. At about the same time, they begin using gestures, with or without vocalizations, to communicate. Speech during this period is characterized by **variegated babbling**, in which adjacent and successive syllables in the string are purposely not identical.

In the second half of the first year, children begin to recognize recurring patterns of sounds in specific situations. The child may even produce sounds in these situations. For example, a child might begin to say *M-m-m* during feeding if this sound is modeled for him or her. In response to caregiver conversations, infants may begin to experiment with *jargon,* long strings of syllables with adult-like intonation.

Many speech sounds develop sound–meaning relationships. Called phonetically consistent forms (PCFs), these sound patterns function as protowords, or "words" for the infant (Dore et al., 1976). The infant notices that adults consistently use certain sound patterns to refer to the same things in the environment.

> PCFs are a child's first attempt at consistent use of a sound to represent, or "stand for," something else.

Word production depends on sound grouping and sound variation. Children adopt a problem-solving or trial-and-error approach to word production. The resultant speech is a complex interaction of the ease of production and perception of the target syllable and its member sounds.

Toddler Speech

At around 12 months of age, you probably produced your first recognizable word. Sometimes a child's word is easily recognizable to others, but some words may be modified by the child for ease of speaking.

When faced with a difficult word, children adopt similar strategies. Armed with the consonant-vowel (CV) structures of babbling and the CV-CV-CV strings of reduplicated babbling, children attempt to pronounce the adult words they encounter. It is therefore not surprising that many words are reduced to variations of a CV structure or another simplification. These adaptations, called phonological processes, are presented in Table 9.2.

Toddlers often omit final consonants, resulting in a CVC word being produced as CV, as in *cake* pronounced as *ca*. It is also possible that children will add an additional vowel to form the CV-CV *cake-a*. Multisyllable words may be reduced to one or two syllables, or the syllables may be repeated. For example, *telephone* might become *tephone,* and *baby* might be modified to *bebe*. If the syllables are not duplicated, only the consonants may be, as in *doggie* becoming *goggie*. Consonant blends might be shortened to single consonants, as in *stop* becoming *top.* Finally, one type of sound might be substituted for another. For example, all

TABLE 9.2

Phonological processes of young children

Process	Explanation	Example
Final consonant deletion	Reduces CVC structure to more familiar CV	*Cat* becomes *ca*
		Carrot becomes *cara* CVCVC → CVCV
Weak syllable deletion	Reduces number of syllables to conform to the child's ability to produce multisyllable words	*Telephone* becomes *tephone*
		Vacation becomes *cation*
Reduplication	Syllables in multisyllable words repeat	*Baby* becomes *bebe*
		Mommy becomes *mama*
Consonant cluster reduction	Reduces CCV+ structures to the more familiar CV	*Tree* becomes *te* *Stay* becomes *tay*
Assimilation	One consonant becomes like another, although the vowel is usually not affected	*Doggie* becomes *goggie*
Stopping	Fricatives (/f/, /v/, /s/, /z/, and others) are replaced by stops (/b/, /p/, /d/, /t/, /g/, /k/)	*Face* becomes *pace* *This* becomes *dis*
Fronting	Velars are replaced with more anteriorly produced sounds	*go* becomes *do ring* becomes *rin*

initial consonants in words might be pronounced as the same consonant, as in, *Go bye-bye* becoming *Bo bye-bye*.

Preschool Speech

Most of the phonological processes described for toddlers have disappeared by age 4. Consonant blends consisting of two or more adjacent consonants, as in "strong," continue to be difficult for some children, and simplification strategies, resulting in "tong," may continue into early elementary school. Children who experience continuing phonological difficulties may persist in the use of more immature phonological processes.

Children continue to master new speech sounds throughout the preschool period. The acquisition process is a gradual one and depends on the individual sound, its location in words, its frequency of use, and its proximity to other speech sounds. A sound may be produced correctly in single words but not in connected speech.

We can make a few generalizations about speech-sound acquisition by young children:

- Phoneme acquisition is a gradual process.
- Vowels are easier to master than consonants. Usually, English vowels are acquired by age 3, whereas some consonants may not be mastered until age 7 or 8.
- Many sounds are first acquired in the initial position in words.
- Consonant clusters (*consider*) and blends (*street*) are not mastered until age 7 or 8, although some clusters appear as early as age 4.
- Some sounds are easier than others and are acquired first by most children. As a group, stops (/p, b, t, d, g, k/) and nasals (/m, n, ŋ/) are acquired first.
- Much individual difference exists.

This information is presented in Figure 9.3. Children with neuromuscular problems, sensory deficits, perceptual problems, and poor learning skills have difficulty acquiring all the sounds of the language.

Development of individual sounds depends on the location in words, frequency of use, and the influence of other speech sounds.

Figure 9.3 Mastery of English speech sounds.

Ages by which most children have acquired speech sounds in all positions. Vowels are not included because they are usually mastered by age 2–3 years.

Age 2	p, h, n, b, k
Age 3	m, w, g, f, d
Age 4	t, ʃ ("sh"), j ("y")
Age 5	s, v, ŋ("ng"), r, l, tʃ ("ch"), z, dʒ ("j")
Age 6	θ ("th" in "<u>th</u>in"), ð ("th" in "<u>th</u>e"), ʒ ("zh" in "mea<u>s</u>ure")
Age 8	Consonant blends and clusters

Sources: Compiled from Olmsted (1971); Prather et al., (1975); and Sanders (1972).

School-Age Speech

By early elementary school, your phonological system probably resembled that of an adult. A few children will still have difficulty with multiple consonant blends, such as *str* and *sts,* as in *street* and bea*sts,* respectively.

Other developments, such as **morphophonemic contrasts**—changes in pronunciation as a result of morphological changes—will take several years to master, some extending into adulthood. For example, in the verb *derive,* the second vowel is a long *i,* transcribed phonetically as /aɪ/. When we change *derive* to the noun *derivative,* the second vowel is changed to sound like the *i* in *give,* transcribed as /ɪ/. Other contrasts were mentioned in Chapter 2.

Five-year-olds still have difficulty with a few consonant sounds and with consonant blends. Six-year-olds have acquired most English speech sounds. By age 8, children have acquired consonant blends, such as *str, sl,* and *dr*.

Phonology and Articulation

The distinction between phonology and articulation is often difficult to understand. Articulation refers to the actual production of speech sounds; phonology is knowledge of speech sounds within a language and the ways in which they are combined.

The correct use of speech sounds in a language requires knowledge of the sounds of the language and the rules that govern their production and combination, called *phonology*. Speech also requires neuromotor coordination to actually say sounds, words, and sentences—termed *articulation*.

To help you understand this distinction, visualize learning a new language such as French. You will be exposed to new words and sound combinations and begin to grasp the nature of that language's sound system or phonology. But you must also be able to form the words with your lips, tongue, and so on. You might find this very difficult because your neuromotor pathways have been trained to make English words; the inability to coordinate your muscles to produce the words correctly is a problem of articulation.

Phonological impairments are disorders of conceptualization or language rules. Remember that phonology is concerned with classes of sounds and sound patterns within words. For example, English has both open and closed syllables at the ends of words. An **open syllable** is one that ends in a vowel—for example, *hi*; a **closed syllable** ends in a consonant (*hat*). A child who uses only open syllables and deletes all final consonants exhibits a disorder of phonology. In this example, the child would say *hi* correctly but produce *hat* as *ha*.

Articulation impairments are disorders of production. A child whose only speech error is incorrect production of the /s/ phoneme has a disorder of articulation. Disorders of articulation are typically characterized as:

- Substitutions
- Omissions
- Distortions
- Additions

Substitutions occur when one phoneme is replaced with another. For example, a person who says *shair* for *chair* would be substituting *sh* for *ch*. An omission is the deletion of a phoneme, as in *chai* for *chair*. Distortions occur when a nonstandard form of a phoneme is used. An example of an addition would be *chuh-air* for *chair*. Some individuals have disorders of both phonology and articulation. We talk more about specific patterns and types of errors later in this chapter.

Click here to check your understanding of the concepts in this section.

ASSOCIATED DISORDERS AND RELATED CAUSES

The causes of phonological and articulatory disorders in most children are not readily identifiable. In these cases, when no cause is known, it may be termed a *functional disorder*. Recognizing the limited usefulness of this concept, researchers have directed their attention to **correlates**, or related factors. Correlation means that two or more things occur together but one does not necessarily cause the other(s).

Nevertheless, correlates may offer some clues to causality that should prompt further research. Figure 9.4 lists some correlates of phonological impairment. In the next few sections, we describe the characteristics associated with a few well-established correlates of phonological and articulatory impairment. Data from long-term studies suggest that more persistent problems may be related to motor-speech deficits (Flipsen, 2003).

Most children with disordered articulation and phonology do not exhibit an identifiable physical reason for the problem.

Developmental Impairment in Children

Language and speech learning is not easy. Words are composed of phonemes that are typically acquired gradually by 8 years of age. Many children with articulation and phonological difficulties exhibit a developmental impairment in speech-sound production with no readily identifiable corollary factors. When a child's speech is delayed, you would expect that he or she is not producing the phonemes expected at that age. Other children may be idiosyncratic in their phoneme use. Some researchers identify these children as "disordered" in their development. This dichotomy is a difficult one, however, because of the wide range of behaviors in young children (Howell & Dean, 1994; Stoel-Gammon & Dunn, 1985).

Phonological processes involve more than individual phonemes. Final consonant deletion can involve any consonant, as when the target "Give him the book" is produced as "Gi- hi- the boo." Many children exhibit multiple processes.

Figure 9.4 Possible correlates of phonological and articulatory impairments.

Hearing loss

History of otitis media during the first few years of life

Diminished speech-sound perception and discrimination ability

Atypical tooth alignment and missing teeth

Impaired oral-motor skills

Eating problems

Tongue thrust swallow after 6 years of age

Neuromotor disabilities

Mental retardation

Language difficulties

Male sex

Family history of speech delay

Low maternal education

Phonological Impairments

As previously mentioned, children's phonological and phonotactic simplifications are called *phonological patterns* or *processes* (Table 9.2). The average age of diagnosis of a phonological disorder is 4 years, 2 months (Shriberg & Kwiatkowski, 1994), although the roots of these problems may present much earlier. Case Study 9.2 describes a young girl who demonstrates the unusual phonological process of *backing*.

Lifespan Issues

By age 6, 75% of children outgrow their speech-sound errors; by age 9, most of these children will have normalized their errors (Shriberg, 1997). Speech therapy can help children correct speech-sound errors more quickly, however. A small percentage of children will continue to have residual sound errors, possibly throughout their lives. These often involve substitution or distortion of /r/, /s/, /z/, or /l/. Such errors may have a negative impact on the individual's academic and professional accomplishments as well as on personal relationships. Although speech-sound production can be modified at any stage of life, old habits become more firmly entrenched, so change can be more difficult.

Language Impairments

Children who have language impairments, as described in Chapter 4, may also be impaired in their production of the sounds of the language. It has been estimated that a general impairment in expressive language is present in about 60% of children who are difficult to understand and who have multiple speech-sound errors (Shriberg & Kwiatkowsi, 1994; Tyler & Watterson, 1991). These children have more complicated problems than do youngsters who have isolated phonological or articulatory deficiencies.

CASE STUDY 9.2

Personal Story of a Child with a Phonological Disorder

Brandi was just over 3 years of age when she was first brought to the University Speech and Hearing Center by her mother, Mrs. A. A preschool screening program had identified Brandi as needing further evaluation. Mrs. A. noted that Brandi mispronounced many words and could not be understood by people outside of the family, Brandi's 5-year-old brother frequently interpreted Brandi's speech so that others could understand her. Examination at the center revealed that Brandi had normal hearing and physical structure for speech. Her receptive and expressive language skills were above average in all areas but phonology. Brandi was diagnosed with a moderate to severe phonological disorder of unknown cause, and therapy was recommended.

An example of Brandi's speech at the beginning of therapy is as follows:

Target: Stop playing with my toy.

Brandi: Kop payin' wid my koy.

Because of her young age and her high spirits, therapy was presented through structured play activities. By the end of 3 months, she frequently self-corrected in the clinical setting. At the end of a year of therapy, Brandi's mother reported that her daughter was self-correcting at home. As a result, her speech intelligibility improved dramatically, even to unfamiliar listeners.

Speech Characteristics

The speech-sound productions of children with language learning disabilities are similar to those with developmental impairments, although complex syllable structures may be especially challenging (Orsolini et al., 2001). Children with language learning disabilities are also more likely to exhibit phonological errors that affect morpheme production (Owen et al., 2001). Speech-sound errors may increase also when children produce longer, more complex sentences.

Lifespan Issues

Although many individuals with language learning disabilities have normal or nearly normal intelligence, speech-sound disorders may have a deleterious effect on the acquisition of reading and writing skills. Learning to read requires knowledge and awareness of sounds and how sounds combine to form syllables, words, and sentences (i.e., phonological awareness skills). Children with language learning disabilities and phonological disorders may have poor phonological awareness skills (Larrivee & Catts, 1999; Peterson et al., 2009) and are at greater risk for reading and writing difficulties. This may require support and the use of various strategies to achieve their full potential (Owens, 2010).

Hearing Impairments

Because hearing is the primary way in which we acquire the speech sounds of a language, it is not surprising that individuals with hearing impairments may have disordered articulation and phonology. Not only are those with hearing loss limited in their ability to hear others, but their ability to monitor their own speech production may be inadequate. It must be recognized that phonology will not be impaired alone, but all parameters of speech, including voice quality, pitch, rate, and rhythm, will similarly be affected.

Speech Characteristics

Although the specifics vary, in general, the more severe a person's hearing loss, the less intelligible his or her speech is likely to be (Wolk & Schildroth, 1986). Although an exact relationship between type and degree of hearing impairment and speech cannot be made, certain patterns are frequently observed (Bernthal et al., 2013). Speech-sound errors produced by deaf children are provided in Table 9.3.

Thought Question

Lifespan Issues

The age at onset and the degree and type of hearing impairment influence the nature of the articulation and phonological disability. Individuals who are born deaf or with severe hearing impairment typically have poorer speech than those who lose hearing later in life. Speech deteriorates over time, however, for those who are initially hearing and become hard-of-hearing or deaf after they have learned to talk. Accuracy of speech-sound production can be enhanced by the use of hearing aids (for individuals with some hearing) and appropriate training. (See Chapter 12.) Even the best speech of many adults with deafness is nearly unintelligible to others.

TABLE 9.3

Typical speech-sound errors in children who are deaf

Sound Substitution Pattern	Examples
Voiced for voiceless sounds	*see → zee* [zi]
	can → gan [gæq]
Nasal for oral consonants	*dog → nong* [nɔŋ]
Sounds with easy tactile perception for those difficult to perceive	*run → wun* [wʌn]
Tense vowels for lax vowels	*sick → seek* [sik]
Diphthongs for vowels	*miss → mice* [maɪs]
Vowels for diphthongs	*child → chilled* [tʃɪld]

Sources: Based on Bernthal et al. (2013) and Calvert (1982).

Neuromuscular Disorders

The dysarthrias are a group of motor-speech disorders caused by neuromuscular deficits that result in weakness or paralysis and/or poor coordination of the speech musculature. Dysarthrias typically affect respiration, phonation, resonance, and articulation. They are described in more detail in Chapter 10.

About 75% to 85% of children with **cerebral palsy (CP)** have impaired speech production skills (Love & Webb, 2001). CP is a neuromotor disorder caused by brain damage before, during, or soon after birth (Pena-Brooks & Hedge, 2007). The location and severity of brain damage predict dysarthria type(s) and degree of communication impairment. However, articulatory difficulties are the most prominent deficit for children with CP (Mecham, 1996).

Speech Characteristics

The speech characteristics associated with dysarthria depend on the type of CP. The most common type is spastic CP, caused by lesions to motor neurons in one or both frontal lobes. If the lesions are bilateral, the child exhibits spastic dysarthria, which results in a slow speech rate, imprecise articulation of consonants, harsh voice, hypernasality (with possible air escape out of the nose), and prosodic abnormalities (e.g., equal and excess stress patterns). Errors tend to be similar whether reading aloud, speaking to a group, or during one-to-one conversation. Speech training or the use of augmentative or alternative communication may be required.

Lifespan Issues

In CP, the general motor and speech signs are present from early childhood onward. Approximately a third of individuals with CP have average to above-average intelligence; the rest exhibit varying degrees of cognitive deficits. Accompanying deficits may include epilepsy, visual processing deficits, and/or hearing impairment (Cummings, 2008). Although the damage to the brain does not progressively worsen, general motor functioning may deteriorate over time (Long, 1994).

Childhood Apraxia of Speech

Childhood apraxia of speech (CAS) is a neurological speech-sound disorder that affects the ability to plan and program the movement sequences necessary for accurate speech production. It is not the result of neuromuscular weakness (American Speech-Language-Hearing Association [ASHA], 2007). Before speech is produced, the motor plan/program that specifies all the necessary parameters for accurate production of that utterance (e.g., positioning and timing of the articulators; amount of muscle activation) is accessed in the brain. This enables speech to be produced rapidly yet accurately. If we had to think about how each structure needed to move (i.e., lips, tongue, jaw, vocal folds, respiratory muscles) and with how much force every time we spoke, we might need several minutes to produce a sentence rather than the several seconds that is typical.

Because children with apraxia of speech have impaired motor planning and programming capabilities, they are unable to learn the motor plans/programs necessary for rapid, accurate speech production in the same fashion as unimpaired children. As a result, their connected speech is often highly unintelligible, segmented or choppy, disfluent, and lacking in prosodic variation. Children with severe apraxia of speech with normal cognition and receptive language abilities are often aware that speech is difficult and may initially be unwilling to try to talk because they know they will fail. It is therefore important that you as an SLP build a trusting relationship with the child. It is essential that a child at least attempt to imitate words with an SLP to determine if he or she does in fact have CAS. Specific treatment for children with CAS is discussed later in this chapter.

Speech Characteristics

Although there are no definitive neurological or behavioral markers of CAS, ASHA (2007) has proposed the following constellation of speech characteristics to help guide SLPs in properly diagnosing CAS:

- Inconsistent errors on consonants and vowels in repeated productions of syllables or words
- Lengthened and disrupted transitions between sounds and syllables
- Inappropriate prosody, especially in the realization of word or phrasal stress

In addition, children with CAS often have limited consonant and vowel repertoires, may exhibit groping and/or trial-and-error behaviors, frequently omit sounds or inappropriately add sounds, and produce single words better than they produce running speech (Davis et al., 1998). Although most consider CAS to be a motor-speech disorder, because speech is necessary to learn language and linguistic sound representations, children with CAS have concomitant expressive language and phonological impairments as well.

Lifespan Issues

Children can be diagnosed with CAS as early as 3 or 4 years of age; however, to make this diagnosis correctly, children need to attend and focus on the clinician and attempt multiple repetitions of word stimuli. Standardized assessments are available, such as the Verbal Motor Production Assessment for Children (Hayden & Square, 1999) and the Kaufman Speech Praxis Test for Children

(Kaufman, 1995); however, no one test has been shown to be completely reliable or valid with regard to diagnosing CAS (McCauley & Strand, 2008). Children with severe CAS initially may be nonverbal. Therefore, children may need to rely on other means to help communicate effectively (i.e., augmentative or alternative communication) as they are learning to speak.

Children with normal or nearly normal cognition and receptive language abilities have a good prognosis for verbal communication. However, they may continue to have poor intelligibility throughout the school-age years. They will likely also have difficulties with phonological awareness skills, reading, writing, and spelling. Children with CAS continue to exhibit phonological errors well past the age at which these should have resolved. They may continue to have difficulties with certain classes of sounds and/or production of multisyllabic words (e.g., umbrella) into adolescence and young adulthood. The Apraxia-KIDS website (www.apraxia-kids.org) provides the latest research in the area of CAS for parents and caregivers of children with CAS.

The most readily apparent difficulties in individuals who persist with motor planning/programming difficulties are prosodic abnormalities. Even if speech is intelligible, they may continue to have flattened prosodic contours, a segmented speech pattern, and/or incorrect word and sentential stress. Note that CAS is a speech diagnosis that changes with maturation and with treatment. A child may present early on with a primary diagnosis of CAS, but this may change as he or she gets older. Some children present with a primary diagnosis of phonological impairment but may also exhibit some minor motor planning/programming difficulties. It is your job as an SLP to correctly differentially diagnose the child in order to select the appropriate treatment approach and targets (Strand & McCauley, 2008).

Click here to check your understanding of the concepts in this section.

Structural Functional Abnormalities

Rapid and accurate movements involving the jaw, lips, tongue, hard and soft palates, and teeth are necessary for articulatory precision; however, usually only gross abnormalities of these structures can negatively impact speech intelligibility. Individuals are remarkably adept at compensating for most structural abnormalities, even partial or complete surgical removal of the tongue. Severe deformity of the hard and soft palates as a result of clefting is far more detrimental to speech production as discussed in Chapter 8.

LANGUAGE AND DIALECTAL VARIATIONS

A person whose speech reflects a regional or foreign language influence may also have a speech disorder. However, the regionalism or foreign dialect in itself is not a disorder.

If you are a native speaker of American English and go to another country, such as Greece, to live, you will learn Greek to communicate with those around you. When you speak in Greek, your speech will reveal your American background. You will speak Greek with an "American accent." This is not a speech disorder.

Similarly, if you are from Georgia and move to Massachusetts, you will bring your Georgia regionalism with you. Again, this is not a disorder but a dialectal difference to those in your new environment. Many Americans take pride in their regional and linguistic backgrounds and cherish the cultural diversity that characterizes this country.

In assessing phonological skills, an SLP must guard against over- and underdiagnosis, especially with bilingual and minority dialect speakers (Yavas & Goldstein, 1998). The SLP must differentiate between disordered phonology and

that which is simply different due to foreign language or dialect influences. This can be accomplished by doing the following:

1. Recognize cultural differences.
2. Evaluate phonological competence in all relevant languages whenever possible.
3. Select appropriate assessment tools.
4. Use nonstandard assessments often with the help of bilingual assistants.
5. Describe phonological patterns.
6. Diagnose any phonological disorders that exist (Yavas & Goldstein, 1998).

The SLP then plans and engages in intervention, as appropriate. If dialect differences are targeted, the SLP must assess the client's attitude toward his or her dialect and the individual's motivation for accent reduction. Some generalizations can be made regarding the speech of individuals from various linguistic and regional backgrounds. Table 9.4 highlights just a few of them.

TABLE 9.4

Sample phonological characteristics of American English dialects and non-English language influences on spoken English

Rule	Example
African American Vernacular	
Final cluster reduction	*presents → presen*
Stopping of interdental initial and medial fricatives	*they → dey*
	nothing → noting
Deletion of *r*	*professor → puhfessuh*
Appalachian English	
Addition of *t*	*once → oncet*
Addition of initial *h*	*it → hit*
Addition of vowel within clusters	*black" → buhlack*
Portuguese, Italian, Spanish	
Final consonant deletion	*but → buh*
	house → hou
Cantonese	
Confusion of /i/ and /ɪ/	*heat → hit*
	leave → live
	hit → heat
	live → leave
Spanish	
Confusion of /d/ and /ð/	*they → day*
Devoicing of *z*	*lies → lice*
Affrication of /ʃ/	*shoe → chew*

Sources: Based on Iglesias & Goldstein (1998) and Yavas & Goldstein (1998).

Characteristics of Articulation and Phonology

It is impossible to describe all the variations in articulation and phonology that reflect non-English or dialectal influences. The first language may interfere with languages that are learned later. For example, in Spanish, /d/, and /ð/ are allophones, or variations of the same phoneme, whereas in English, these are two separate phonemes, as can be seen in the words *dough* [do] and *though* [ðo]. Native Spanish speakers, however, may confuse the /d/ and /ð/ and pronounce both words the same way (Yavas, 1998). Some first-language interferences are neutral or positive.

Lifespan Issues

Some adults for whom English is a second (or third or fourth) language choose to modify their foreign accent. Often this desire is based on professional considerations. Teachers of English as a second language and SLPs may contribute to the improvement of English expression and comprehension. However, for adolescents and beyond, the articulatory patterns of a first language are often firmly established and are difficult to entirely eliminate. The goal, then, is not to make a non-native speaker sound like a native but rather to improve intelligibility and thereby the person's communicative effectiveness.

Assessment

Disorders of articulation and phonology sometimes, but not always, occur with other communication impairments.

Comprehensive assessment by an SLP is necessary to determine the nature of a speech-sound disorder. Formal and informal measures specifically designed to assess phonological and articulation impairments are discussed in the following sections. The goals of speech-sound assessment are as follows:

- Describe the individual's speech-sound inventory.
- Identify patterns of errors (i.e., phonological processes).
- Determine the impact of speech-sound errors or error patterns on communicative effectiveness.
- Identify factors that may relate to etiology or maintenance of the speech-sound impairment.
- Plan treatment when appropriate.
- Make a prognosis.
- Monitor change over time (Bernthal et al., 2013).

In addition, the case history, interview, hearing screening, and structural functional examination may provide insight into the etiology of a disorder and contribute to predictions of improvement. Collection of baseline data from which to measure change over time with or without intervention is an integral part of the initial assessment. Typical assessment procedures are briefly described and explained in the following sections.

Description of Phonological and Articulatory Status

An SLP should obtain data on several aspects of speech-sound production.

Speech-Sound Inventory

A speech-sound inventory and description of word and syllable shapes are highly appropriate for children who are at a very early stage of development and for others whose speech is markedly unintelligible. A recommended system for listing phonemes is by manner of production and syllable and word position (Grunwell, 1987; Klein, 1998). Table 9.5 shows a speech-sound inventory for Pablo, a 4-year-old boy who is receiving speech and language therapy.

Syllable and Word Structure

A list of the CV patterns that have been produced in words suggests their complexity. An SLP might list the word and syllable shapes that are most characteristic of a client's speech as well as the reductions or simplifications that have occurred. Figure 9.5 provides a list of the words in Pablo's language sample, in both standard orthography and phonetic transcription.

Sound Error Inventory

In all cases, an SLP needs to identify phonemes that a client misarticulates. This list is typically compiled on the basis of formal testing of sounds in words. The Goldman-Fristoe Test of Articulation-2 (GFTA-2) (Goldman & Fristoe, 2000) and the Structured Photographic Articulation Test II–Featuring Dudsberry (SPAT-DII) (Dawson & Tattersall, 2001) are two commonly used published tests. Sound errors are reported as **substitutions**, **omissions**, **distortions**, and **additions** in syllable/word positions. For example, if 8-year-old Amanda pronounced *lemon* as *wemon,* the SLP might record:

> w/l (I) [meaning *w* was substituted for *l* in the initial position; i.e., at the beginning of a word]

Errors can be compared with norms for the child's age.

> If a client has only one or two speech-sound errors and all other phonemes are correctly produced, a statement to that effect is sufficient. A listing of all the correct phonemes is not needed.

TABLE 9.5

Phonemes produced in various word positions by Pablo, age 4 years

Manner of Production	Syllable Initial Word Initial	Syllable Initial Word Within	Syllable Final Word Within	Syllable Final Word Final
Nasals	/m/ /n/ *more, no*	/n/ *nana*	/m/ *Sam-uel*	/m/ *drum*
Stops	/p/ /b/ /t/ /d/ *put, ball, top, drum*	/p/ /b/ /d/ *happy, Toby, lady*		
Fricatives	/h/ /f/ /s/ *house, face, see*	/f/ *coffee*		
Glides	/w/ /j/ *wet, you*	/j/ *yo-yo*		

Note: Words were taken from a spontaneous language sample. Italicized words are exemplars of produced phonemes in given word positions. Production accuracy of the entire word is not suggested.

Figure 9.5 Words in Pablo's language sample in standard orthography and phonetic transcription.

more → [mɔə]	*happy* → [hæpi]	*baseball* → [bebɔ]
no → [no]	*Toby* → [tobi]	*ice cream* → [aɪtim]
banana → [nænə]	*lady* → [ledi]	*face* → [fe]
Samuel → [sæmu]	*house* → [hau]	*wet* → [wɛ]
put → [pʊ]	*face* → [fe]	*you* → [ju]
ball → [bɔ]	*see* → [si]	*yoyo* → [jojo]
top → [tɑ]	*shoe* → [su]	*light* → [jaɪ]
drum → [dʌm]	*coffee* → [tɔfi]	*balloon* → [bʌju]

The word shapes produced include CV ([no]), CVCV ([jojo]), CVC ([dʌm]), and VCVC ([aɪtim])

The word shapes that were reduced are

CVC → CV	(*put* → [pʊ])
CVCVCV → CVCV	(*banana* → [nænə])
CVCCVC → CVCV	(*baseball* → [bebɔ])
VCCCVC → VCVC	(*ice cream* → [aɪtim])

Phonological Process Analysis

Many research studies have shown that targeting a process rather than an individual phoneme has the advantage of encouraging generalization of learning to similar phonemes and phonological contexts (Gierut, 1998). Therefore, if an individual has numerous errors, it is helpful to identify which phonological processes are apparent. An SLP may analyze phonological process information on the basis of transcriptions of a child's conversational or single-word utterances. Often SLPs use a published test such as the Khan-Lewis Phonological Analysis–2 (Khan & Lewis, 2002), which analyzes phonological processes on the basis of the findings of the Goldman-Fristoe Test of Articulation–2 (Goldman & Fristoe, 2000). Other published tests for determining phonological processes include the Hodson Assessment of Phonological Patterns–3 (HAPP-3) (Hodson, 2004) and the Bankson-Bernthal Test of Phonology (Bankson & Bernthal, 1990). One version of the Comprehensive Test of Phonological Processing addresses the needs of older individuals ages 7 through 24 years (Wagner et al., 1999).

Phonological processes also may be analyzed by using a computerized program. These systems often save time and provide more detailed information than hand-scored procedures. One example of a computerized phonological analysis program is the Computerized Articulation and Phonological Evaluation System (Masterson & Bernhardt, 2001). The HAPP-3 noted in the previous paragraph is also available in an updated computerized version called *Hodson Computerized Analysis of Phonological Patterns* (4th edition) (Hodson, 2012). The Khan-Lewis Phonological Analysis–2 mentioned previously also has computer assistive software that can be purchased at an additional cost.

Thought Question

In the case of Amanda above, if her only phoneme error were /l/ → /w/ (I), this would not be indicative of a phonological process; it is a *single* sound substitution, an error of articulation. If, however, Amanda produced /l/ → /w/ (I,M) and

/r/ → /w/ (I,M), this *pattern* could be described as the phonological process gliding for liquids because /l/ and /r/ are liquids, and they were produced as the glide /w/.

Intelligibility

Speech **intelligibility** refers to how easy it is to understand an individual. Poor intelligibility has a negative impact on communicative effectiveness. Intelligibility depends on such factors as the number, type, and consistency of speech-sound errors. The person's voice, fluency, rate, rhythm, language, and use of gesture also contribute to ease of comprehension, and these should be noted. Other factors beyond the speaker include the listener's hearing acuity, familiarity with the speaker, and experience listening to disordered speech, as well as environmental noise, message complexity, and environmental cues. Figure 9.6 illustrates a commonly used subjective way of reporting intelligibility.

A more objective measure of intelligibility is percentage of intelligible words. If speech is exceedingly poor, intelligibility may be measured in terms of syllables or consonants (Strand & McCauley, 1997). A recorded sample of continuous speech is transcribed, and the percentage of intelligible words is computed as follows:

$$\text{Percentage of Intelligible Words} = \frac{\text{Number of Intelligible Words}}{\text{Total Number of Words}} \times 100$$

The percentage of intelligible syllables or consonants is computed in a similar fashion. Intelligibility measures are becoming increasingly common in research and clinical use (Shriberg et al., 1997; Wilcox & Morris, 1999). In general, highly unintelligible speech signals a severe disorder, whereas readily intelligible speech suggests that the disorder may be mild.

Prognostic Indicators

Detailed description of a client's speech provide some insight into the prognosis for improvement with and without therapy. The client's age, severity of the disorder, other medical or concomitant problems, and availability of family support also help predict the client's improvement. For adults, the etiology of the speech-sound impairment largely impacts prognosis (i.e., stroke vs. neurodegenerative disease). For children, the consistency of speech-sound errors, stimulability for correct production of error sounds, and possibly the ability to discriminate error sounds from target sounds may help determine prognosis.

Consistency

Think about your own speech. If you are reading aloud in front of a class, you are likely to be very careful in how you produce all the sounds of the words. In contrast, when you are speaking casually to a friend, your articulation is probably

Although computer analysis of phonological processes might save time, once the program is learned, the SLP must still understand the nature of the processes to work effectively with the client.

Figure 9.6 Subjective descriptors of intelligibility.

1. Readily intelligible even when the context is not known
2. Intelligible with careful listening when the context is not known
3. Intelligible with careful listening when the context is known
4. Unintelligible with careful listening even when the context is known

far less precise. Inconsistency is not uncommon, and it may be a clue to the exact nature of an articulation or a phonological error. Let's go back to Amanda. If her misarticulation of /l/ occurs only when she is in conversational speech and then only at the beginning of words, her speech-sound error may be more amenable to change. Lack of consistency is considered a positive prognostic indicator. Ironically, an individual with consistent errors may be easier to understand than someone whose error pattern is inconsistent. Consistency of phoneme errors is achieved by evaluating the client's speech during more than one task and in more than one word position and phonemic context (Bernhardt & Holdgrafer, 2001).

Stimulability

Assessment should always include trial therapy. **Stimulability** is the ability of an individual to produce the target phoneme when given focused auditory and visual cues. Typically, an SLP will say, "Look at me. Listen to me. Now say exactly what I say: _____." The SLP will first prompt correct production of the error phoneme or pattern within the word in which it had been misarticulated. If the client does not correctly imitate the SLP, the prompt is moved to the syllable or phoneme level.

Although stimulability is often a positive prognostic indicator, research studies suggest a more complex relationship. Children who are stimulable may respond more quickly to correction of the target phoneme and may also be more likely to self-correct without therapy than those who are not stimulable. Those sounds for which a child is not stimulable are highly unlikely to change without treatment. However, among children in therapy, those with low stimulability scores often make more progress, especially with untreated sounds, than do those who are more stimulable.

Error sound discrimination is often assessed both externally and internally. **External error sound discrimination**, or **interpersonal error sound discrimination**, refers to the ability to perceive differences in another person's speech. For example, in external discrimination, the SLP might ask the client, "Are these the same or different: *wemon—lemon?*" Sometimes two words are contrasted, and the client is asked to point to pictures that can be labeled using either the targeted phoneme or the one that was substituted; for example, shown two pictures, the client is told, "Point to awake. Now point to a lake." **Internal error sound discrimination**, sometimes termed **intrapersonal error sound discrimination**, is the ability to judge one's own ongoing speech. The client may be asked to judge the accuracy of her or his phoneme productions.

The relationship of speech-sound discrimination to articulation and phonology remains unclear. Perception of a contrast such as /r/ or /l/ and /w/ usually precedes production in children who are developing typically (Strange & Broen, 1980). In addition, children who are better at internal discrimination have been reported to have more correct articulations (Lapko & Bankson, 1975). From this, we might conclude that error sound discrimination ability signals a more favorable prognosis than the absence of this ability. Two warnings about phoneme discrimination testing are warranted: (1) Only the error phonemes appear to relate to therapeutic prognosis, so only these should be routinely assessed. (2) Many young children do not understand the concept of same vs. different; therefore, their error sound discrimination is difficult to judge.

Improvement in non-targeted phonemes, in addition to those that are taught, is often made when the targets are relatively difficult.

INTERVENTION

If the results of an assessment suggest that treatment is appropriate, an SLP must determine how to proceed. Initial questions to be answered include the following:

- Where will therapy occur? (Clinic, school, or home setting?)
- How frequently will the client be seen? (Once or twice a week or three, four, or five times weekly?)
- How long will the sessions be? (The typical range is 20 to 60 minutes.)
- Will therapy be one to one or in a group setting?

Answers to these questions will be related to the facilities that are available as well as to the needs of the client. In addition to such administrative-type decisions, an SLP must determine the following:

- What are the treatment targets?
- What treatment approach appears most suitable?

Family members may be enlisted to reinforce treatment goals under the guidance of a speech-language pathologist. Carefully structured homework assignments can provide a client with additional beneficial practice.

Target Selection

The major goal of therapy should be to make the client easier to understand and improve communicative effectiveness. One factor is the frequency of a particular misarticulated phoneme within the language: For example, /ʒ/, as in *treasure* ([trɛʒɚ]), does not occur in many American English words, so it would not normally warrant early attention. However, targets that may generalize to correction of phonological processes would be extremely helpful in improving intelligibility. If a child exhibits the process stopping of fricatives, as in saying *zoo* as [du] and *five* as [paɪb], intervention for correct production of /z/ may generalize to other fricatives, including /f/ and /v/.

A second factor in target selection is likelihood of success. An SLP might initially choose targets that a client will probably master relatively quickly. The best predictors of ease of mastery are stimulability and inconsistency. If the client can produce the target phonemes when prompted to imitate with increased visual and auditory stimulation, this is a favorable sign. In addition, if the client does not misarticulate a particular target in all words or situations, this demonstrates that successful intervention is likely (Miccio et al., 1999).

Some research studies have demonstrated that greater generalization to nontarget phonemes occurs when the targets are more difficult—that is, not stimulable, later developing, and more phonetically complex (Gierut, 1998). The complexity approach is discussed later in this chapter. It is up to an SLP to determine whether early success on a few targets or more long-term progress on multiple phonemes is best for an individual client.

Intervention Approaches

A variety of therapy approaches and techniques exist. An SLP might target one or two phonemes or multiple phonemes at a time. Therapy might focus on phonological patterns of errors, emphasize motor-speech production, or target the nonsegmental aspects of speech such as rate, rhythm, and stress and intonation. Most SLPs adjust their approach to suit each client and combine procedures to provide

individually tailored therapy. Highlights of select therapy approaches are provided in the next few sections (c.f. Kamhi, 2006b, for more details), and the evidence in support of specific approaches or techniques is summarized in Box 9.1.

Bottom-Up Drill Approaches

Bottom-up drill approaches focus on discrete skills, with progression from the simplest to the most complex movements. Some begin with auditory discrimination training, oral-motor exercises, or isolated sound productions and work up

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BOX 9.1 | **Evidence-Based Practices for Individuals with Articulation and Phonological Disorders**

General Intervention

- Approximately 70% of preschool children who receive intervention for speech-sound disorders exhibit improved intelligibility and communication functioning.
- Approximately 50% of children who are unintelligible to both familiar and unfamiliar listeners progress so that they are intelligible to all listeners.
- More therapy is equated with more improvement.

Specific Behavioral Treatment Approaches or Techniques

- The *traditional motor* and *sensory-motor* approaches are highly effective for children who have only one or a few sounds in error (e.g., /l/, /r/) and for whom language skills are within normal limits.
- *Dynamic Temporal and Tactile Cueing* (*DTTC*) has been shown to be effective for a small number of children with severe childhood apraxia of speech. This intensive treatment involves speech production practice sessions two times per day (30 minutes each), 5 days per week for a total of 6 weeks. Replication studies examining the effectiveness of DTTC fewer times per week (i.e., three times per week for 60 minutes) showed positive results for some but not all research participants. More research is needed to determine the long-term effectiveness of DTTC.
- The *Lee Silverman Voice Treatment* was shown to be effective in four young children with spastic CP. Improvements in loudness and speech intelligibility were maintained at 6 months follow-up.

- The *complexity approach,* based on the work of Judith Gierut and colleagues, has shown that targeting later-acquired sounds and/or consonant clusters leads to increases in treated and in untreated sounds, both within and across sound classes. Also, using phoneme pairs that are maximally contrasted (i.e., differ by major class distinctions) and that compare two new phonemes (vs. including the child's error sound) also results in greater systemwide changes.
- The steps of *whole language* used during storybook reading improve phonological performance in some children, but more research is needed. This approach is not suitable for children with severe speech-sound disorders who require direct, structured therapy.
- The *cycles approach* targets multiple phonological processes over an extended period of time and is effective for children who are highly unintelligible. Three to six cycles of phonological intervention involving 30 to 40 hours of instruction are reportedly necessary for a child to become intelligible.
- The *multiple oppositions approach* is best suited for children who substitute one sound for many different sounds. This approach has been shown to be effective for children who are highly unintelligible, particularly during the early stages of treatment.
- The *Metaphon approach* is aimed at developing the child's metaphonological awareness skills in two phases. Limited evidence is available about the effectiveness of this approach, however.

Source: Based on Fox & Boliek (2012); Gierut (2009); Gierut et al. (1996); Hodson & Paden (1991); Hoffman et al. (1990); Howell & Dean (1994); Jarvis (1989); Maas & Farinella (2012); Maas et al. (2012); Strand et al. (2006); Williams (2000).

to correct production of the error sound in connected speech (Kamhi, 2006b). No evidence supports the use of oral-motor exercises, however, so these are not recommended. The utility of auditory discrimination training is also not well established, and more research is needed.

In bottom-up drill approaches, the error sounds are targeted one at a time. Speech production practice may involve production of an error sound in isolation or in nonsense words, structured phrases, sentences, or conversational speech. Various ways to establish correct production of an error sound may be used, including phonetic placement (e.g., using a tongue blade to push the articulators into position) or sound shaping (i.e., using a sound the child can produce to help produce the new sound).

When a sound is mastered in the therapy setting, speech assignments are provided to allow the client daily practice of his or her new skills and promote generalization outside the therapy setting. Instruction on self-monitoring of correct speech-sound production and/or monitoring by others in a child's environment may also be introduced (Pena-Brooks & Hedge, 2007).

The **traditional motor approach** and **sensory-motor approach** are two well-known bottom-up drill approaches. The traditional motor approach begins with auditory discrimination training (i.e., ear training); establishment of the new sound using sound-evoking techniques (e.g., phonetic placement); production practice with the newly established sound in isolation and in nonsense syllables, words, phrases, sentences, and conversation; and generalization and maintenance practice (e.g., homework assignments, practice in other communicative settings or situations) (Van Riper & Emerick, 1984). The sensory-motor approach is similar, but it does not include auditory discrimination training and begins with production at the syllable level rather than the sound in isolation (McDonald, 1964; Pena-Brooks & Hedge, 2007).

Language-Based Approaches

Language-based approaches integrate the learning of error sounds into meaningful, functional contexts either through play or through the reading and retelling of storybooks. The focus is actually on increasing language and/or narrative complexity without explicit instruction on speech-sound production. Rather, instruction is implicit, or within the context of language learning. Such an approach is not suitable for children who exhibit severe speech delays and require more direct, structured speech practice. Language-based approaches have proven effective for promoting generalization of newly learned sounds to spontaneous speech following successful drill-type therapy (Williams, 2000).

Phonological-Based Approaches

Children who have multiple speech-sound errors and are highly unintelligible may benefit from phonologically based treatment that focuses on targeting phonological patterned errors (processes) as opposed to individual sounds. By targeting a phonological process, such as final consonant deletion, many sounds can be practiced at one time, thereby increasing the child's speech-sound inventory and improving speech intelligibility more rapidly.

One of the most well-known and widely used phonologically based approaches is the *cycles approach* (Hodson & Paden, 1991). A cycle can be one 60-minute session, two 30-minute sessions, or three 20-minute sessions. Only

one phonological process is targeted at a time, and several cycles may be necessary for each target process. Therapy begins with the most stimulable phonological process and progresses through multiple cycles until all phonological processes have been addressed (Pena-Brooks & Hedge, 2007).

Cycles training sessions are highly structured. Each session involves review of the previous session, auditory-perceptual training, and production training that incorporates use of **minimal pair** contrasts, or the contrasting of phonemes in pairs of words. This is accomplished by presenting the child with two pictured words that differ by one phoneme; one pictured word contains the child's error sound/error pattern and the other is the correct form (e.g., *pig–big*). These production exercises involve having the child produce both words in sentences and asking the child if the sentences make sense (e.g., "The *big* lives on the farm").

In addition to minimal pair contrasts that differ by one or a few phoneme features, treatment approaches may use phoneme contrasts that differ by many different features, including place, manner, and voicing (e.g., *chop–mop*). These phoneme pairs are called **maximal contrasts**. The **multiple oppositions approach** uses maximal contrast word pairs. This approach is effective for children who substitute one sound for multiple sounds, which results in production of the same word for different words (e.g., "dip" is produced for *chip*, *trip*, *ship*, and *kip*). Word pairs are created to contrast all error sounds at the same time.

Other phonologically based approaches aim to increase the child's **metaphonological skills**, or the ability to analyze, think about, and manipulate speech sounds (Pena-Brooks & Hedge, 2007). One such approach is the **Metaphon approach**, which is designed to increase the child's active cognitive participation in the remediation of his or her speech-sound disorder. Metaphon theorists believe a child must be aware of his or her speech errors, have a desire to modify them, know the relevant speech targets, and have the neuromotor capability to produce the targets correctly with adequate speed in various speech contexts (Hewlett, 1990).

The Metaphon approach consists of two phases. Phase 1 focuses on expanding the child's knowledge of the sound system of the language, thereby preparing him or her to learn how sounds are produced and how they differ from one another. Phase 2 focuses on transferring this knowledge to communicative situations and teaches the child to self-monitor and correct speech output (Howell & Dean, 1994).

Complexity Approach

It has been argued that *what* is treated in therapy is more important than *how* it is treated (Gierut, 2005). Given that no one treatment approach for articulation or phonological impairments has proven more effective than another, eliminating error sound patterns and increasing the child's speech-sound inventory in a shorter time frame may be a better goal in some cases. The complexity approach involves training more difficult sounds (e.g., teaching a 3-year old to produce /v/, which is not mastered until much later), which then leads to generalization of untreated but less complex sounds (e.g., /f/).

This approach is considered more efficient than other phonological approaches (e.g., cycles), because only a few complex targets need to be trained to promote change in the child's overall speech-sound system (Gierut, 2001, 2005). The caveat, however, is that it may take longer initially to train children to produce more complex speech targets. As a result, these children may

remain unintelligible for longer periods at first, thereby becoming frustrated with their continued lack of communicative effectiveness. Therefore, success of this approach depends on the severity of the child's disorder, his or her frustration level, and the overall goal of therapy (i.e., increase speech intelligibility vs. promote significant changes in the child's overall speech-sound system) (Kamhi, 2006; Pena-Brooks & Hedge, 2007).

Treatment of Neurologically Based Motor-Speech Disorders

Two evidence-based approaches are gaining in popularity for use with children with neurologically based motor-speech disorders. One was specifically designed for children with childhood apraxia of speech, and the other was adapted from the adult version used with patients with Parkinson's disease for children with dysarthria. These specific approaches are discussed in the next section.

Dynamic Temporal and Tactile Cueing

Dynamic Temporal and Tactile Cueing (DTTC) is an intensive motor-based, drill-type treatment designed for children with severe apraxia of speech (Strand et al., 2006). Unlike in the bottom-up approach, treatment with DTTC targets include a small number of functional words and phrases. Speech production practice of each word or phrase involves use of techniques that are effective for adults with apraxia of speech (Rosenbek et al., 1973; Strand & Skinder, 1999). For instance, a clinician says to a client, "Watch me, listen to me, and do what I do" and then provides various levels of cues (e.g., tactile, simultaneous productions), depending on the client's needs.

In DTTC, the client practices the target words slowly and produces them simultaneously with the clinician at first. In addition, this approach incorporates principles that promote motor learning (e.g., daily, repetitive practice, systematic feedback). The clinician may use tactile cues (e.g., physically maneuvering the child's jaw into the correct position) to help the child achieve the correct starting position for the desired utterance. As the child's productions improve, direct imitation, delayed imitation, and spontaneous productions of target utterances are elicited.

The eventual goal is to have the child produce the word correctly spontaneously, both in and out of the clinic. Five to 10 minutes of home practice daily with family members is also recommended. The rationale for practicing only a small set of words is that it will foster neural maturation of motor planning/programming substrates, thus facilitating future speech motor learning (Strand et al., 2006).

Lee Silverman Voice Treatment

The Lee Silverman Voice Treatment (LSVT), discussed briefly in Chapter 8 is an intensive treatment provided four sessions per week, 60 minutes per session, for 4 weeks and was originally designed to increase loudness levels of patients with Parkinson disease. This treatment has since been used successfully with children with CP, with only slight modifications (Fox & Boliek, 2012). Note that SLPs must obtain proper training and certification prior to using this approach with clients. Go to the LSVT website (www.lsvtglobal.com) for more information about how to become certified in LSVT.

Thought Question

Computer Applications

Computer programs, games, and apps are available that can be used in conjunction with direct treatment provided by an SLP. These programs provide exercises in both perception and production of speech-sound targets, as well as nonsegmental targets (i.e., pitch, duration, and loudness). Computer applications provide an opportunity for daily practice of treatment targets, which is essential to the learning of new skills. Some computer games are even designed to involve caregivers in the treatment process, which facilitates effective communication between a child and his or her primary communication partners (Patel & Salata, 2006).

Generalization and Maintenance

Success of treatment is determined by the application of what has been learned in a clinical setting to everyday life.

Click here to check your understanding of the concepts in this section.

Once a client has achieved an acceptable level of correct phoneme production, an SLP must ensure that slippage does not occur and that the new speech pattern becomes habitual. Many SLPs introduce self-monitoring exercises from the very beginning of therapy. Doing so helps clients understand that they are ultimately responsible for their own success. Once an SLP believes that a client is ready for dismissal from therapy, follow-up sessions may be scheduled at progressively longer intervals. If the progress has been maintained over time, the remediation has been effective.

SUMMARY

Producing the sounds of a language during speech is a complex process. It involves an inner conceptualization of phonemes and phonotactic rules so that in our "mind's ear" we know how the language we are speaking should sound. Speech production also requires the neuromotor ability to move our articulators to form the desired sounds in a smooth, rapid, and automatic fashion. As children develop spoken language, they typically employ phonological processes that simplify adult forms. If these persist beyond the expected ages, they may present difficulties. Hearing disorders, neurological impairments, and structural abnormalities may contribute to phonological and articulatory disorders. Foreign language background and regional dialects contribute to variations in speech. Assessment of articulation and phonology includes a detailed description of the individual's phonological output, as well as investigation of etiology and determination of prognosis. Intervention strategies may include perceptual training, contrasted phonemes in word pairs, and speech production drill practice. The general goal is improved intelligibility in spontaneous speech.

SUGGESTED READINGS

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10 Motor Speech Disorders

CHAPTER LEARNING GOALS

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

- Define *motor speech disorder*.

- Differentiate between dysarthria and apraxia of speech.

- Describe three etiologies of motor speech disorders in adults and children.

- Explain the general assessment and treatment techniques used with motor speech disorders, as well as the research-based findings on their efficacy.

- Describe a specific technique for treating each of the speech production subsystems (i.e., respiratory, phonatory, resonatory, articulatory).
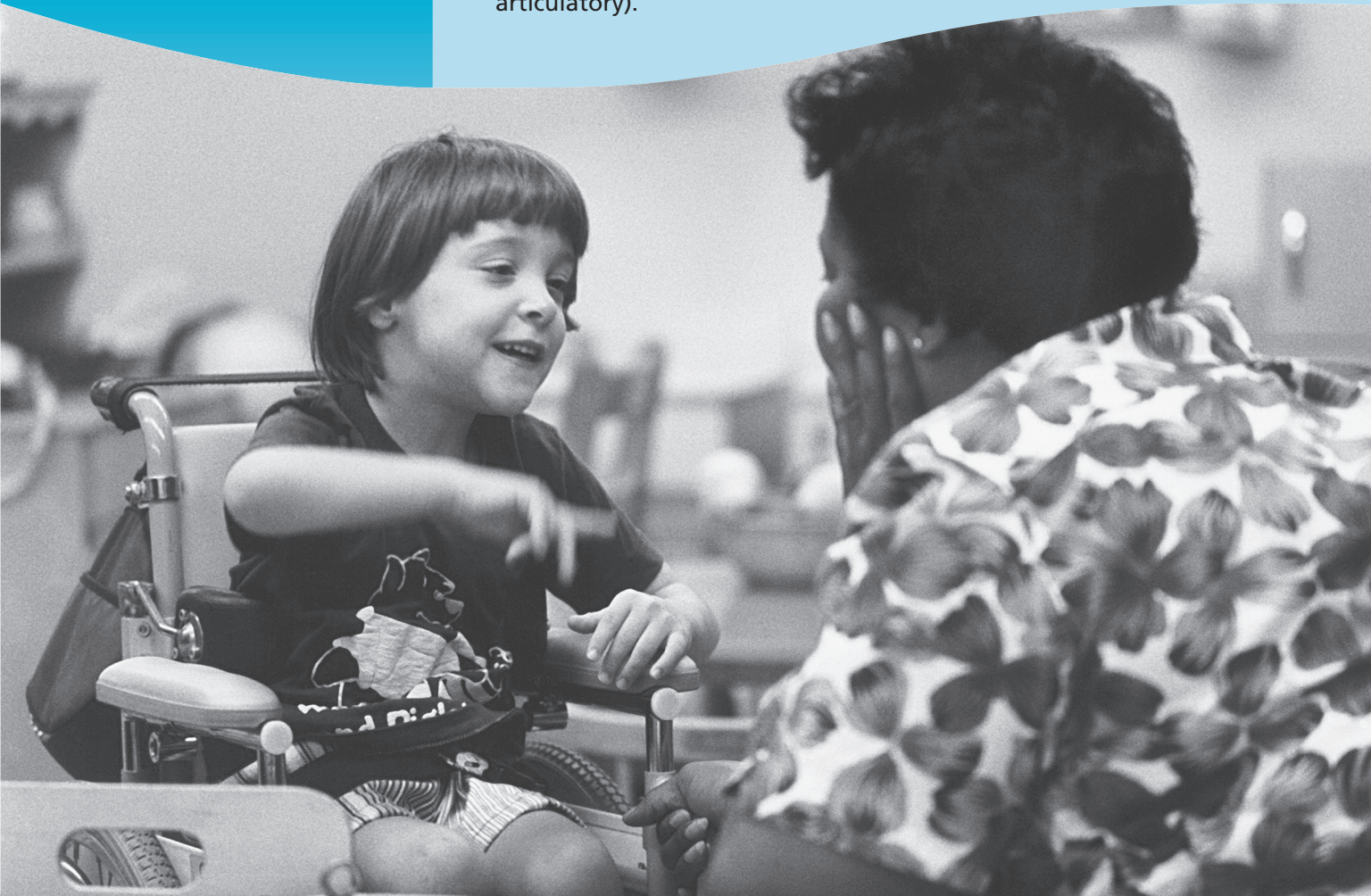
M otor speech disorders are difficulties related to problems of movement resulting from neurological disorder or injury. They are a heterogeneous group of neurological impairments that affect motor planning, programming, coordination, timing, and execution of movement patterns used for speech production in both children and adults. Any or all of the processes of respiration, phonation, resonation, and articulation described in previous chapters may be affected. Although voice and fluency may also be involved, these are addressed in other chapters. Language disorders often co-occur with motor speech disorders; these are described in Chapter 6.

This brief explanation does not begin to hint at the complexity of the disorders that fall within the boundaries of motor speech disorders. So finite and particular are the movements needed for speech that more area in the brain is devoted to control of vocal folds, tongue, lips, and other articulators than to any other bodily movement, even walking. Given this complexity, it is amazing that the process of speech production becomes so automatic that we give little thought to it when speaking. In fact, we rarely consider the process unless something goes wrong.

As with language, there does not seem to be a specific area of the brain devoted to speech motor control. Even those areas of the frontal lobe that are important for speech are not solely devoted to speech-specific tasks. They also participate in nonspeech motor tasks. In this chapter, we limit our discussion to motor speech. We discuss the two main types of motor speech disorders: dysarthria and apraxia of speech. In addition, we discuss five different types of dysarthria and briefly explain how to differentiate each from one another, and from apraxia of speech. Case Study 10.1 is an example of a young woman who developed motor speech disturbances as the result of a brain tumor.

MOTOR SPEECH CONTROL

Structures of the Brain Important for Motor Speech Function

A complex network of structures and pathways in the brain is responsible for speech motor control. Recall from Chapter 6 that the right and left hemispheres of the cerebrum are each divided into four lobes—frontal, parietal, occipital, and temporal—as depicted in Figure 10.1. The frontal lobes house the **primary motor cortex**, a 2-centimeter-wide strip immediately in front of the central sulcus. Descending pathways originate from primary motor cortex and are important for initiating voluntary motor movements. Damage to an area of primary motor cortex in one of the cerebral hemispheres (e.g., the region of the arm in the left hemisphere) will cause weakness or paralysis of that part of the body on the opposite side (i.e., right arm). Recall that the sensory and motor functions of the cerebrum are contralateral, meaning that each hemisphere is concerned with the opposite side of the body.

The *direct activation pathway,* known as the **pyramidal tract**, originates in primary motor cortex and is responsible for rapid, discrete, volitional movement of the limbs and of the articulators for speech production. The pyramidal tract directly connects the cortex (outer layer of the brain) to the neurons that directly control the activation of muscles for the initiation of movement.

The *indirect activation pathway,* or **extrapyramidal tract**, is important for regulating reflexes and maintaining posture and muscle tone, thus providing

Neurons are the basic unit of the nervous system. Each neuron has three parts: the *cell body,* a single long *axon* that transmits impulses away from the cell body to the next neuron, and several branching *dendrites* that receive impulses from other cells and transmit them toward the cell body. *Lower motor neurons* are responsible for muscle activation. A muscle is innervated by several hundred lower motor neurons. When lower motor neurons degenerate or die, as is the case in diseases such as amyotrophic lateral sclerosis (i.e., Lou Gehrig's disease), muscles become weak and eventually atrophy, or waste away.

CASE STUDY 10.1

Case Study of a Teen with a Motor Speech Disorder: Chelsea

Chelsea, a 16-year-old cheerleader and member of the high school drama club, came home early from school because she believed she had the flu. She went to school the next day but noticed difficulty with her speech and writing. That evening, her parents noted that Chelsea's speech was slurred and difficult to understand. They asked her to talk more slowly, but Chelsea continued to make speech errors each time she tried to correct herself. She started to get very frustrated, and her parents became worried. The next morning, Chelsea began complaining of a severe headache, so her parents rushed her to the emergency room, where she underwent a neurological evaluation, including a brain imaging scan. It was determined that Chelsea had a tumor that was putting pressure on the left frontal lobe of her brain, and she was scheduled for neurosurgery the following morning.

Although the surgery was successful, Chelsea was still experiencing speech difficulties and was referred for a speech-language pathology consult. A comprehensive evaluation of Chelsea's motor speech production skills was completed, and the speech-language pathologist (SLP) recommended treatment to improve her speech

so that her friends, family, and teachers would be able to understand her. The school-based SLP collaborated with the hospital SLP so that similar services could be provided to Chelsea at school.

Chelsea received outpatient services at the hospital one time per week; she learned various strategies (e.g., pausing more often, reducing speech rate) to improve the understandability of her speech. The school-based SLP saw Chelsea two times per week and worked on the same strategies at school, ensuring that she was using them when participating in class discussions. Her parents participated in her treatment too and helped by reminding her to use her strategies at home. After 8 months, Chelsea returned to her normal, pre-trauma levels of speech performance.

As you read this chapter, think about:

- Possible explanations for Chelsea's pre- and post-neurosurgery speech difficulties
- Examination tasks the SLP might have used to assess Chelsea's motor speech production
- Other treatment techniques that might have been useful for Chelsea after her surgery to help her to be better understood

Figure 10.1 Schematic diagram of the human brain.
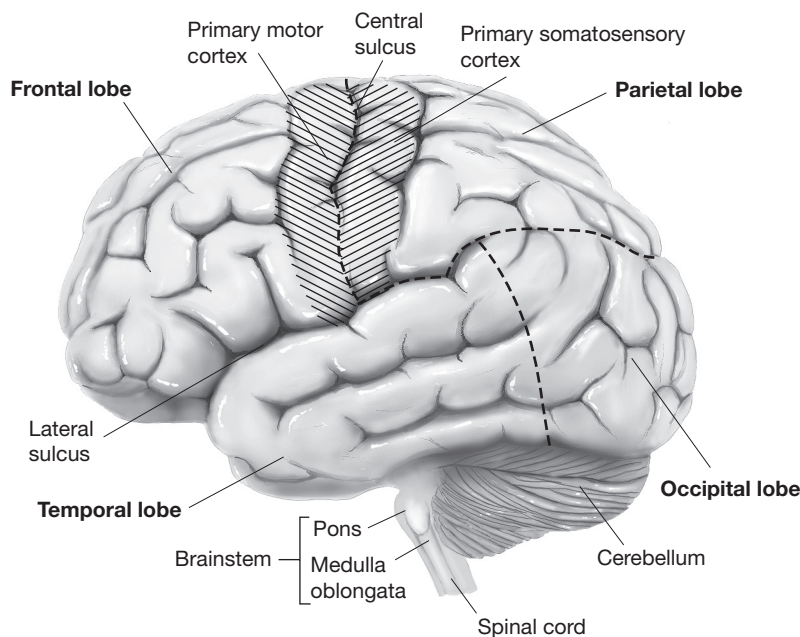
the necessary framework to facilitate movement carried out by the direct activation system. Together, the direct and indirect activation pathways form the *upper motor neuron system* (Duffy, 2013).

The **basal ganglia** are large subcortical nuclei that regulate motor functioning and maintain posture and muscle tone; thus they are part of the brain's extrapyramidal system. The basal ganglia modulate the activity of the primary motor cortex and indirectly influence movement. This is accomplished by direct and indirect control loops that have opposing functions. The direct pathway serves to increase or facilitate movement, while the indirect pathway serves to decrease or inhibit movement. Depending on which pathway is involved, damage to basal ganglia will either result in reduced and/or slowed movement, as seen in Parkinson disease, or will result in abnormal, involuntary movements as seen in Huntington's chorea. Chorea involves quick, continuous, and purposeless movements of the head, face, tongue, and/or limbs, discussed a little later in this chapter (Duffy, 2013).

The cerebellum, or "little brain," consists of right and left cerebellar hemispheres and a central vermis. The cerebellum is connected to many other parts of the brain and has access to much of the brain's information. The cerebellum and its connections coordinate the control of fine, complex motor activities, maintain muscle tone, and participate in motor learning. Figure 10.2 summarizes the areas of the brain important to motor control. Visit http://sciencenetlinks.com to download the free three-dimensional (3D) brain application (type "3D brain" into the search bar on this website) for your computer or iPad.

Figure 10.2 Areas of the brain important for motor function.

Signals to the muscles originate in the motor cortex and are sent deep into the brain to begin their descent. The cerebellum sets the overall tone and posture that gives the motor cortex the ability to execute intentional movements. In addition, although the motor cortex determines where to move, the cerebellum implements the proper timing and force. Motor nerve impulses continue through the pyramidal tract that relays intentional movement and the extrapyramidal tract that relays automatic, involuntary movement.
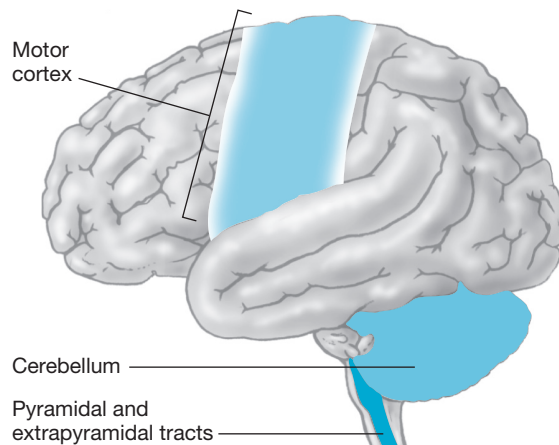
Motor Speech Production Process

In the process of motor speech production, first the movement plan/program, which is an organized set of motor commands that specifies all of the necessary parameters of movement (Keele, 1968), is retrieved from memory. Next, it is sent to the motor control areas (e.g., primary motor cortex); then it is transmitted with precise timing along the nerves to muscles and structures of the speech mechanism, resulting in sequences of acoustic signals that are recognized as speech sounds. Along the way, these nerve impulses are modified to ensure precise, smooth muscle movement.

Typical movement patterns are purposeful and efficient and are under the control of the individual, who can therefore change or modify the movement. Motor responses are initiated, changed, and coordinated on the basis of both external and internal sensory information. External sensory mechanisms detect and analyze the external environment. Internal movement feedback from muscles (proprioceptive feedback) and nerves helps us know the position and movement of body structures in space. For speech production, auditory and proprioceptive feedback help ensure proper coordination of the speech mechanism. For a comprehensive review of the motor speech production process, see Maas et al., 2008.

Cranial Nerves Important for Speech Production

Whereas the central nervous system (CNS) comprises the brain and spinal cord, the **peripheral nervous system (PNS)** consists of 12 pairs of cranial nerves, most of which originate in the brain stem, and 31 pairs of spinal nerves that exit the vertebral column and travel to and from muscles of the body. By transmitting messages to muscles and receiving sensory information, the PNS helps the CNS communicate with the body.

The **cranial nerves** (Figure 10.3) are especially important for speech production. Because they are arranged vertically along the brain stem, they are referred to by Roman numerals corresponding to their vertical order. Thus, number VII, the facial nerve, is seventh from the top. The majority of the **spinal nerves**—22 of the 31 pairs of these nerves—are important for breathing for purposes of speech production. In contrast, special control centers in the brain stem govern breathing for life.

Click here to check your understanding of the concepts in this section.

MOTOR SPEECH DISORDERS

Damage to any structure or pathway involved in the speech production process can cause a motor speech disorder. Recall that motor speech disorders encompass both the dysarthrias and apraxia of speech, and they reflect a disturbance in the motor planning, programming, neuromuscular control, or execution of speech (Duffy, 2013).

Dysarthria

Dysarthria is a general diagnostic term for a group of speech disorders resulting from disturbances in the central and peripheral nervous systems that control the muscles of speech production. Dysarthria can affect the speed, range, direction,

Figure 10.3 Cranial nerves important in speech production.

Trigeminal (V): A mixed nerve with both sensory and motor functions for the jaw and tongue for speech and chewing.

Facial (VII): A mixed nerve for sensation of taste and motor control of the facial muscles important in facial expression, such as smiling, tearing, and salivation.

Glossopharyngeal (IX): A mixed nerve with sensory input from the tongue for taste and motor control of the pharynx for salivation and swallowing.

Vagus (X): A mixed nerve serving the heart, lungs, and digestive system. A sensory nerve to the larynx and throat. A motor nerve to the larynx for phonation, the soft palate for lifting, and the pharynx for swallowing.

Accessory (XI): A motor nerve controlling muscles of the pharynx, soft palate, head, and shoulders.

Hypoglossal (XII): A motor nerve controlling the muscles of tongue movement.

strength, and timing of motor movements for respiration, phonation, resonance, and articulation, and it is a result of weakness, spasticity, discoordination, or involuntary movements. Motor movements that were previously established may have been lost or modified in some way, though the pattern for that movement still exists.

It is important to note that dysarthria is not a language disorder. An individual can present with dysarthria alone and thus exhibit good language structure and vocabulary, good reading comprehension skills, and effectively participate in

the give and take of conversation as well as his or her physical limitations permit. An individual with dysarthria can convey by other means, such as a computer device, sentences that he or she may be unable to produce freely through speech.

Types of Dysarthria

The muscular disorders that cause dysarthria represent a variety of neurological diseases. Although individuals with dysarthria share some common symptoms, distinct clusters of neurological and speech characteristics exist that describe specific types of the disorder.

Different types of dysarthria result from lesions to different parts of the CNS and/or PNS. Certain commonalities exist across these types, as shown in Table 10.1, including inadequate respiratory drive, voice disturbances such pitch and loudness problems; prosodic abnormalities such as excessive stress patterns; rate difficulties such as slow, rapid, or varying speeds; hypernasality; and imprecise articulation.

TABLE 10.1

Characteristics of the dysarthrias

Type of Dysarthria	Lesion Location	Speech Characteristics
Flaccid dysarthria: Muscles are weak and reduced in tone; decreased reflexes; flaccid paralysis; eventual atrophy of muscles	Damage to lower motor neurons (i.e., cranial and spinal nerves) or to the muscle unit itself	Continuous breathiness; monopitch; hypernasal; short phrases; imprecise articulation
Spastic dysarthria: Weak, spastic muscles; hyperactive reflexes; increased muscle tone	Damage to upper motor neurons (i.e., direct and indirect activation pathways)	Slow rate; strain-strangled voice quality; hypernasal; imprecise articulation; excess and equal stress
Ataxic dysarthria: Incoordination; reduced muscle tone; poor accuracy and timing of movements	Damage to the cerebellum or cerebellar control circuitry	Irregular breakdowns in articulation; imprecise consonants; vowel distortions; prosodic abnormalities (e.g., excess and equal stress; prolonged pauses)
Hypokinetic dysarthria: Reduced movement; muscle rigidity and stiffness; difficulties starting and stopping movements	Damage to basal ganglia and basal ganglia circuitry	Accelerated speech rate; imprecise articulation due to reduced range of motion of the articulators; breathy/harsh/hoarse voice quality; reduced loudness; disfluencies
Hyperkinetic dysarthria: Involuntary movements	Damage to basal ganglia and basal ganglia circuitry	Irregular breakdowns in articulation; prosodic abnormalities; variable speech rate
Mixed dysarthrias: Combination of two or more dysarthrias	Damage to multiple brain structures or circuits.	Imprecise articulation; slow rate; harsh voice; monopitch/ monoloudness; hypernasality; excess and equal stress

Source: Based on Duffy (2013).

Five distinct types of dysarthria can be identified by their speech characteristics and the impaired neuromuscular processes, including **flaccid**, **spastic**, **ataxic**, **hypokinetic**, and **hyperkinetic** dysarthria (Duffy, 2013). When multiple motor systems are involved, a mixed dysarthria may occur, as in the case of individuals with amyotrophic lateral sclerosis (ALS), multiple sclerosis (MS), and Wilson's disease, to name a few. Each type of dysarthria is briefly discussed here.

Flaccid Dysarthrias

Muscles that exhibit flaccid paralysis are weak and soft, exhibit low tone (i.e., hypotonia), and fatigue quickly. Flaccid dysarthria frequently results from lesions of the cranial and spinal nerves, collectively known as the *lower motor neurons,* or damage to the muscle unit itself. Affected muscles may cause reduced respiratory drive for speech breathing, continuously breathy voice quality, reduced pitch and loudness levels, monopitch, hypernasality, and imprecise articulation. Etiologies of flaccid dysarthria include Bell's palsy, a facial nerve (CN VII) disorder, progressive bulbar palsy, myasthenia gravis, and muscular dystrophy.

Bell's Palsy

Bell's palsy is an idiopathic condition of underdetermined cause that results in unilateral (i.e., one side) damage to the facial nerve (i.e., cranial nerve VII). It is a fairly common condition that occurs suddenly and resolves spontaneously in the majority of cases. Unilateral damage of the facial nerve affects the muscles of the upper and lower face, and in some cases, the ability to close the eyelid on the affected side (Duffy, 2013). Flaccid dysarthria associated with Bell's palsy tends to be very mild, with mild articulatory imprecision as its primary speech characteristic.

Progressive Bulbar Palsy

Your body's immune system is a network of cells, tissues, and organs that work to prevent foreign substances that cause infection from entering your body and to destroy invading microorganisms once they have entered. Autoimmune diseases occur when the immune system mistakes healthy cells and tissues as infected and attacks and destroys them. The reason the immune system responds in this way toward healthy body tissues is unclear.

Progressive bulbar palsy is a neurological disease that causes degeneration of lower motor neurons resulting in flaccid paralysis of muscles and eventual muscle atrophy. Damage to lower motor neurons in progressive bulbar palsy also results in **fasciculations**, or visible, isolated twitches in resting muscle due to spontaneous firing of nerve impulses in response to nerve degeneration (Duffy, 2013). Individuals with progressive bulbar palsy have described fasciculations as feeling like a bubbling under the skin. In flaccid dysarthria secondary to progressive bulbar palsy, fasciculations are often seen on the tongue or in the chin region, and speech sounds weak, hypernasal, monopitched, along with imprecise articulation.

Myasthenia Gravis

Myasthenia gravis is an autoimmune disease that affects the neuromuscular junction (i.e., the area between the motor nerve axon and the muscle). The disorder is characterized by rapid weakening of muscles due to the inadequate transmission of nerve impulses to the muscles. With repeated use such as during speech production, muscles become progressively weak but regain their strength with a short period of rest. The flaccid dysarthria that results is characterized by imprecise articulation and hypernasality that rapidly gets worse with prolonged speaking, but dramatically improves following 1 to 2 minutes of rest.

Muscular Dystrophy

Muscular dystrophies are a group of genetic diseases that cause progressive degeneration of the muscles themselves. The muscles are unable to contract and relax normally, and all aspects of speech production may eventually be affected.

Spastic Dysarthria

Spastic paralysis of muscles reflects the combined effects of weakness and loss of inhibitory motor control. As a result, reflexes become hyperactive, muscle tone is increased at rest, and individuals exhibit *spasticity* or increased resistance to passive stretch. Spasticity of the speech mechanism is the hallmark of spastic dysarthria, causing movements of the articulators to become slowed and reduced in force and range of motion. Spasticity at the level of the larynx causes the vocal folds to inappropriately adduct (close) during speech production, resulting in a strain-strangled voice quality. Spastic dysarthria typically results from bilateral upper motor neuron lesions (due to strokes) in the cerebral hemispheres or a single lesion in the brain stem, where direct and indirect activation pathways are in close proximity (Duffy, 2013).

As you watch the following **video**, note the slowness of speech and reduced articulatory precision of the client with spastic dysarthria due to bilateral cerebral hemisphere damage following multiple strokes.

Ataxic Dysarthria

Damage to the cerebellum or cerebellar control circuitry results in incoordination and reduced muscle tone, called *ataxia*. Ataxic dysarthria reflects the effects of incoordination and the improper timing of movements, causing irregular breakdowns in articulation and abnormalities of prosody. Ataxia and ataxic dysarthria are not caused by weakness. Muscles are not reduced in strength; rather, they are poorly timed and improperly coordinated during movement. Movements are inaccurate, jerky, and lacking smoothness. Too much alcohol consumption can result in temporary ataxia. In fact, individuals who have had a stroke in the cerebellum, or who have a neurological disease that causes degeneration of the cerebellum, often complain that they look and sound drunk.

Hypokinetic Dysarthria

Hypokinetic movements are slow and reduced in range of motion due to the effects of rigidity, or increased resistance to passive stretch in all directions. Individuals with **hypokinesia** (i.e., reduced movement) feel stiff and find it difficult to get movements started. Once started, they then struggle to stop. The most common cause of hypokinesia is Parkinson disease where a degeneration of dopaminergic neurons (i.e., neurons that make dopamine, a neurotransmitter important in motor control) in the brain stem prevents proper functioning of the basal ganglia, the subcortical structure that indirectly influences the quality of movement. Reduced range of motion is the hallmark of hypokinetic dysarthria. The articulators appear to be barely moving during speech production, and as a result, speech rate becomes very fast. Disfluencies are common, and loudness levels gradually diminish such that is often difficult to hear a person with Parkinson disease when he or she is talking.

Note this woman's reduced loudness during connected speech in the following **video**.

Case Study 10.2 provides a firsthand account of an individual living with Parkinson disease.

CASE STUDY 10.2

The Story of Carlos, a Man with Parkinson Disease

Carlos is 64 and retired. He had to retire because the effects of Parkinson disease prevented him from continuing to work as a foreign language professor. His wife, 3 years younger, has also retired in order to take care of her husband. About 15 years ago, Carlos noticed tremors in his hands, usually when he was at rest. At first, they were intermittent, and he thought they were caused by nervousness, stress, or muscle fatigue. As they became more frequent, Carlos found it harder and harder to ignore the symptoms.

Carlos's disease has progressed to the point where he walks by shuffling his feet, and he can climb stairs only with assistance and support. In danger of falling when he walks, Carlos has found that even getting over the upturned edge of a carpet can offer a genuine challenge. For this reason, he and his wife rarely go out, although they daily walk the lightly traveled road in front of their house, which is flat and easy for him to manage. Carlos calls it his "workout routine."

Carlos finds meals less satisfying than he used to because the consistency of some foods makes them difficult for him to chew. Although Carlos eats independently, his food must be cut beforehand into small pieces. If he uses a knife at all, it is for spreading, not cutting.

Although his speech is affected and is spoken in short quiet bursts, Carlos has maintained his sense of humor and his sarcastic wit. He still loves to tell stories of growing up in New York City.

Along with resting tremors and decreased range of movement, Carlos has experienced other physiological changes related to Parkinson disease. He tires easily, quickly becomes short of breath, and has difficulty concentrating. At other times, he seems to become lost in seemingly repetitive tasks, such as picking up lint. Medication that raises his dopamine level gives him smoother movement but provides only temporary relief. He is sometimes frustrated by his response to the medication and his inability to time its effect on his movement for special times, such as a visit by his grandchildren.

Parkinson Disease

Parkinson disease (PD) is a common degenerative neurological disease that affects 1% to 2% of people over age 50. Average life expectancy after diagnosis is approximately 15 years (Duffy, 2013). Parkinson disease is idiopathic, meaning that there is no known cause; genetic and environmental factors are believed to play a role. More information about Parkinson disease can be found at www.michaeljfox.org by clicking on "Understanding Parkinson's." The Mayo Clinic website is also a useful resource (www.mayoclinic.com). Click on the "Health Information" tab, then "Diseases & Conditions A–Z." Click on "P" and scroll down until you see the tab for Parkinson's disease.

Hypokinetic dysarthria may not be apparent in the first several years following the initial signs of PD, but it is eventually present in 90% of cases of PD over the course of the disease (Duffy, 2013). As mentioned previously, voice and speech difficulties associated with hypokinetic dysarthria include reduced loudness, accelerated rate of speech, disfluencies, and imprecise articulation due to reduced range of motion of the articulators. In addition, voice quality may be breathy and harsh or hoarse, and pitch and loudness variability is significantly reduced, resulting in monopitch and monoloudness.

Hyperkinetic Dysarthrias

Hyperkinetic dysarthrias are also due to damage to the basal ganglia control circuitry; however, in this case, the indirect pathway and/or structures of basal ganglia that help to inhibit unwanted movements are damaged. As a result,

hyperkinesia (i.e., increased movement) occurs. Hyperkinetic dysarthria is essentially the production of motorically normal speech that is interrupted in some fashion by abnormal involuntary movements (Duffy, 2013). A number of hyperkinetic movement disorders can result in hyperkinetic dysarthria.

Tremor, the most common involuntary movement disorder, involves rhythmic movement of a body part, such as the limbs, head, or voice (Duffy, 2013). The best way to determine whether an individual has voice tremor is to ask him or her to sustain the vowel /a/ for as long as possible. Voice tremor may go unnoticed during conversational speech but is quite evident during vowel prolongation.

Tics are rapid, patterned movements that are not completely involuntary and can be suppressed for brief periods with effort. Tics are commonly associated with Tourette's syndrome, which affects more males than females (approximately 3:1 ratio) with onset prior to age 18; they can be motor in nature (e.g., eye blinking, head twitches) or vocal (e.g., throat clearing; snorting; sniffing; compulsive swearing). Vocal tics are the hallmark of hyperkinetic dysarthria in individuals with Tourette's syndrome, with rapid production of these noises, sounds, or words causing significant interruption to the normal flow of speech.

Dystonia is a slow hyperkinesia that may involve the entire body (i.e., generalized dystonia) or may be localized to just one body part (i.e., segmental dystonia). Involuntary movements are characterized by slow, sustained abnormal posturing, with possible twisting of body parts (e.g., arm, leg, head). Hyperkinetic dysarthria in individuals with dystonia may include excessive pitch and loudness variations, irregular breakdowns in articulation, variable rate, and inappropriate silences (Duffy, 2013).

Unlike dystonia, **chorea** is characterized by rapid and unpredictable movements of the limbs, face, and tongue. The term is derived from the Greek word meaning "dance," and patients with chorea appear to move continuously, in an unstable dance-like fashion. Hyperkinetic dysarthria in individuals who exhibit chorea is characterized by variable speech rate, irregular articulatory breakdowns, and significant prosodic abnormalities.

Huntington's Chorea

Huntington's chorea, also known as Huntington's disease, is an inherited progressive disease that results in degeneration of structures in basal ganglia. Initial symptoms, which appear between the ages of 30 and 50, include involuntary choreatic movements and changes in behavior. As the disease progresses, involuntary movements worsen and become more generalized. Significant changes in mood and personality become evident, with subsequent development of depression and dementia. Average survival rate is about 20 years; however, individuals diagnosed with Huntington's chorea have a higher risk of suicide than do those with other neurodegenerative diseases, although the mechanisms for this are poorly understood.

Mixed Dysarthrias

When two or more types of dysarthria are present in an individual, an SLP diagnoses the individual with mixed dysarthria. Mixed dysarthrias are common in neurodegenerative diseases that cause damage to multiple areas of the central nervous system. This is the case in **amyotrophic lateral sclerosis (ALS)**, also known as Lou Gehrig's disease. In ALS, both upper and lower motor neurons degenerate, thereby causing both spastic and flaccid paralysis. Thus, the

individual with ALS will exhibit a mixed spastic-flaccid dysarthria. The speech characteristics of spastic dysarthria are often more pronounced in ALS; therefore, the patient will have a slow rate of speech, hypernasality, imprecise articulation, and a strain-strangled voice quality. The primary features of lower motor neuron damage in patients with ALS will be the presence of fasciculations and atrophy of the tongue. Recall that fasciculations are visible, isolated twitches in resting muscle due to spontaneous firing of nerve impulses in response to nerve degeneration (Duffy, 2013). The severity of mixed dysarthria in individuals with ALS becomes worse as the disease progresses, and 75% of those affected are unable to speak at the time of death. Age of onset is usually in the mid-50s, and males are affected more often than females. Death usually occurs within 5 years after initial diagnosis.

Traumatic brain injury **(TBI)**, discussed in Chapter 6, also causes mixed dysarthria. Typically, a mixed spastic-ataxic dysarthria is seen following TBI, such as a motor vehicle accident or a fall. In these particular cases of trauma, the axons of neurons that enable one neuron to communicate with another are severely damaged. This is called *axonal shearing,* and it results in diffuse damage throughout the brain. Males are at greater risk than females for sustaining traumatic injury, and approximately 70% of injuries resulting in TBI occur in the under-35 age group.

Lifespan Issues

Most acquired dysarthrias occur in adulthood. An individual with even mild dysarthria may be reluctant to speak, perhaps leading others to assume that the person is tense, shy, or unfriendly. For some individuals, even a slight speech abnormality can be cause for embarrassment or depression. In more severe cases of dysarthria, individuals may be frustrated as loved ones and acquaintances attempt to communicate for them by finishing their sentences or ordering for them in restaurants. In turn, these individuals may communicate or socialize less. Difficulty communicating may limit opportunities to participate in social, occupational, and educational activities, leading to feelings of isolation. You as an SLP can provide a person with dysarthria and his or her communication partners various strategies to promote increased communicative participation and significantly improve the quality of their lives.

In the later stages of progressive degenerative diseases, an individual with dysarthria may be unable to live independently and may need daily living assistance or institutional care. Movement may become difficult, and the person may be unable to care for himself or herself. The person may eventually be unable to speak at all, and you as an SLP can continue to work to improve the quality of life for such individuals with profound dysarthria, with the help of augmentative and alternative communication (AAC) devices.

Motor speech disorders are not limited to speech production and may have a negative effect on many aspects of an individual's life.

Apraxia of Speech

Apraxia of speech is a clinically distinct neurological speech disorder that impairs the ability to plan or program the sensory and motor commands needed for speech production. Unlike dysarthria, apraxia of speech is not a result of damage to speech muscles, nor does it involve muscle weakness; rather, it is a higher-level deficiency in motor control. The motor speech production process begins with a motor program being retrieved from memory. A motor program is an organized

set of motor commands that specify all the necessary parameters of movement for speech production; they are learned and consolidated in memory over time. Apraxia of speech results in an inability to adequately retrieve these speech motor programs, thereby causing disordered articulation of vowels and consonants, slowed rate, and prosodic disturbances (e.g., inappropriate pausing or lengthening of speech segments; incorrect word and sentential stress patterns). It generally occurs following damage to the left cerebral hemisphere, particularly the motor and premotor areas of the left frontal lobe.

The speech of individuals with apraxia is characterized by groping attempts to find the correct articulatory position, with great variability (inconsistency) over repeated attempts. Frequent sound substitutions, omissions, and additions of sounds occur, along with significant difficulties sequencing sounds when producing multisyllabic words. Unlike a person with dysarthria who produces predominately sound distortion errors and/or related sound substitution errors, a person with apraxia often produces unrelated substitutions, repetitions, or additions. A person with apraxia of speech recognizes his or her errors and will make repeated attempts to correct them. As the person tries to produce the correct sound or word, there may be frequent pauses, lengthened sound segments, and re-initiations of words and sentences. As a result, speech production may appear as stuttering-like in nature. Unlike a person with dysarthria who repeats the same error, an individual with apraxia of speech often produces widely varying productions on repeated attempts. Such inconsistencies are specific to apraxia of speech and thereby help you as an SLP correctly diagnose apraxia of speech from dysarthria. A speech sample from a person with apraxia follows:

> O-o-on . . . on . . . on our cavation, cavation, cacation . . . oh darn . . . vavation, oh, you know, to Ca-ca-caciporenia . . . no, Lacifacnia, vafacnia to Lacifacnion . . . on our vacation to Vacafornia, no darn it . . . to Ca-caliborneo . . . not bornia . . . fornia, Bornifornia . . . no, Balliforneo, Ballifornee, Balifornee, Californee, California. Phew, it was hard to say Cacaforneo. Oh darn.

Consonants and consonant clusters and blends are particularly challenging for those with apraxia, although more frequently used phonemes and words are produced with more accuracy. As you might expect, complex, long, and unfamiliar words are most difficult to produce.

Individuals with apraxia of speech may have no difficulty producing words on one occasion that they struggle to produce on another. In fact, clients may exhibit periods of error-free speech during automatic or emotional utterances. It is not uncommon to have a client struggle with volitional production of a word such as *vacation* only to hear the client easily say later, "Wow, I sure had a lot of trouble with *vacation*!"

A person with apraxia of speech is usually aware of his or her errors, as mentioned previously, and may even anticipate them but be unable to correct them. Monitoring of speech in anticipation of these errors tends to result in a slowed, almost cautious rate of speech, with equal stress and spacing, although prosodic abnormalities such as slow rate and equalized stress patterns are hallmark characteristics of this disorder. Clients frequently report that they know what they want to say but can't initiate the sequence or keep it going. Faced with a naming task, these individuals frequently respond, "I know it, but I can't say it."

Although apraxia and aphasia often co-occur, the two are not the same. Aphasia is a language disorder, while apraxia is a motor speech disorder. An individual with aphasia has difficulty with word recall in all modalities, whereas a person with apraxia of speech may be able to recall a word more easily when writing but be unable to say it correctly. In addition, apraxia of speech can be an individual's only diagnosis, and thus, language structure may be perfectly intact. Case Study 10.3 is a story of a woman with apraxia of speech.

While there appear to be overlapping characteristics between the dysarthrias and apraxia of speech, the two are distinctly different types of motor speech disturbances. Correct diagnosis of a client is essential for speech treatment to be effective. Table 10.2 presents the major differences between the disorders, although there will be many individual variations.

Lifespan Issues

The impact of acquired apraxia of speech on an individual's life depends on the etiology of the disorder, as well as the severity. Most individuals who acquire apraxia of speech do so following a stroke in the left hemisphere, specifically Broca's area in the left frontal lobe. Depending on the severity of the stroke, individuals can make a full recovery and speech may return to normal. In other cases, speech may recover to some extent, but mild prosodic abnormalities such as slow rate and incorrect stress patterns may persist. For an individual who has apraxia of speech secondary to a progressive neurological disease (e.g., corticobasal degeneration), an SLP should get the client to think about AAC early as such individuals are likely to lose most or even all ability to speak. It is important for an SLP to always encourage clients to continually practice speaking when they can and to utilize their AAC device as often as possible to promote communicative participation. It's also important to promote a positive attitude in clients with apraxia of speech, as well as all other types of motor speech disorders, as helping to maintain a satisfactory quality of life throughout the course of a degenerative disease is an essential role of an SLP.

✔ Click here to check your understanding of the concepts in this section.

CASE STUDY 10.3

Personal Story of a Woman with Apraxia of Speech

Ruth is a 75-year-old woman who suffered a stroke in the frontal lobe of the left cerebral hemisphere. After being discharged from the hospital, Ruth began receiving services twice weekly at a rehabilitation center for her speech and for other motor difficulties related to her stroke.

Six months after the incident, she continues to exhibit severe apraxia of speech, characterized by consonant cluster reduction, inconsistent sound omissions, distorted consonant substitutions, and primary use of single words during conversation. When she is reading, her speech intelligibility decreases with increasingly complex material. She has difficulty initiating speech and difficulty with sound and syllable

sequencing. Ruth's speech appears to improve with pre-formulation of the message and when using gestures.

Auditory comprehension during conversation and silent reading comprehension are both intact. Although Ruth reads the newspaper, she seems less interested in the more substantial pleasure reading that occupied much of her time previously. Her memory and attention skills seem unaffected.

A retired schoolteacher and widow, Ruth lives alone. She has six children. Her two oldest daughters are attempting to supplement the home health care she receives in order to help her to progress more quickly with her rehabilitation.

TABLE 10.2

Differences between dysarthria and apraxia

Dysarthria	Apraxia of Speech
Speech-sound distortions	Speech-sound substitutions
Substitution errors related to target phoneme	Substitution errors often not related to target phoneme
Highly consistent speech-sound errors	Inconsistent speech-sound substitution
Consonant clusters simplified	Schwa (/ə/) often inserted between consonants in a cluster
Little audible or silent groping for a target speech sound	Audible or silent groping for a target speech sound
Rapid or slow rate	Slow rate characterized by repetitions, prolongations, and additions
No periods of unaffected speech	Islands of fluency
Little difference between reactive or automatic speech and volitional speech; both affected	Often very fluent reactive or automatic speech, nonfluent volitional speech

ETIOLOGIES OF MOTOR SPEECH DISORDERS

Motor speech disorders can be either acquired (i.e., occurring after the neuromotor system is fully mature) or congenital (i.e., occurring at or before birth). Thus far, we have discussed a number of diseases that typically affect individuals in adulthood and, therefore, represent acquired disorders, including neurodegenerative diseases such as Parkinson disease or speech disturbances caused by stroke or traumatic brain injury. Motor speech disorders can also occur in children due to congenital impairments that were present either at or just before birth.

Cerebral Palsy

Cerebral palsy (CP), a heterogeneous group of non-progressive, permanent disorders of movement and postural development, is a congenital disorder that causes dysarthria in children. CP often results from oxygen deprivation to the brain (i.e., anoxic brain injury) that occurs either during development of the fetus, during the birth process, or shortly after birth. Hemorrhages in the brain can also cause CP. Any interruption in the blood supply, as occurs in a hemorrhage in the vascular system, can cause damage to a developing brain.

Infections and toxins may also disrupt brain development. Bacterial and viral infections, such as HIV, may infiltrate the brain from other bodily organs or may be transported within the blood supply. During the first few months of pregnancy and before the development of the placental barrier, the embryo is especially susceptible to infections of the mother, such as influenza, rubella, and mumps, that can damage the developing brain. Toxic agents such as heavy metals, mercury, and lead may accumulate in brain tissue and disrupt development. Malnutrition and/or the use of alcohol or drugs by pregnant women can also result in children being born with brain dysfunction. Finally, accidents during

pregnancy and in the neonatal period can result in fetal brain injury. These may include automobile accidents and, unfortunately, physical abuse of the mother while she is pregnant or of the infant.

CP is the most common etiology of chronic physical disability in the pediatric population (2 and 3 per 1000 children). It causes abnormal muscle tone (often hypertonia), loss of selective motor control, muscle weakness, and impaired balance (Narayanan, 2012; Rosenbaum et al., 2007).

Individuals with CP vary in age, culture, education, and type and severity. The type of CP varies with the areas of the central nervous system that are damaged. Injury may occur in the motor cortex, the pyramidal or extrapyramidal tracts, and the cerebellum. Most types of CP can be classified in one of three ways: spastic, athetoid, or ataxic. The primary features of each are summarized in Table 10.3.

Spastic CP

For about 60% of individuals with CP, the prominent characteristics include spasticity and increased muscle tone. Recall that spasticity is increased resistance to passive stretch due to damage to upper motor neurons, meaning that when the muscle of someone with **spastic CP** contracts, the opposing muscle may react abnormally to stretch by increasing muscle tone to a greater-than-normal degree. This is referred to as an *exaggerated stretch reflex*.

The damaged upper motor neurons are unable to inhibit signals that increase muscle tone; the result is hypertonicity. With increased muscle tone in the muscles opposing the muscle movement attempted, the desired movement ends up jerky, stiff, labored, and slow. In severe cases, the limbs may be rotated inward, with the arms drawn upward and the head turned to one side. Figure 10.4a shows the posture of an individual with severe spastic CP.

TABLE 10.3

Characteristics of cerebral palsy

Type of Cerebral Palsy	Characteristics	Area of Brain Affected
Spastic	Spasticity, increased muscle tone in opposing muscle groups Exaggerated stretch reflex Jerky, labored, and slow movements Infantile reflex patterns	Motor cortex and/or pyramidal tract
Athetoid	Slow, involuntary writhing Disorganized and uncoordinated volitional movement Movements occur accompanying volitional movement	Extrapyramidal tract, basal ganglia
Ataxic	Uncoordinated movement Poor balance Movements lack direction, force, and control	Cerebellum

Figure 10.4 Characteristic posture of severe spastic and athetoid cerebral palsy.

(a) Spastic cerebral palsy   (b) Athetoid cerebral palsy

Athetoid Cerebral Palsy

About 30% of individuals with cerebral palsy have **athetoid CP**. *Athetosis* is characterized by slow, involuntary writhing, most pronounced when the individual attempts volitional movement. The resultant movement behavior is disorganized and uncoordinated. Like other involuntary movements, athetosis is due to damage to basal ganglia structures and/or pathways that work to inhibit involuntary movements. Damaged inhibitory mechanisms cannot appropriately monitor the excitation mechanisms of the motor cortex; the result is too much movement. Speech and breathing problems are more severe in individuals with athetoid CP than with any other type.

In its most severe form, athetosis causes an individual's feet to turn inward, the back and neck to arch, and the arms and hands to be overextended above the head. Figure 10.4b shows the posture of a child with severe athetoid CP. The severity of athetoid CP varies, however. For instance, when an individual is quiet or at rest, the athetoid movements might not be evident. Athetosis occurs or is exaggerated when purposeful movement is attempted and/or when the individual is excited or emotionally upset.

Ataxic Cerebral Palsy

Ataxic cerebral palsy, accounting for approximately 10% of the population with CP, is characterized by uncoordinated movement and disturbed balance. Movements are clumsy and awkward, with poor rate and direction control. Walking may be particularly difficult for an individual with ataxic CP, and in extreme cases, it may be characterized by a wide stance, with the head pushed forward and the arms back, in an almost bird-like appearance. Even those who are less affected may have a gait resembling that of someone who is intoxicated.

Recall that ataxia results from damage to the cerebellum. Injury to this part of the brain impairs the monitoring of information about balance from the inner ears, as well as proprioceptive information from the muscles about the rate, force, and direction of movements. Coordination of muscle movement is difficult without accurate feedback. It is easy to see why walking would be especially problematic.

Thought Question

Motor Speech Disorders Associated with Cerebral Palsy

Not everyone with CP has motor speech difficulties. For example, individuals may have spastic CP that involves only their legs (paraplegia). On the other hand, most people with athetoid CP exhibit motor speech abnormalities that affect each of the speech production subsystems: respiratory, phonatory, resonatory, and articulatory. While adults with acquired motor speech disorders once had normal speech, a developing child with CP did not and consequently may also present with atypical motor patterns of production in the process of learning speech with a faulty

motor system. Therefore, you as an SLP must consider both the motor control dysfunction contributing to speech deficits and the overlaid faulty learning.

Speech breathing difficulties are a common problem in children with CP, particularly those with spastic CP. Because vital capacity (i.e., the total amount of air that is expelled after a deep inhalation) may be decreased, there is an insufficient amount of air available to exhale for speech production purposes. Therefore, an individual with CP may produce short phrases or even be limited to single-word utterances.

Inconsistent or inadequate airflow, along with involvement of laryngeal muscles, will affect phonation. Voice quality may vary from a breathy voice with puffs of air to voice with a strained, harsh quality due to weakness and spasticity. A breathy voice may indicate use of a compensatory strategy to force more air from the lungs.

Resonance may be characterized by hypernasality as a result of velopharyngeal dysfunction. The inability to seal off the nasal cavity from the oral cavity results in loss of the air pressure that is critical for precise production of consonants.

Articulation may be extremely difficult if there is involvement of the tongue, lips, and/or jaw. The tongue of an individual with CP may move as one unit, with limited ability to differentiate its parts. Consequently, speech sounds, particularly those made by moving the tongue tip (e.g., /s/, /z/, /l/, and /r/) will be particularly challenging. Lip movements may be slow and restricted. Articulation deficits will vary, depending on the type of CP. For instance, individuals with athetoid CP may exhibit excessive jaw movements, limited tongue mobility, and velopharyngeal inadequacy.

Prosodic aspects of speech, including pitch, loudness, and duration, may also be affected in individuals with CP. A client may be unable to make the rapid muscular adjustments of the respiratory and phonatory systems to mark lexical stress or convey more subtle meanings of words. Poor muscle control may make it difficult to initiate phonation and sustain it. As a result, speech may be segmented (i.e., choppy), with short phrases or words and frequent interruptions. Speech may be characterized as disfluent, nonrhythmic, and very monotonous.

Other issues may also complicate speech production, including intellectual, attention, auditory processing, and language deficits. While many individuals with CP have average to above-average intelligence, approximately one-third have significant cognitive impairment. Hearing and speech sound discrimination may be problematic, and delayed language development may include immature linguistic structures and use.

Lifespan Issues

Early symptoms of CP may include irritability, weak crying, and sucking, excessive sleeping, minimal interest in surroundings, and persistence of primitive reflexes beyond the newborn stage. Initial parental reactions on learning that their infant has CP vary and may include guilt, grief, anger, and denial. Typically, parents adjust well to their child but may exhibit chronic grief or the continuing desire for their child to be "normal." The parent–child bonding process may be strained as the child fails to respond in predictable ways. In addition, the care of a child with CP may tax the family and introduce stress into the family environment.

It may take up to 2 years to confirm a diagnosis of CP in an infant with mild involvement. The type of CP may change within the first few years, and it is important for the child and family to be in contact with medical and educational professionals. Motor delays associated with CP are often the first sign. As an SLP,

you may participate on an early intervention team to address delays in speech, language, and/or feeding and swallowing, as well as help counsel families who struggle with having a child with CP.

Variables such as severity, concomitant disorders, parental involvement, and school system flexibility are important in determining the appropriate educational environment for a child with CP. In general, children with average or higher-than-average intelligence with mild CP are more likely than other children with CP to have a typical educational experience. It is extremely important to assess the cognitive abilities of individuals with severe motor disabilities appropriately because a physical disability may obscure deficits in intellectual functioning.

Many individuals, especially those with mild physical and cognitive difficulties, obtain higher education and/or go into competitive employment. Often physical adaptations are made to improve performance in the educational and workplace settings. Other individuals may work and learn in centers run by agencies or the state. Day treatment programs are available to provide training in daily living and vocational skills for individuals with severe motor deficits and/or cognitive impairment. Case Study 10.4 presents the story of a young man with CP.

CASE STUDY 10.4

Personal Story of a Boy with Cerebral Palsy

Jake was born 3½ months prematurely, in a small rural hospital. The delivering obstetrician was concerned about possible oxygen deprivation at the time of his birth, although Jake was put in an incubator shortly after he was born.

Because of their son's prematurity, Jake's parents were counseled to expect developmental delays. They reported that he was irritable and seemed to have difficulty ingesting milk. At 4 months of age, his pediatrician expressed concern because of the continued presence of some reflexive behaviors such as the whole-body response to startle and lack of eye–hand coordination. She referred Jake to a developmental team in a large urban hospital.

The multidisciplinary team consisted of a pediatrician, a neurologist, a physical therapist, an occupational therapist, and a speech-language pathologist. They determined that Jake had cognitive and motor delays, as well as moderate dyskinesia. He was given a diagnosis of athetoid cerebral palsy.

Following the evaluation, it was recommended that Jake participate in home-based early intervention services, provided by the multidisciplinary team's rehabilitation specialists (i.e., physical therapist, occupational therapist, SLP), with periodic follow-up assessments at the hospital. The diagnosis of CP was very disheartening and painful for Jake's parents. Therefore, the team also recommended that the parents receive counseling and participate in a parental support group as part of their son's treatment plan.

By age 3, Jake was able to feed himself finger foods, but he still had some difficulty. Dressing was limited to pulling down a shirt that had been fitted over his arms and head. He could walk but not without significant difficulties, as he needed support to steady himself. His speech consisted of a few words and phrases that were often unintelligible to people other than his family. On the advice of the SLP at the special needs preschool Jake attends, he began training on an AAC device. At first this involved pointing to pictures on a communication board. Although his pointing response was somewhat imprecise, Jake continued to use the communication board until he entered elementary school.

In first grade, he began using a computer with specialized communication software. Pictures evolved into words and then into individual letters. Now in third grade, Jake is communicating using a combination of his own speech and selection of pictures, words, and simple spelling on his computer. He takes his computer everywhere and can even order his favorite foods at restaurants independently.

EVALUATION OF MOTOR SPEECH DISORDERS

To correctly identify motor speech disorders, you must first obtain a thorough case history from the client or client's caregiver, as motor speech disorders are often accompanied by predictable complaints and symptoms. In addition, it is important to have a client attempt various speech production tasks specifically designed for purposes of differential diagnosis, along with perceptual and objective measures of the speech production subsystems (i.e., respiratory, phonatory, resonatory, articulatory). Such measures will allow you to determine the most effective treatment approach for the client.

As an SLP, you will likely serve on a diagnostic team with medical professionals, particularly when your client is exhibiting generalized neurological impairments. By correctly identifying different speech patterns consistent with a particular type of motor speech disorder, you as an SLP provide valuable information to other members of the team responsible for differential diagnosis of underlying neurological conditions.

When assessing a child or adult client, the purposes of the motor speech evaluation are many and include the following:

- To determine whether a significant long-term problem exists
- To describe the nature of impaired functions, specifically the types of problems, their extent/severity, and the effect of these impairments on everyday functional communication
- To identify functions that are not impaired
- To establish appropriate goals and decide where to begin intervention
- To form a well-reasoned prognosis, based on the nature of the disorder, the client's age, the age or stage of injury or disease, the presence of other accompanying conditions, client motivation, and family support

You as a speech-language pathologist will evaluate the structure and function of a client's oral mechanism, connected speech, and speech in special tasks. Although a few commercial test procedures are available, many SLPs working in hospitals or outpatient clinics have a standard assessment protocol that they use for their motor speech evaluations in pediatric and adult populations. These procedures may or may not rely on the use of instrumental approaches and computerized analysis.

To begin, you examine the oral peripheral mechanism and note the following with particular interest:

Watch as the speech-language pathologist in the following **video** conducts a structural-functional exam on her patient.

- Symmetry, configuration, color, and general appearance of the face, jaw, lips, tongue, teeth, and hard and soft palate at rest
- Movement of the jaw, lips, tongue, and soft palate
- Range, force, speed, and direction of the jaw, lips, and tongue during movement

You also need to either directly (using instrumental and computerized methods) or indirectly (during nonspeech tasks or perceptual speech production tasks) determine the following:

- Lung capacity, respiratory driving pressure, and control during speech production
- Phonatory initiation, maintenance, and cessation

- Pitch and pitch variability
- Loudness and loudness variability
- Volitional pitch–loudness variations
- Velopharyngeal function

For adults who may have acquired apraxia of speech, the following speech production tasks will help in differential diagnosis:

- Imitation of single words of varying lengths
- Sentence imitation
- Reading aloud
- Spontaneous speech
- Rapid repetition of "puh," "tuh," "kuh," and "puh-tuh-kuh" (or "buttercup")

Note that these tasks are repetitive and imitative. Recall that in apraxia of speech, performance will likely vary with repeated performance, and thus errors will be inconsistent. Modes of stimulus presentation are also important because the person with apraxia responds better to auditory-visual stimuli than to either auditory or visual stimuli alone. Additional assessment techniques for children suspected of having childhood apraxia of speech are specifically discussed in Chapter 9.

Thought Question

TREATMENT OF MOTOR SPEECH DISORDERS

Some basic principles underlie treatment of motor speech disorders in children and adults. These include (1) restoring lost function, (2) using compensatory strategies, and (3) making adjustments for lost function (Duffy, 2013). For adults with acquired motor speech disorders such as dysarthria or apraxia, a full recovery is quite possible, particularly in mild cases of stroke, for instance. But generally speaking, residual motor speech deficits persist for long periods of time in many individuals with acquired disorders, and especially in those with congenital disorders such as cerebral palsy. Therefore, compensation for inadequate functioning of the motor speech system will be necessary. For degenerative diseases such as ALS or Parkinson disease that are progressive, ongoing adaption to lost function will be necessary, and compensatory strategies and the use of prosthetic devices may be effective throughout the course of the disease.

Management of Dysarthria

Because dysarthria affects all aspects of speech production, management must address a client's difficulties with respiration, phonation, resonation, articulation, and prosody. Specific intervention techniques to target increased respiratory drive for purposes of speech breathing might include speech practice production using a pausing/phrasing strategy. In this way, clients (both adults and children, when appropriate) learn to pause more often, using shorter phrases as a means to take in more air and start their speech utterances at a higher lung volume. As a result, speech utterances will be louder (although shorter in length) and, often, more clear. If respiratory muscle weakness impedes the use of such a strategy, as in the case of ALS or in some children with spastic cerebral palsy,

the use of an abdominal binder is an effective prosthetic for increasing respiratory drive and, therefore, improving loudness and voice quality. Patients with severe respiratory weakness and significantly reduced loudness levels may also use voice amplifiers.

Specific medical interventions and voice techniques for improving voice and voice quality are described in Chapter 8. An evidence-based behavioral approach to increasing phonatory competence in adults with Parkinson disease and for treating respiratory and phonatory deficits in children with spastic cerebral palsy is the Lee Silverman Voice Treatment (LSVT). LSVT is an intensive, 4-week speech treatment program that has been shown to produce marked and long-term improvement in voice and speech function. LSVT trains speakers to use a louder voice and to self-monitor use of this new loud voice. View the LSVT LOUD Pre- and Post-Treatment video of "Shirley" by clicking on "Video/News" at www.lsvtglobal.com.

While voice and voice quality improve as a result of LSVT, indirect benefits of this treatment have also been seen in velopharyngeal function, articulation, and swallowing. New computer software is available that allows an individual to participate in LSVT treatment at home. Visit the LSVT Global website, at www.lsvtglobal.com, and click on "Products." Then click on "LSVT Companion System" to see demonstrations of the software and learn more about its application.

Techniques and prosthetic devices to improve velopharyngeal function were described in detail in Chapter 8, including continuous positive airway pressure (CPAP) and use of a palatal lift. These same management techniques may prove useful in individuals with dysarthria secondary to palatal weakness. As mentioned previously, LSVT has also been shown to improve velopharyngeal function in adults and children with dysarthria of varying etiologies.

Intensive, repetitive speech production drill practice with meaningful words and phrases is an effective way to increase articulatory accuracy and thus improve speech intelligibility. Slowing speech rate is also an effective means of increasing articulatory precision in both pediatric and adult populations. Electropalatography (EPG), mentioned in Chapter 8, has utility in increasing articulatory precision in children with dysarthria due to CP and in adults with acquired dysarthria by providing visual feedback of tongue movement placement for articulatory accuracy. Although the device may be awkward at first, wearing an EPG palate for as little as 2 hours in a period of a day results in speech that sounds typical (McLeod & Searl, 2006). Through a combination of EPG computer display, speech monitoring, and biofeedback, some pediatric and adult clients with dysarthria learn better tongue control for improved articulation of speech sounds.

Historically, intervention to improve articulation in individuals with dysarthria has included nonspeech oral-motor treatments (NSOMTs), including exercise, massage, blowing, positioning, icing, cheek puffing, and other nonspeech activities. Data on the value of this methodology are weak. Despite popularity of NSOMTs, evidence-based practice suggests that there is insufficient evidence to support their use, and NSOMTs are therefore not recommended at this time as a means to improve articulation in adults and children with dysarthria.

Speech supplementation strategies have been shown to increase listener comprehension of speech produced by adults with dysarthria. In particular, using alphabet cues, where the speaker points to the first letter of each word on an

alphabet board as he or she says the word, is very effective in improving speech comprehensibility. In addition, combined cues, including using alphabet cues along with topic cues (stating the topic of conversation and indicating topic changes) has also been shown to be effective in increasing speech comprehensibility (Hustad et al., 2003). Such strategies may be effective with older children with dysarthria also.

For children and adults with markedly severe to profound dysarthria, the use of AAC (see Chapter 13) in conjunction with verbal forms of communication is most beneficial. Individual assessment is needed to determine the optimal system, including the client–device interface or input mode.

Management of Acquired Apraxia of Speech

One of the most effective treatments for acquired apraxia of speech continues to be *integral stimulation,* a speech production approach developed by Rosenbek et al. (1973) that utilizes the basic process "watch me, listen to me, and do what I do." Integral stimulation procedures involve an eight-step continuum comprising a hierarchy of cuing techniques (e.g., tactile, simultaneous production, immediate repetition, delayed repetition) that an SLP uses to help a client with apraxia retrain his or her motor planning/programming abilities necessary for correct speech production. The treatment approach also utilizes a core set of functional vocabulary words or phrases such that stimuli practiced are meaningful and, thus, motivating.

Integral stimulation techniques also incorporate the principles of motor learning (e.g., intensive practice distributed throughout the week), which is important for relearning motor skills that can no longer be accessed following brain injury (e.g., stroke). For a comprehensive discussion of the principles of motor learning, see Maas et al. (2008).

Other useful therapeutic approaches for acquired apraxia of speech include *melodic intonation therapy (MIT),* an approach that focuses on prosody, emphasizing the melody, rhythm, and stress patterns of spoken utterances. With this approach, an SLP models an utterance for a client by essentially "singing" the phrase and tapping out the rhythm while the client attempts to imitate. As the client is producing the utterance, the SLP works to fade the rhythmic cues until the client is able to imitate speech without such cues (Yorkston et al., 2010). Because acquired apraxia of speech typically involves an infarct in the left hemisphere, melodic intonation therapy is believed to facilitate motor planning/programming for speech production by accessing functions of the right hemisphere (i.e., singing).

Thought Question

Another treatment approach for acquired apraxia of speech that focuses on prosody is contrastive stress. In this approach, the client practices producing sentences by emphasizing stress on particular words in the sentence and thus changes the meaning of that sentence (e.g., *I* didn't say he stole the money"; "I *didn't* say he stole the money"; "I didn't say *he* stole the money"). Contrastive stress practice is most effective for clients with mild to moderate apraxia of speech who continue to exhibit prosodic abnormalities while having otherwise adequate speech articulation skills (Yorkston et al., 2010). Box 10.1 summarizes the evidence-based treatment approaches that may be beneficial for individuals with motor speech impairments.

Click here to check your understanding of the concepts in this section.

BOX 10.1 | **Evidence-Based Practice with Motor Speech Impairments**

Repetition/Practice

- Repetition is important for maintaining changes in the brain and their related functional benefits. In general, maintenance of intervention gains requires long-term, consistent use of a skill.

Intensity of Intervention

- Following a stroke, early overuse of a weak limb can result in greater deficits, but complete disuse can also slow recovery. How this relates exactly to speech motor control is unclear; however, it suggests that motor speech intervention should be less intense very early post-injury and become more intense over time.
- There are more beneficial results from prolonged practice distributed over time than from intensive massed practice to promote speech motor learning.

Techniques

- Electropalatograph (EPG) technology offers modest gains in speech production.
- Evidence does not support the use of nonspeech oral motor treatments (NSOMTs) as standard

treatments. These methods should not be used as speech production interventions.

Apraxia of Speech

- Integral stimulation is beneficial when addressing speech production difficulties in individuals with acquired apraxia of speech.
- Melodic intonation therapy (MIT) is useful during the early stages of acquired apraxia of speech, when speech production may be very difficult.
- Contrastive stress is beneficial for mild to moderate apraxia of speech when prosodic abnormalities persist.

Parkinson Disease

- The Lee Silverman Voice Treatment (LSVT) produces marked and long-term improvement in voice, speech, and swallowing functions in individuals with PD.
- Surgical interventions, such as deep brain stimulation (DBS), may improve limb motor function but actually cause further motor speech deficits.

Source: Based on Fossett (2010); Ludlow et al. (2008); and Yorkston et al. (2010).

SUMMARY

The two main types of motor speech disorders are dysarthria and apraxia of speech. Dysarthria is a group of speech impairments that affect the speed, range, direction, strength, and timing of motor movement as a result of paralysis, weakness, or discoordination of the speech muscles. Five distinct types are flaccid, spastic, ataxic, hyperkinetic, and hypokinetic dysarthria. Disorders affecting multiple motor systems may yield a mixed dysarthria.

Dysarthria can be acquired in adulthood as a result of neurological disease such as Parkinson disease, or it can be congenital, as in the case of children with cerebral palsy (CP). CP is characterized as a group of developmental, non-progressive neurological difficulties resulting from brain injury that occurs very early in fetal or infant development, and affects motor movement, communication, cognition, growth and development, learning, and sensation. The three main types of CP—spastic, athetoid, and ataxic—result in very different motor patterns and speech difficulties.

Apraxia is an acquired disorder in voluntary motor planning and programming of movement gestures for speech that is unrelated to muscle weakness, slowness, or paralysis. Acquired apraxia of speech often results from a lesion in the central programming area for speech in the left frontal lobe that details and plans the coordination of sequenced motor movements for speech.

Motor speech disorders, both congenital and acquired, offer a special challenge to the affected individual, family, friends, and speech-language pathologist. Many clients are in the very frustrating position of being able to formulate a message but unable to produce it intelligibly.

Intervention methods differ greatly. A child with CP may learn to communicate using an augmentative and alternative communication (AAC) device. Meanwhile, an older adult with motor speech deficits may relearn or retrieve previously learned speech patterns. Finally, an individual with a progressive degenerative disease, such as Parkinson disease or amyotrophic lateral sclerosis (ALS), may attempt to maintain the level of effective communication that was previously possible or may explore additional methods of communication. Changing intervention techniques and promising new surgical procedures and medical management continue to offer hope to individuals with motor speech disorders of neurogenic origin.

SUGGESTED READINGS

Duffy, J. (2013). *Motor speech disorders: Substrates, differential diagnosis, and management* (3rd ed.). St. Louis, MO: Elsevier, Mosby.

Yorkston, K., Beukelman, D., Strand, E., & Hakel, M. (2010). *Management of motor speech disorders in children and adults* (3rd ed.). Austin, TX: PRO-ED.

Yorkston, K. M., Miller, R. M., & Strand, E. A. (2004). *Management of speech and swallowing disorders in degenerative disease* (2nd ed.). Austin, TX: PRO-ED.

11

Dysphagia

CHAPTER LEARNING GOALS

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

- Explain why speech-language pathologists are concerned with swallowing

- Describe the basic process of human swallowing

- Identify some causes of swallowing disorders in children and adults

- Describe basic clinical and instrumental assessment techniques

- Discuss evidence-based practices in swallowing treatment

S peech-language pathologists (SLPs) play a major role in the evaluation and management of dysphagia, or swallowing disorders. The American Speech-Language-Hearing Association's (ASHA's) 2005 *Health Care Survey in Speech-Language Pathology* found that 87% of respondents reported that they were the primary providers of dysphagia management in their work settings. In this same survey, 16% of SLPs working in medical settings reported that they provide feeding and swallowing services to infants and children (ASHA, 2005c). Furthermore, SLPs may be required to manage dysphagia in children in their school-based setting (Hutchins et al., 2011).

An SLP is responsible for identifying, evaluating, and treating individuals with feeding and swallowing disorders. With the continually growing number of adult and pediatric patients identified every year with feeding and swallowing disorders, specific knowledge about normal and abnormal swallowing patterns is essential for effective evaluation and management of this clinical population. Case Study 11.1 describes an elderly woman with swallowing difficulties similar to those that you as an SLP will frequently encounter in the aging population.

With much of the work that SLPs do, they do not function alone. SLPs who treat patients with swallowing problems are generally part of a team consisting of a physician, a nurse, a nutritionist, a radiologist, a gastroenterologist, a

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CASE STUDY 11.1

Case Study of a Woman with Dysphagia: Rhea

Rhea is an 80-year-old woman who lives alone. Her son was concerned about a rapid and noticeable weight loss and approached Rhea's primary care physician with his concerns. A routine physical examination did not reveal anything that could be contributing to the loss of weight. During the doctor–patient interview following the physical examination, Rhea mentioned that she felt a frequent tightness in her throat and would sometimes gag when she was eating. Her son also told the physician that Rhea's normally robust appetite had recently become significantly diminished and that she seemed unduly anxious during mealtime. Based on the negative results of the physical examination regarding the cause of Rhea's weight loss and the information presented in the follow-up interview, her physician referred Rhea to the hospital for an evaluation for a potential swallowing disorder.

The staff SLP in charge of swallowing disorders performed the initial portion of Rhea's swallowing examination. Following a review of the case information, the SLP conducted an interview with Rhea and her son. The SLP noted that Rhea was alert during the interview and cognitively intact. During the oral-motor examination, the SLP evaluated head and body posture, the anatomy and general health of Rhea's mouth, the function of her oral structures, and

her ability to produce a strong cough. No problems were found in any of these areas. A modified barium swallow study (videofluoroscopy) showed an efficient swallow. Further testing with variegated textures of liquids and foods revealed that foods that were thick or sticky and hard to chew such as peanut butter or tough meats increased Rhea's anxiety, often causing her to gag. Upon reviewing the swallow examination results, the swallowing team agreed that Rhea's difficulty with swallowing was related to life circumstances. The team recommended that Rhea be provided with more opportunities to eat with others rather than alone. In addition, they recommended modifying her dietary intake, particularly reducing thick, tough, and chewy foods. By following the recommendations of the swallowing team, Rhea has begun to gain weight, and her family reports that she experiences less anxiety when eating.

As you read this chapter think about:

- How the consistency of a food might affect the person's ability to swallow
- How a swallowing disorder might affect a person's daily life
- Conditions other than age that might adversely affect a person's ability to swallow

dentist, an otolaryngologist, a neurologist, an occupational therapist, a physical therapist, a respiratory therapist, and family members. The role of each of these specialists will become clear when we discuss evaluation and treatment later in this chapter.

Swallowing and the efficient intake of food have both medical and psychosocial implications. Eating is essential to physical health. Without proper nourishment, one cannot grow, develop, or survive. Swallowing disorders increase the risk of choking and may lead to *aspiration* of food into the lungs and respiratory illnesses such as pneumonia. Problems or weakness related to the anatomy of swallowing may result in **gastroesophageal reflux (GER)**, the movement of food or acid from the stomach back into the esophagus. Eating is also one of our major social activities. Feeding difficulties in children may stress the parent–child relationship. Among older people, dysphagia may lead to isolation, depression, frustration, and diminished quality of life.

In this chapter, we describe the normal processes involved in swallowing, characteristics and correlates of disordered swallowing, evaluation, and treatment.

Thought Question

The term *dysphagia,* which comes from the Greek, literally means "difficulty with eating."

LIFESPAN PERSPECTIVES

Feeding and swallowing problems exist in both children and adults. They may occur at any point in the lifespan. Newborns may be unable to suckle and/or ingest nutriment. As they age, infants may refuse food and develop unhealthy food preferences. Neuromotor problems and structural anomalies that are congenital or acquired at any age can interfere with feeding and swallowing, as can a host of psychosocial factors. Dysphagia may be related to many diverse conditions; therefore, we describe only some of the most common ones. The correlates of swallowing disorders are not mutually exclusive; for example, an individual may be impaired in swallowing because of intellectual disability or laryngeal cancer. Whatever the etiology, the outcomes of a swallowing disorder at any age include malnutrition, ill health, weight loss, fatigue, frustration, respiratory infection, aspiration, and even death. Table 11.1 lists common correlates of swallowing disorders in children and adults.

Thought Question

TABLE 11.1

Correlates of swallowing problems in children and adults

Congenital Difficulties	Acquired Conditions
Cerebral palsy	Stroke
Spina bifida	Mouth, throat, laryngeal, or esophageal cancer
Intellectual disability and developmental delay	HIV/AIDS
Pervasive developmental disability/autism	Multiple sclerosis
HIV/AIDS	Amyotrophic lateral sclerosis
Cleft lip or palate	Parkinson disease
Pierre Robin syndrome	Spinal cord or traumatic brain injury
Treacher Collins syndrome	Medications and drugs
Pyloric stenosis	Dementia
	Depression and social isolation

THE SWALLOWING PROCESS

Most of us don't typically think about how we swallow food. We know very generally that we put something edible in our mouth, chew for a while, and then swallow. Sometimes, however, we experience difficulty that calls attention to the process. For example, we might eat and cough or feel that the food has "gone down the wrong pipe." Occasionally while drinking, we might laugh and find that fluid comes out of our nose. Once in a while, we feel "all choked up" for an emotional reason and feel unable to eat and swallow. Before we can understand disorders of swallowing, we need to examine the basics of nonproblematic swallowing. Normal swallowing can be described in four phases: oral preparation, oral, pharyngeal, and esophageal.

Oral Preparation Phase

When you are ready to eat, you put food or beverage into your mouth and close your lips. In the oral preparation stage of drinking, the tongue forms a cupped position and holds the fluid in a liquid **bolus**, the substance that is to be ingested, against the front portion of the hard palate. In preparation for swallowing solid foods, the tongue and cheeks move the food to the teeth for chewing and mixing with saliva to form a solid bolus. The prepared liquid or solid bolus is held in the mouth by the soft palate, which moves forward and down to touch the back of the tongue and close the passage to the pharynx or throat.

Oral Phase

Once the bolus is formed, the oral stage begins. This stage consists of the movement of the bolus from the front to the back of the mouth. When the substance reaches the anterior faucial arch at the rear of the mouth, the pharyngeal swallow reflex is triggered. Oral transit typically takes about 1 to 1.5 seconds.

Pharyngeal Phase

The oral and pharyngeal phases of swallowing involve much of the same anatomy that is used in speaking. There is wisdom to the traditional advice "Don't eat and talk at the same time."

During the pharyngeal phase, the velum moves up to meet the rear wall of the pharynx and to prevent the bolus from going into the nasal cavity. The base of the tongue and the pharyngeal wall move toward one another to create the pressure that is needed to project the bolus into the pharynx. The pharynx contracts and squeezes the bolus down. While this is occurring, the hyoid bone rises, bringing the larynx up and forward. The larynx prevents the bolus from entering the trachea by closing the true and false vocal folds and lowering the epiglottis, covering the airway. The pharyngeal phase is complete when the upper esophageal or pharyngoesophagoal segment opens and the food or liquid moves into the esophagus. The pharyngeal phase occurs very quickly and is usually complete in less than 1 second.

Esophageal Phase

Click here to check your understanding of the concepts in this section.

The last stage of the swallowing process occurs when the muscles of the esophagus move the bolus in peristaltic—or rhythmic, wavelike—contractions from the top of the esophagus into the stomach. This typically takes 8 to 20 seconds in an unimpaired individual.

DISORDERED SWALLOWING

Problems in swallowing can occur in any or all phases of the process. A person may lack appetite or be unable to form a bolus and move it to the rear of the mouth. In addition, difficulties may arise later, if the bolus moves inadequately or is blocked as it passes through the pharynx and esophagus to the stomach.

Oral Preparation/Oral Phase

If the lips do not seal properly, drooling can occur. Chewing may be impaired because of poor muscle tone or paralysis involving the mouth or because of missing teeth. Insufficient saliva will impede adequate bolus formation. The muscles of the tongue might not function purposefully or efficiently enough to move the food to the teeth for chewing and to transport the bolus from the front to the rear of the mouth to prepare for the pharyngeal phase.

Pharyngeal Phase

Several serious problems are associated with limitations during the pharyngeal phase. If the swallow is not triggered or is delayed, material may be *aspirated*, or fall into the airway, and eventually into the lungs. Failure to close the velopharyngeal port, the passageway to the nose, can lead to substances going into and out of the nose. Poor tongue mobility may result in insufficient pressure in the pharynx, which is needed to drive the bolus into the esophagus.

Esophageal Phase

If peristalsis is slow or absent, the complete bolus might not be transported from the pharynx to the stomach. Residue might be left on the esophageal walls, resulting in infection and nutritional problems.

Pediatric Dysphagia

Infants and children with swallowing disorders may experience inadequate growth, ill health, fatigue, difficulty learning, and poor parent–child relationships. Children with central nervous system or peripheral nervous system deficits or neuromuscular disease are vulnerable to feeding and swallowing disorders. Dysphagia may occur at any phase and may range from mild to severe. Some of the most prevalent correlates of pediatric dysphagia are described next.

Cerebral Palsy

As discussed in Chapter 10, cerebal palsy (CP) is a nonprogressive neuromotor disorder that occurs as a result of brain damage prior to or during birth, or soon thereafter. It is the most common cause of neuorgenic pediatric dysphagia (Arvedson & Brodsky, 2002). An infant with spastic CP exhibits excessive muscle tone, abnormal postures and movements, and possibly a hyperactive gag reflex. The child may be difficult to hold because of his or her increased

tone, causing excessive flexion of the arms, an arched posture, and abnormal posturing of the legs. The infant may also gag during breastfeeding or may be unable to move the tongue rhythmically to suckle. The unpleasantness of the feeding situation will undoubtedly have adverse effects on the quality of the child–mother interaction.

GER is common in infants and children with CP, and ingestion of food may become painful. Uncoordinated swallowing is also a problem for individuals with CP, thereby increasing their risk of aspiration (Sullivan, 2008). In severe cases of dysphagia, children with CP require gastrostomy tube feedings.

Spina Bifida

Approximately 1 in 1000 infants is born with **spina bifida**, a congenital malformation of the spinal column that typically involves associated neural damage, which results in limited sensation and motor control difficulties. A child with spina bifida may experience feeding difficulties in all phases of the process. Sucking and intake of food are often disturbed, due to sensory impairments and frequently exhibited dyspraxia (i.e., difficulty coordinating movement). The pharyngeal and esophageal stages of swallowing may be affected by cranial nerve damage due to the disorder.

Intellectual Disability and Developmental Delay

About 2 to 3 of every 100 individuals are considered to have intellectual functioning below average that qualify as an intellectual disability or developmental delay. Children with intellectual disability and developmental delay are also delayed in motor coordination skills, and this delay may interfere with eating and the oral phase of swallowing. Communication disorders are common in this population, and children may be limited in their ability to express food desires and preferences.

Autism Spectrum Disorder

Although children with autism spectrum disorder (ASD) do not usually exhibit swallowing disorders, they may have significant feeding problems. Recall that children with ASD may be socially withdrawn, have impaired communication, and exhibit repetitive or stereotypic behaviors. They may also be hypersensitive to sound, light, pain, smell, and touch. This pattern of symptoms often contributes to feeding difficulties. For instance, social withdrawal and communication deficits may impede the child's ability to indicate hunger or thirst to an adult or caregiver. Further, repetitive patterns of behavior or sensory issues may restrict the types of food that are consumed, possibly leading to poor nutrition (Lukens & Linscheid, 2008).

HIV/AIDS

HIV (human immunodeficiency virus) causes the illness known as **AIDS (acquired immunodeficiency syndrome)**. It infects white blood cells, the brain, skin, and other tissues of the body. Children infected with HIV often acquire the disease from their mothers in utero, during the delivery process, and/or through the mother's breast milk. The number of HIV-positive children increases daily

in the United States, and feeding and swallowing disorders are quite prevalent in this population (McNeilly, 2005). One study found that 20.8% of 150 children were determined to have feeding or swallowing problems (Pressman, 1992, 2010). These may be due to reduced immunity to infections such as oral herpes that can cause pain during eating.

In the final stages of the disease, HIV-positive children have difficulty managing oral secretions and exhibit **odynophagia**, or painful swallowing. Because HIV is a progressive disease, HIV-positive children often exhibit developmental delays, language deficits, and poor attention skills (McNeilly, 2005).

Structural and Physiological Abnormalities

Children born with cleft lip or palate are impaired in the oral phase of swallowing. Congenital abnormalities of the jaw, as in **Pierre Robin syndrome**, or of the face, as in **Treacher Collins syndrome**, also negatively affect the ability to use the mouth for intake of food and swallowing. **Esophageal atresia**, which occurs when the esophagus does not have an open connection to the stomach, prevents normal esophageal swallowing and results in choking. This is a life-threatening condition for newborns and must be surgically treated immediately (Prontnicki, 1995).

Similarly life threatening is **pyloric stenosis**, in which the pyloric sphincter at the outlet of the stomach narrows and prevents food from passing to the small intestine. When this is a congenital condition, the infant vomits and cannot ingest milk or water. Prompt surgical intervention usually successfully corrects this difficulty. Pyloric stenosis may also be acquired later in life; in that case, it is caused by peptic ulceration or carcinoma.

Infants who are born today do not spend much time in a hospital. Rapid diagnosis of and attention to congenital defects are essential for the welfare of the child.

Dysphagia in Adults

Up to 22% of individuals over age 55 experience swallowing difficulties (Howden, 2004). Therefore, there is an increased demand for qualified SLPs who can provide feeding and swallowing services to adult patients in various clinical settings.

Common neurological etiologies of dysphagia include stroke, head trauma, and progressive neurological disease. Swallowing problems can be seen in patients treated for head and neck cancer who require surgical resection of their tumors. Many other conditions can also cause feeding and swallowing problems in the adult population. These are addressed in the following sections.

Stroke

Dysphagia is a serious problem for 25% to 75% of individuals who suffer stroke. Prevalence estimates vary as a result of different assessment methods, timing of assessment, and individual characteristics of stroke patients studied. Facial paresis (muscle weakness) appears to be the primary factor associated with dysphagia due to stroke. All phases of ingestion are likely to be slowed and impaired. Swallowing and breathing are poorly coordinated, putting the patient at risk for aspiration pneumonia. Pneumonia is the cause for about a third of deaths following stroke (Martino et al., 2005; Odderson et al., 1995).

Cancer of the Mouth, Throat, or Larynx

Surgery, radiation, and chemotherapy are used to treat tumors of the mouth, throat, and larynx. Swallowing problems are likely after any type or combination of treatments. Surgery requires removal of the tumor and closing of the wound. For larger lesions, tissue from another area may be excised and used to help patch the deficit. The degree of swallowing impairment is closely related to the size and location of the original tumor and the surgical procedure used to close or reconstruct the area. For example, if a relatively small area of the tongue has been removed, a short-term swallowing problem is likely, due to the swelling following surgery. In more radical surgical procedures in which the tongue is sewn into the mandible to close the floor of the mouth, swallowing is severely affected (Logemann, 1998).

A visit to the dentist often makes the oral phase of swallowing difficult. Imagine how much more impaired a person is after oral surgery or radiation.

Radiation therapy may result in diminished salivation, swelling, and sometimes mouth sores. The swallowing reflex may be reduced. These interferences with normal swallowing may occur during, soon after, or even a year or two after oral radiation therapy. Chemotherapy may cause nausea, vomiting, and loss of appetite, which interfere with the eating process (Tierney, 1993).

HIV/AIDS

Individuals with AIDS are susceptible to numerous opportunistic infections because of the immune deficiency nature of the disease. A situation was reported in which a 61-year-old man with AIDS complained of swallowing difficulties. The results of the clinical evaluation revealed perforations and growths in the esophagus, which were attributable to Hodgkin's disease, a form of cancer (Gelb et al., 1997). Esophageal ulcers and esophagitis, or inflammation of the esophagus, were reported in about 16% of a group of heterosexual men with AIDS (Yang et al., 1996).

Multiple Sclerosis

Numbness, or a "pins-and-needles" sensation, in the extremities or on one side of the face may be an early sign of MS.

Multiple sclerosis (MS), a central nervous system disorder, may affect one or several cranial nerves. MS is of unknown cause and is typically characterized by periods of both relapse and remission. The major general symptoms are poor coordination, muscle weakness, and often speech and visual disturbances. Delayed swallowing reflex and reduced pharyngeal peristaltic action are the primary forms of dysphagia associated with multiple sclerosis (Logemann, 1998).

Amyotrophic Lateral Sclerosis (Lou Gehrig's Disease)

Amyotrophic lateral sclerosis (ALS), discussed in Chapter 10, is a progressive disease that may begin in middle age. It is characterized by muscle atrophy due to degeneration of motor neurons. Poor tongue movement is sometimes an early sign. ALS may interfere with swallowing in several ways. Reduced tongue mobility may result in spillage into the airway before the pharyngeal swallow has been triggered. The larynx might not elevate and close adequately during the pharyngeal phase. Pharyngeal peristalsis is frequently reduced, causing material to remain in the pharynx. Any of these difficulties could result in aspiration of food or liquid.

Parkinson Disease

Parkinson disease (PD), also discussed in Chapter 10, is a progressive disorder, typically of midlife, and is characterized by slowness of movement, muscle rigidity, and tremor. About 30% of individuals with PD have been reported to exhibit dysphagia; however, this does not seem to be related to the severity or duration of the disease (Castell et al., 2001).

Any or all phases of the swallowing process may be impaired, although in one study, only 10% percent of people with PD were found to need dietary aid (Clarke et al., 1998). When dysphagia occurs, the bolus is usually formed normally in the oral preparatory stage. However, oral transport may be impaired by a front-to-back rolling pattern until the back of the tongue finally lowers sufficiently to permit the bolus to pass to the pharynx. Pharyngeal swallow may be delayed, and laryngeal closure may be impaired in advanced cases of PD. Aspiration sometimes occurs when the patient inhales after a swallow, and material remaining in the pharynx falls into the airway (Logemann, 1998). Esophageal motor abnormalities that impede swallowing may occur in PD even in early stages of the disease (Bassotti et al., 1998; Johnston et al., 2001).

> Tremors and rigidity that are visible in a person's extremities may also occur within the body, resulting in swallowing and other difficulties.

Spinal Cord Injury

Individuals who have injured their spinal cords in accidents have a higher incidence of esophageal dysphagia than noninjured people do. Among the problems that they experience are heartburn, chest pain while swallowing, and slow, abnormal peristaltic contractions of the esophagus (Stinneford et al., 1993).

Surgery to the front portion of the upper (anterior cervical) spine may result in dysphagia. These swallowing problems may affect any phase of swallowing. Oral preparation and transit stages are impaired in some postsurgical patients; others experience weakness in the pharyngeal phase or suffer upper esophageal sphincter malfunctioning (Martin et al., 1997).

Medications and Nonfood Substances

Although medications are used to cure and manage disease, they may also have negative side effects. Some medications, including decongestants, cough suppressants, and muscle relaxants, might make a patient feel drowsy and/or confused. This condition can interfere with anticipation and the oral phase of swallowing. A dry mouth, or insufficient saliva, has been reported to be a side effect of more than 300 medications (Toner, 1997). High doses of steroids may impede pharyngeal swallowing. Antipsychotic drugs may result in **tardive dyskinesia** (involuntary, repetitive facial, tongue, or limb movements) after a year or more of use. At the extreme, tardive dyskinesia may result in the inability to chew and swallow.

Behaviors such as smoking and ingesting excessive amounts of caffeine and alcohol may also interfere with normal swallowing. Appetite may be depressed and sensations dulled, resulting in anticipatory phase impairment. Alcohol abuse has been implicated in pharyngeal phase dysphagia (Feinberg, 1997).

Dementia

Unlike intellectual disability associated with developmental delay, dementia is an acquired disorder. Although found in some older people, decreases in intellectual function are not always a consequence of the aging process. We all know people in their 80s and 90s whose minds are sharp and capable. As we learned in Chapter 6,

dementia is associated with Alzheimer's disease, several small strokes, PD, MS, and other ailments that may occur among older people. The cognitive deficits of dementia may impede attention and orientation to food. Those with dementia may forget to eat or may eat the same meal multiple times due to memory deficits. Oral preparatory tongue and jaw movements may be lacking in purpose, resulting in poor bolus formation and drooling. Transport of the bolus may be prolonged. Pharyngeal swallow may be delayed and laryngeal elevation reduced, resulting in possible aspiration (Cherney, 1994; Hardy & Robinson, 1993).

Depression and Social Isolation

Life circumstances among elderly people may interfere with several phases of swallowing. Meals are traditionally social events. We eat with family members and friends. As people enter old age, they may find themselves alone and lonely. Spouses and friends have died. Children have moved away. Some may have no experience preparing food and so do not have adequate meals. Others are not motivated to cook just for themselves. Communal meals in retirement homes or long-term care facilities may feature unfamiliar foods and may be served in a noisy, hurried environment. For example, mealtime difficulties in one home for the aged were documented in 87% of the residents (Steele et al., 1997).

Feelings of depression among elderly people are common. Depression is associated with diminished interest in food, restlessness, and fatigue. The throat may feel tight, making swallowing uncomfortable. Some individuals may feel too tired to eat and then are exhausted after they do eat. This may prompt a cycle of inadequate food intake, weight loss, and malnutrition (Toner, 1997).

Click here to check your understanding of the concepts in this section.

EVALUATION FOR SWALLOWING

Not everyone with the correlates described in the previous sections has a swallowing disorder. Furthermore, swallowing problems are not always readily apparent. Patients may not report difficulties, and some may experience **silent aspiration** (lack of cough when food or liquid enters the airway) (Logemann, 1996). Therefore, the first step in evaluation is to identify individuals who are at risk for dysphagia. Following this screening, an SLP will serve on a team to obtain background information and to use clinical and instrumental techniques to assess swallowing. A determination is made about appropriate intervention, and treatment strategies are developed and implemented in coordination with other professionals. SLPs are advocates for their clients and help provide education and counseling to them, their families, and related others.

Some birthing centers have lactation consultants who encourage and assist mothers and infants in the nursing process.

Screening for Dysphagia in Newborns and the Elderly

A primary indication of dysphagia in infants is **failure to thrive**. Infants in a neonatal intensive care unit are carefully monitored for weight gain and development. Full-term infants who are not accepting breast or bottle are signaling feeding problems. Such infants are observed during mealtimes to evaluate breathing and physical coordination (e.g., suck/swallow/respiratory sequence), oral-motor functioning (e.g., tongue elevation), and techniques that enable quantification of nutritive and nonnutritive sucking skill (e.g., responsive to stroking around

Figure 11.1 Three-ounce water swallow test.

Task: Patient drinks three ounces of water from a cup without interruption.

Outcome:

1. No problems.
2. Coughing during swallow.

3. Coughing after swallow.
4. Wet-hoarse voice quality after swallow.

Pass: Outcome 1 *Fail:* Outcome 2, 3, or 4.

Source: Based on DePippo et al. (1992).

the mouth) (c.f., Arvedson, 2000). Caregivers can be counseled and instrumental evaluation recommended when warranted.

Checklists to screen for dysphagia in older individuals are also available. The *Burke Dysphagia Screening Test* is a relatively quick way to screen patients who have had a stroke (DePippo et al., 1992). The 3-ounce water swallow test used in the *Burke* has been found to identify between 80% and 98% of patients who were aspirating, as later confirmed by more elaborate tests (DePippo et al., 1992; Suiter & Leder, 2008). Figure 11.1 outlines this procedure. It is important to note, however, that there is some evidence to suggest that the *Burke* may not identify patients experiencing silent aspiration.

Additional screening instruments include the *Examine Ability to Swallow* (*EATS*) (Wood & Emick-Herring, 1997) and the *Repetitive Oral Suction Swallow* (*ROSS*), which screens swallowing function as individuals sip water through a straw (Nilsson et al., 1998). Stroke patients who, at bedside, exhibit a delay in moving food from the front to the rear of the mouth and incomplete oral clearance signal the likelihood of dysphagic complications (Mann & Hankey, 2001).

Inappropriate weight for a person's size may be an indication of nutritional problems that could be due to dysphagia (Sheppard, 1991). All these measures and indicators have been reported to be useful in identifying serious swallowing difficulties and the need for more complete clinical and instrumental assessment.

Case History and Background Information Regarding Dysphagia

A parent, caregiver, physician, nurse, or professional from an early intervention program or an adult day treatment center may make a referral to a dysphagia team, typically based on three general areas of concern:

- Difficulties have been observed related to feeding and ingestion of food or liquid.
- The client appears to be at risk for aspirating food or liquid into the lungs.
- The client appears to not be receiving adequate nourishment.

An SLP then seeks answers to questions such as those presented in Figure 11.2. The answers to these questions provide preliminary information about the location of the swallowing problem (oral, pharyngeal, or both), the kinds of food substances that are easiest and hardest to swallow, and the nature and severity of the disorder (Logemann, 1998).

Figure 11.2 Important questions pertaining to swallowing.

Does the infant accept breast or bottle?	When was the problem first observed?
Does the individual refuse certain foods? Which ones?	Did it worsen slowly or rapidly?
Does the individual appear to chew food?	What exactly happens when the person tries to swallow?
Has drooling been observed?	Does material seem to stop somewhere? Where?
Does the child or adult eat excessively slowly?	What medical diagnoses or conditions may affect the swallow?
Does the child or adult eat excessively rapidly?	Has the person had surgery that may relate to swallowing?
Does coughing or choking occur at mealtimes?	Is the individual using any medications?
Is food or liquid expelled from the nose?	How is the client's respiratory health?
Is food or liquid regurgitated?	How attentive is the client?
Is the child gaining weight?	Is the client able to follow directions?
Is the adult maintaining weight?	

Source: Based on Hardy & Robinson (1999).

Clinical Assessment

Caregiver and Environmental Factors

A treating clinician will want to observe feeding as it occurs normally between caregiver and client. The therapist will pay special attention to the following:

- Is the caregiver patient and attentive?
- Does feeding take place in a reasonably quiet environment that is free from distractions?
- What position is the individual in when eating or drinking?
- How does the client express feeding preferences?

The parent or caregiver is an important part of the swallowing team. Careful observation and communication will help an SLP assess how best to improve this person's contributions. This is also an opportunity for an SLP to learn about a client's position in the family and cultural and individual factors that may influence intervention techniques. For example, certain foods and spices may be preferred to others. When possible, personal and cultural desires should be respected and accommodated (Logemann, 1998). Case Study 11.2 describes portions of the assessment of a 51-year-old man who was referred for a swallowing evaluation.

Cognitive and Communicative Functioning

Is the client alert and awake during feeding? Can he or she follow directions? What is the client's general level of functioning? Answers to these questions will influence the type of intervention that is most suitable for a client.

CASE STUDY 11.2

The Personal Story of a Man with Dysphagia

Mr. García was 51 years of age when he was referred as an outpatient by the director of Neurology and Rehabilitative Medicine at Municipal Hospital to the staff SLP in charge of swallowing disorders. The referral note read "myotonic dystrophy, dysarthria, dysphagia for solids." The SLP recognized her role in ensuring the patient's safety. Difficulty in swallowing foods could result in choking and/or aspiration pneumonia. The SLP was also concerned about the dysarthria and wondered to what degree this affected Mr. García's communication.

At their first meeting, the SLP learned that Mr. García, a recent immigrant from Colombia, had limited English proficiency. Once again, the SLP was grateful for her own Spanish language skills; the summer she had spent in Spain after her third year of college had been worthwhile in a multitude of ways. Many of the patients and staff at this inner-city hospital spoke Spanish as their primary language. Although Mr. García was mildly dysarthric, his speech was readily intelligible. His responses during the interview were appropriate in form (Spanish) and content. Mr. García reported that he choked on rice, a staple of his diet. Other foods and liquids did not appear to be problematic. He reported that he smoked "a little, just at the Saturday evening dances." A cursory evaluation of the oral mechanism revealed adequate strength and motion of the lips, tongue, velum, and mandible. Although coughing, choking, and gurgling were not observed during trial feeding, an apparent delay in the pharyngeal swallow reflex was noted with both liquids and solids. The SLP recommended a modified barium swallow study to confirm and document dysphagia.

Several types of foods were mixed with barium in preparation for the X-ray procedure. Mr. García ate a spoonful of applesauce and then a bite of cookie as the radiologist and the SLP watched the X-ray monitor. No difficulties were noted in the oral phase. However, they observed food lingering in the esophagus and building up with each successive swallow. Although the larynx elevated for swallowing, the bolus did not clear, and residue remained on the right **vallecula** and **aryepiglottic fold**. Mr. García was instructed to produce an abdominal cough, but he was unsuccessful, and the food remained on the fold.

The SLP made the following recommendations: Mr. García should not eat alone. He should avoid clear liquids and take only a small amount of food before swallowing. He should try to cough deeply when he feels food stuck in his throat. At the next appointment, in 2 weeks, Mr. García would be instructed in the supraglottic and hard swallow techniques. Because myotonic dystrophy is a progressive disease, Mr. García requires regular monitoring.

Head and Body Posture

It is important to note whether a patient can hold his or her head erect. Does it lean to one side or the other? Does it tend to tilt forward or back? Can the client position the head when asked to do so? An SLP will also note general body posture and tone. Swallowing and ingestion of food and drink involve more than the head, so a complete picture of an individual is important.

Oral Mechanism

The integrity of the anatomy and health of a patient's mouth needs to be determined. Abnormalities of structure of the lips, teeth, tongue, palate, and velum are noted. An SLP looks for facial symmetry and notes weakness (i.e., drooping) when present. Motor difficulties such as tremor, flaccidity, excessive muscle tone, and poor coordination are observed. Oral reflexes are examined. Certain reflexes such as sucking and rooting (turning to the direction of a cheek that is touched) are expected in infants but should disappear as a child matures. An SLP observes for any drooling, which may signal neuromuscular deficits, gum

Myotonic dystrophy is a rare, slowly progressive hereditary disease. It is characterized initially by poor muscle relaxation following contraction and later by muscle atrophy, especially of the face and neck.

and tooth infections, and upper airway obstruction. An SLP also notes a client's response to sensation. Does the client accept touch such as face washing? If the client is an older child or adult, is she or he aware of food residue or saliva on the face?

Laryngeal Function

An SLP cannot directly observe the larynx in the way that he or she can look at the oral mechanism. An SLP therefore looks for indirect signs of difficulty. In older children and adults, a hoarse, gurgly, or breathy voice quality before, during, or after a swallow may signal laryngeal dysfunction. Other indications of laryngeal problems include the following:

- Inability to rapidly repeat the syllable /ha/ with a clearly voiced vowel sound
- Inability to produce vocal tones up and down the musical scale
- An s/z ratio greater than 1.3 (See Chapter 8.)
- Inability to produce a strong cough

If an SLP observes any of these difficulties, he or she should refer the client to an otolaryngologist for a thorough laryngeal evaluation.

Bedside Swallowing Examination

An SLP should observe swallowing on more than one occasion. The nature of the food presented and a client's comfort level and hunger will influence the acceptance of foods.

If a client is alert and does not have a history of aspiration, a bedside swallow evaluation can be completed. Usually, food or beverage is used, although some SLPs prefer to conduct this assessment with a piece of gauze that has been soaked in water to reduce the risk of aspiration. If real food substances are used, the oral anticipatory and oral phases of swallowing can be assessed. Pharyngeal phase swallowing efficiency can be judged in part by noting specific behaviors during food or drink intake.

An SLP evaluates a client's reaction to the appearance of food or drink and the associated utensils, observing whether the client's activity level changes and whether the person appears eager to receive food. A small amount (1 teaspoon) of thin or thick liquid may be placed in the mouth, and the client is then encouraged to swallow. Oral mechanism function is observed throughout the swallow.

An SLP examines a client's lips to see whether they are together before the intake of food. An SLP is interested in answering questions such as the following:

- Do the lips open and then close around the nipple, cup, or spoon?
- Is there sucking activity on the nipple?
- Is food successfully removed from the spoon?
- Is liquid or food dribbled out of the sides of the mouth?

An SLP also observes tongue movement. Again, answers to certain questions are vital:

- When the mouth opens to take in food, does the tongue cup in anticipation?
- Does the client move the tongue to one side of the mouth if food is presented laterally?
- Does the client move the tongue adequately to form a bolus?

- Is the bolus transported efficiently from the front to the back of the mouth?
- Is the tongue used to remove food substances from the lips?

In addition, an SLP notes movements of the jaw and chewing patterns when solid foods are presented:

- Does the client bite food efficiently?
- Does the client isolate tongue and jaw movement?
- Does chewing continue for an adequate period of time?
- Is the jaw clenched?

Several observations pertaining to the adequacy of pharyngeal swallow are performed. If a client is unable to cough, this may suggest difficulty closing the larynx to protect the airway. Nasal regurgitation points to possibly inadequate velopharyngeal closure. An SLP observes the movement of the hyoid bone and thyroid cartilage in the neck by watching and possibly placing a finger gently on this area. These should move up during pharyngeal swallow. The SLP records the number of times the client swallows while ingesting each amount of food or drink. Multiple swallows may suggest inadequate pharyngeal contraction. If vocal quality changes after swallowing, this may indicate residue at the level of the vocal folds.

Of importance to an SLP are which food consistencies appear to cause difficulties and which seem to be swallowed efficiently. Similarly, an SLP notices whether there is a preferential placement in the mouth for food or liquid.

Managing a Tracheostomy Tube

Some clients will have a **tracheostomy tube** in place to facilitate breathing. A swallowing evaluation can still be conducted in most such cases, with a physician's approval. An SLP or nurse deflates the cuff of the tube before assessment and suctions secretions from the mouth and within and below the tracheostomy tube. The swallowing evaluation is similar to the one just outlined; however, the patient is instructed to cover the tube with a gauze pad or gloved finger before each swallow to normalize tracheal pressure (Logemann, 1998). See Aaron's Tracheostomy Page, at www.tracheostomy.com, for more in-depth information about tracheostomies.

Instrumentation

Although the bedside swallowing evaluation is useful in identifying the presence or absence of a swallowing problem, it cannot adequately determine the nature or severity of dysphagia of the pharyngeal phase (Coyle et al., 2009). Complete, accurate assessment of swallowing function requires the use of instrumentation. An SLP collaborates with other team members, such as a physician, a radiologist, and an X-ray technician, in the use of diagnostic technology. Some of the most commonly used instrumental procedures are described in the following paragraphs.

Solid knowledge of anatomy and physiology is essential in order to interpret videofluoroscopic swallowing studies accurately (Wooi et al., 2001).

Modified Barium Swallow Study

The **modified barium swallow study**, also referred to as **videofluoroscopy**, is an X-ray procedure that has been considered the "gold standard" in dysphagia diagnosis in children or adults (Sonies & Frattalli, 1997). This procedure is used when clinical evaluation or screening suggests dysphagia and/or aspiration.

Barium, a substance that can be seen on X-rays, is coated onto or mixed into the food or beverage to be ingested. An SLP typically determines the size, texture, and consistency of the food or beverage to be presented and the head and body position of the patient during the study. A radiologist and an X-ray technician use fluoroscopic (X-ray) equipment to observe the movement of the barium throughout the swallow. These views are videorecorded for further analysis by the physician and SLP. The study provides real-time visualization of the swallowing process and is highly useful in determining whether the client should be fed orally or nonorally, what food textures are safest, and what types of treatment are appropriate (Hardy & Robinson, 1999; Rogers et al., 1994).

Fiber-Optic Endoscopic Evaluation of Swallowing

> The FEES procedure is increasingly being used because of its convenience and portability.

Fiber-optic endoscopic evaluation of swallowing (FEES) may be used with pediatric and adult patients who are too ill to be brought to a radiology department for the modified barium swallow study. FEES is not an X-ray procedure. Instead, following topical or localized anesthesia, an otolaryngologist inserts a flexible fiber-optic laryngoscope through the patient's nose and down into the pharynx. A specially trained SLP can also perform this procedure, in consultation with a physician. When the scope is in place, the patient may be asked to cough, hold his or her breath, and swallow foods of different textures and thickness that have been dyed for better visualization. FEES may reveal bolus spilling into the pharynx before swallowing, and residue may be seen after the swallow. The actual swallow cannot be viewed with FEES due to a "white-out" period when the epiglottis obscures the view. Oral and esophageal phases of swallowing are also not visible with FEES. Nevertheless, observations with FEES can be performed at the bedside and provide valuable information about desirable body and head posture during feeding, preferred food types, and aspiration. FEES may also be more cost-effective than videofluoroscopy, particularly for patients with head and neck cancer (Aviv et al., 2001; Leder et al., 1998; Sonies, 1997). To see video examples of FEES go to ASHA's website www.asha.org and type in "Endoscopic Evaluation of Swallowing" in the search bar and then scroll down to the bottom of the page and click on "Video Examples of Endoscopy from YouTube."

Scintigraphy

Scintigraphy is a computerized technique sometimes used with adults for measuring the amount of aspiration during or after a swallow. A specialized physician such as a radiologist, a gastroenterologist, or an otolaryngologist performs scintigraphy; however, an SLP plays a role in positioning the patient, suggesting swallowing procedures, and interpreting test results. A radioactive tracer is mixed with the food or liquid to be ingested. Radioactive markers may be placed externally on the chin, lip, thyroid notch, and other anatomical landmarks to facilitate measurement. A specialized gamma scintillation camera is used. When scintigraphy is used, it is generally to supplement information obtained from other tests. Scintigraphy provides insight regarding esophageal function and may help in the determination of the safety of oral feedings (ASHA, 1992; Sonies, 1997).

Ultrasound

Ultrasound, or **ultrasonography**, is an imaging technique that uses sound waves at a frequency that is inaudible to human ears, over 20,000 Hz. It is a noninvasive procedure that is safe to use with infants and children as well as adults.

A transducer that generates and receives sound waves is placed below the chin for views of the oral cavity and on the thyroid notch for visualizing the laryngeal area. The acoustic images are videotaped. Ultrasonographic real-time measures are particularly helpful in assessing the duration of the oral phases of swallowing as well the structure and movement of the tongue and hyoid bone. One drawback is that ultrasound does not permit visualization of the pharyngeal stage of swallow (ASHA, 1992; Logemann, 1998; Sonies, 1997).

DYSPHAGIA INTERVENTION AND TREATMENT

Disorders of swallowing present medical, nutritional, psychological, social, and communicative problems, so many individuals are involved in working toward their resolution. As was mentioned earlier, an SLP is usually the coordinator of services and the professional who is most likely to implement dysphagia treatment. Nevertheless, input from other team members is essential to a satisfactory outcome.

Feeding Environment

Whether a patient is an infant, a young child, or an adult, the environment for feeding sets the stage for a satisfactory experience. It is especially important for people with swallowing problems to have their meals in an environment that is conducive to success. Visual and auditory distractions should be minimized. This means that the eating area should not contain nonrelevant objects. Lighting should be comfortable, neither too bright nor too dark, and noise should be reduced.

> Whereas children who have excess muscle tone (hypertonia) benefit from low lighting, soft music, and minimal stimulation, children with insufficient muscle tone (hypotonia) often respond better to bright lights, peppy music, and physical stimulation.

The caregiver should have a relaxed, unhurried manner. He or she must be tuned in to the patient's signals regarding feeding speed, food choices, and quantity. When necessary, these communication strategies may be developed and trained. The caregiver should indicate an interest in the person being fed and reinforce his or her healthy, effective eating behaviors. When possible, the goal is the development of self-feeding skills.

Utensils for feeding need to be appropriate to a patient's functioning. For infants, a slow-flow nipple may be helpful in controlling the amount of liquid taken at a time. A Teflon- or latex-covered spoon may be used for children with infantile tonic bite reflex, who will bite hard on any object that is placed on the teeth or gums. Children and adults with motor coordination difficulties may benefit from the use of a shallow-bowled spoon. Special cutout cups may help to improve tongue positioning in drinking (Hall, 2001; Jelm, 1994; Sheppard, 1995).

Body and Head Positioning

Body posture and stability have a strong influence on oral-pharyngeal movements. The basic premise is that controlled mobility stems from a solid base (Woods, 1995). An upright, symmetrical position with a 90-degree hip angle and sufficient postural support to provide stability is generally needed. The individual's head and neck must be positioned and prevented from making extraneous movement.

Occasionally, a child or an adult may benefit from a hip angle other than 90 degrees. For example, some infants with severe respiratory and swallowing problems may feed better when placed on their stomachs. Some older individuals

who have a considerable amount of pharyngeal residue may eat more safely at a bent-over 45-degree angle to prevent regurgitation of food from the esophagus into the airway (Martin, 1994; Woods, 1995).

An SLP works closely with a physical therapist and an occupational therapist in obtaining optimum positioning for swallowing. The **chin tuck** posture is often recommended for patients with delayed pharyngeal swallow. This position helps prevent food and liquid from entering the airway. The **head-back position** is useful for patients with poor tongue mobility if they have excellent airway closure. **Head tilt** and **head rotation** postures are used when an individual has impairment on one side. In these positions, the head may be moved in the direction of (rotation) or away from (tilt) the impairment. Clients who have been found to have residue in the pharynx during videofluoroscopy may be advised to lie on one side while eating (Hall, 2001; Logemann, 1998; Martin, 1994).

Modification of Foods and Beverages

Textures, Quantities, and Temperatures

During an assessment, liquids and foods of varying consistencies, amounts, and possibly temperatures will have been presented to a patient. On the basis of the findings of these tests, appropriate recommendations will be made.

Thought Question

Certain foods that are hard to chew, are small or slick when wet, or are thick and sticky are not recommended for children under age 5 who exhibit neuromotor difficulties. Specific foods for these infants and young children to avoid are listed in Figure 11.3.

Clients may exhibit a range of food consistency requirements. They might not tolerate any food by mouth, may accept only thin or thick liquids, may require a pureed consistency, or may be able to ingest the range of normal foods. The National Dysphagia Diet (NDD), published in 2002, was developed to establish standard terminology and best-practice procedures for the modification of dietary textures for the treatment of dysphagia (McCullough et al., 2003). It specifies the classification of foods based on four food texture levels:

- *NDD Level 1:* Dysphagia–pureed (i.e., cohesive, pudding-like; minimal chewing required)
- *NDD Level 2:* Dysphagia–mechanical altered (semisolid, cohesive, moist foods; some chewing required)
- *NDD Level 3:* Dysphagia–advanced (soft foods requiring more chewing)
- *NDD Level 4:* Regular (all foods permissible)

Figure 11.3 Specific foods that should be avoided for children younger than age 5 who have neuromotor problems.

Hot dogs	Nuts	Chewing gum
Grapes	Seeds	Raw carrots
Popcorn	Hard candy	

Source: Based on Lotze (1995).

The NDD also specifies four levels of liquid: thin, nectar-like, honey-like, and spoon-thick (McCullough et al., 2003). The texture level of food, liquid level, and amount of food and liquid that clients can manage in their mouths is determined by the modified barium swallow study. With regard to amount of food and liquid, the goal is typically to reduce the amount that is presented. Drinking through a straw typically causes too much fluid to enter the mouth, so straws are usually not advised. Spoons with a shallow bowl are helpful in limiting food amounts. Caregivers and patients must avoid placing food in the mouth until the previous bolus has been swallowed. Finally, patients may be encouraged to swallow twice per bite or sip.

Providing foods of varying temperatures may increase a client's sensory awareness of the food and improve swallowing. Cold food or drink sometimes improves tongue movement during the oral transport phase and helps to stimulate pharyngeal swallow, although some patients with respiratory problems prefer all substances to be ingested at room temperature (Martin, 1994).

Placement

Food or drink should be placed in the mouth where the patient has intact sensation and adequate muscle strength. For example, an individual who has had oral cancer has diminished sensation in the region where surgery occurred. Similarly, the ability to feel may be reduced after radiation therapy. Neurological disease and damage may also impair a person's full awareness of foods that are placed in the mouth. Surgery and neurological problems may also compromise muscle tone and make the person less able to move parts of the tongue, lips, or cheeks. Appropriate placement along with the adjustments in texture, quantity, and temperature is critical to successful dysphagia intervention (Martin, 1994).

Behavioral Swallowing Treatments

Each of the procedures described here is used only after clinical and instrumental assessment has demonstrated its safety and appropriateness. Clients also need to be able to follow instructions. All the techniques may be practiced without food. However, the swallowing techniques are specific to improving the actual swallowing process and are described with the use of food or drink. The evidence bases for these treatments are presented at the end of the chapter.

Strengthening Exercises

Swallowing physiology may be improved through exercise. Clients with impaired swallowing may have restricted mouth opening, tongue or lip movement, and laryngeal elevation. **Range of motion** may be improved by practicing specific exercises. Bite blocks of differing sizes may be used to encourage lowering the mandible. Flavored gauze or a toothette may be placed in various places around the mouth to stimulate tongue and lip movement. A licorice stick or a Life Saver candy on a string may also be used to improve tongue movement. The client may be instructed in moving her or his lips from pucker to smile and back again. Exercises to facilitate awareness of laryngeal movement may involve placement of the hand on the neck at the level of the hyoid bone. A mirror is often used to provide visual feedback to the patient.

Lip strength and seal may be improved by having a client attempt to hold a tongue depressor with the lips. Pushing the tongue against a tongue depressor is a

technique for strengthening that muscle. Improved coordination is taught by asking the client to follow instructions such as moving the tongue to explore the outside and then inside the upper and lower front teeth. Pharyngeal muscle-strengthening exercises involve head-lift exercises, where the patient lies flat on his or her back and then raises the head and holds this position for 1 minute. After three sustained head raisings, the patient rests for 1 minute. The patient then performs 30 additional head-raisings (Shaker et al., 2002). Clark (2004) provides an excellent tutorial regarding neuromuscular treatment of swallowing disorders.

Effortful and Double Swallows

A hard or effortful swallow may be helpful for patients whose tongues do not retract enough to trigger pharyngeal swallow. In such a case, the client is instructed to swallow forcefully and try to feel the tongue moving backward. This technique is helpful as swallowing practice with or without food or drink (Logemann, 1997; Martin, 1994).

Double swallows or multiple swallows are advised for individuals who, for whatever reason, retain some food in the oral cavity after a single swallow. Very simply, the client is instructed to swallow two or more times for each bolus (Martin, 1994).

Supraglottic Swallow

In a normal swallow, the vocal folds are closed to prevent food from entering the airway. A supraglottic swallow may be used for individuals who do not fully close the glottis during swallowing or who close the glottis late. This technique teaches voluntary closure of the glottal area and reduces the depth of misdirected swallows (Bulow et al., 2001). The client is instructed to do the following:

1. Breathe in and hold your breath.
2. Put a small amount of food or liquid in your mouth.
3. Swallow.
4. Cough or clear your throat while exhaling.
5. Swallow again (Hardy & Robinson, 1999).

Results of physiological studies reveal that the supraglottic swallow technique does in fact close the vocal folds earlier in the swallow, and it keeps them together longer (Wheeler-Hegland et al., 2009).

Super-Supraglottic Swallow

The super-supraglottic swallow technique is like the superglottic swallow, except that it requires an *effortful* breath hold. This is to ensure complete glottal closure during the swallow (Groher & Crary, 2010).

Mendelsohn Maneuver

The Mendelsohn maneuver is useful for clients who do not have adequate laryngeal elevation during swallowing. A patient is taught to hold the larynx manually at its highest point during the swallow (see Figure 11.4). The instructions are as follows (Hardy & Robinson, 1999; Groher & Crary, 2010):

1. Place a small amount of food or liquid in your mouth.
2. Chew if necessary.

Figure 11.4 In the Mendelsohn maneuver, the client manually holds the larynx at its highest position to facilitate swallowing. (Kim Farinella)

3. Swallow while placing your thumb and forefinger on either side of your larynx.
4. Manually hold the larynx for 3 to 5 seconds during and after swallowing in the highest position it reached during swallowing.
5. Let go of your larynx and let it drop.

The iSwallow app from www.ucdvoice.org provides comprehensive instructions and video tutorials for patients and SLPs on how to perform each of these swallowing techniques.

During the assessment process, an SLP determines which of these exercises and techniques are appropriate for a particular client. Evaluation continues, however, and modifications in treatment approaches are often made as treatment proceeds.

Medical and Pharmacological Approaches

Drug Treatments

Neurological patients, such as those with PD and MS who are taking medications to improve their condition, benefit from being medicated with their drugs before eating. In addition, the medication atropine has been reported to control drooling (Logemann, 1998), and nifedipine may be useful in managing dysphagia in individuals who have had a stroke (Perez et al., 1998). Injections of botulinum

A current reference book describing prescription drugs is an essential part of the personal library of a well-informed SLP.

toxin have been shown to improve swallowing in individuals with spasticity and hypertonicity of the cricopharyngeal muscle (Shaw & Searl, 2001). As discussed earlier in this chapter, some medications actually cause or contribute to swallowing disorders. In these cases, an SLP needs to work with a physician to determine whether alternatives can be used (Feinberg, 1997).

Prostheses and Surgical Procedures

Patients who lack an intact swallowing mechanism because of malformation, surgery, or another cause may benefit from using a prosthetic device. For example, individuals who had oral cancer and have had a significant portion of the soft palate excised may have a palatal obturator, a permanent or removable plate, that helps close this area during speaking or eating (Logemann, 1998). In addition, children with CP who exhibit dysphagia have been shown to improve their feeding skills and growth significantly when using an appropriately designed intraoral appliance (Haberfellner et al., 2001).

If less invasive approaches have been unsuccessful, surgery to improve swallowing and prevent aspiration is sometimes needed. Some techniques attempt to correct organic defects. For example, if a patient has bony growths on the cervical vertebrae that displace the rear pharyngeal wall, these may be reduced surgically. Other surgical procedures are used to increase the dimensions of the vocal folds or elevate the larynx. In severe cases of aspiration, the true or false vocal folds may be sutured closed, and breathing will have to occur through a tracheostomy (Logemann, 1998). For patients with esophageal dysphagia, injection of botulinum toxin is sometimes effective (Sonies, 1997).

Nonoral Feeding

Clients who require more than 10 seconds to swallow a liquid or food bolus or who aspirate more than 10% of either will likely require at least some nonoral feeding (Logemann, 1998). Several approaches are used.

With **nasogastric tube (NG tube)** feeding, a tube is placed from the nose to the pharynx, the esophagus, and finally the stomach. Liquefied food and water are inserted through this opening. Unlike the more long-term procedures described later, NG tubes are typically not used for periods of more than 5 or 6 months.

In **pharyngostomy**, a feeding tube is inserted into a **stoma**, or hole in the external neck region skin, which extends into the pharynx. **Esophagostomy** is a similar procedure; however, a hole is made into the esophagus from the chest area, and a food tube is inserted through it.

In percutaneous endoscopic gastrostomy (PEG, or G-tube), a hole is surgically made from the abdomen to the stomach. A soft tube is placed through this hole, and blended regular food can be inserted into the tube. This procedure is used in cases of severe dysphagia and may be a permanent means for nutrition and hydration.

PROGNOSES AND OUTCOMES FOR SWALLOWING DISORDERS

The overriding objectives of swallowing intervention are to improve the intake of food and drink and to prevent aspiration of these materials into the lungs. The potential for success of swallowing intervention is determined largely by the cause of the disorder, the severity of aspiration, and the onset of treatment (Denk et al.,

1997). In young children with developmental disabilities, treatment based on a careful diagnosis of the feeding disorder results in improved nutrition and generally better health (Schwarz et al., 2001). Early identification and successful intervention for swallowing disorders reduces the risk of aspiration and death following stroke, shortens the length of time patients need to stay in the hospital, and improves quality of life (Odderson et al., 1995). Although the original causes of swallowing problems may not be remediable, treatment for dysphagia has been reported to be beneficial in at least 80% of cases (Johns Hopkins, 2000). Box 11.1 provides a brief overview of the research evidence supporting the use of various treatment approaches and techniques for patients with dysphagia.

Click here to check your understanding of the concepts in this section.

BOX 11.1 | **Evidence-Based Practices for Individuals with Dysphagia**

General Intervention

- Both clinical and instrumental methods of assessment effectively evaluate dysphagia and guide selection of intervention goals.
- Development of nonnutritive sucking significantly decreases the length of hospitalization for preterm infants.
- Intraoral appliance treatment can result in jaw stability and significantly improved feeding for some children with moderate dysphagia.
- Intervention with adults improves nutrition and hydration and reduces morbidity due to pneumonia and pulmonary problems, thus reducing hospitalization expense and length of stay.
- Compensatory and direct intervention techniques with adults result in improvements in nutrition, feeding efficiency, and swallowing safety, such as less aspiration.
- As a result of SLP intervention, approximately 60% of clients no longer require alternative methods of feeding.

Specific Behavioral Treatment Approaches or Techniques

- Diet modification, particularly modification of thin liquids, is highly effective, at least in the short term, in patients with dysphagia associated with dementia and/or PD. Honey-thickened liquids were most effective for both patient populations, followed by nectar-thickened liquids plus use of the chin tuck technique.
- Postural techniques are effective in eliminating aspiration on thin liquids, although more systematic research is needed in specific patient populations. In neurological patient populations, the chin tuck technique is about 50% effective. The head rotation technique has limited evidence but shows promise for patients with dysphagia of neurological origin.
- The supraglottic technique is difficult for many patients but is effective for some patients with dysphagia associated with neurological disease.
- The super-supraglottic swallow technique has shown positive changes in swallowing in patients with head/neck cancer
- Muscle-strengthening exercises are effective for patients with pharyngeal phase dysphagia. Patients who participated in a 6-week exercise program involving head-raising exercises three times per day showed significant increases in swallowing functioning following the program.
- Case study research has shown that individualized swallowing programs that use principles that promote motor learning (e.g., maximized practice trials, random practice, systematic feedback) are effective for young children with dysphagia.
- Studies examining the effects of neuromuscular electrical stimulation (NMES) applied to the neck via surface electrodes on functional swallowing outcomes in adults with dysphagia are promising. Well-controlled experimental trials are needed to establish the treatment efficacy of NMES procedures, however.

Source: Based on Arvedson (2009); Ashford et al. (2009a, 2009b); Clark et al. (2009); Groher & Crary (2010); (Logemann et al., 1989), (Logemann et al., 1997), Logemann et al. (2008); Nagaya et al. (2004); Shaker et al. (2002); and Sheppard (2008).

SLPs have sometimes been successful in preventing dysphagia. Caregivers of youngsters who are at risk are instructed in feeding techniques soon after the child's birth. Information for the older population is also valuable. Among elderly people, swallowing disorders are sometimes related to poor dentition, which might be corrected by appropriate dental care. Avoiding alcohol, caffeine, spicy products, and foods that are extremely hot or cold may improve swallowing and prevent dysphagia (Toner, 1997).

SUMMARY

Speech-language pathologists who want to focus their careers in the area of dysphagia become specially trained to assess and treat swallowing disorders in pediatric and adult populations. They work with infants who are unable to nurse adequately, children with feeding problems, and older people who have dysphagia. The oral preparation, oral, pharyngeal, and/or esophageal phases of swallowing may be impaired. Causes include congenital or acquired neurological problems, stroke, cancer, developmental disability, dementia, and accident. Swallowing affects not only nutrition and health but also social and personal aspects of life. A team approach is used for both assessment and intervention. Evaluation includes a careful history and direct observation of a client while he or she is feeding. The modified barium swallow study uses videofluoroscopic equipment and is considered the gold standard in dysphagia evaluation. Treatment procedures address the feeding environment, the client's body and facial posture, food textures and temperatures, oral-motor mobility, and specific swallowing techniques. Medical, prosthetic, and surgical approaches are used when necessary. Nonoral feeding may be required in severe cases.

SUGGESTED READINGS

Clark, H. M. (2004). Neuromuscular treatment for speech and swallowing: A tutorial. *American Journal of Speech-Language Pathology, 12,* 400–415.

Hall, K. (2001). *Pediatric dysphagia resource guide.* San Diego, CA: Singular.

Logemann, J. A. (1998). *Evaluation and treatment of swallowing disorders* (2nd ed.). Austin, TX: PRO-ED.

The 2009 issue of the *Journal of Rehabilitation Research and Development, 46*(2), 175–222, provides a systematic review of evidence-based practice in dysphagia treatment.

12

Audiology and Hearing Loss

David A. DeBonis, Ph.D.

CHAPTER LEARNING GOALS

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

- Describe the psychosocial consequences of hearing loss

- Describe the difference between views of deafness as a disability and views of Deafness as culture

- Define *audiology* and describe the role of the audiologist in various employment settings

- Describe the mechanics of sound production and demonstrate a basic understanding of the anatomy and physiology of the auditory system

- Identify the general types of hearing loss and potential causes of each

- Identify the components of the audiological test battery and explain the general purpose of and method used in each test

- Define *aural* (*audiologic*) *habilitation/rehabilitation* and describe the basic techniques that are used to reduce the effects of hearing loss on communication

Those who are unfamiliar with the topic of hearing loss often have the misconception that it is a disorder that primarily affects the elderly population and is caused by age. In reality, hearing loss is common in people of all ages—from newborns to school-aged children, from teenagers and young adults to seniors—and it can be caused by a number of factors. Another common misconception is that hearing loss is a disorder that simply affects a person's ability to hear. Hearing loss can affect the overall quality of a person's life. It can have a very negative impact on speech and language development, reading skills, educational achievement, job performance, social interactions, and psychological well-being. It can also have a significant negative impact on family members and close friends. In this chapter, we provide an introductory overview of how hearing loss occurs, the many ways it impacts people's lives, how it is diagnosed, and how it is treated.

INCIDENCE AND PREVALENCE OF HEARING LOSS

One of the first questions that comes to mind when introducing students to the topic of hearing loss is "How many people are we talking about?" Although this question is difficult to answer precisely, a general estimate is that approximately 12% of the population in the United States, or 30 million people, have some degree of hearing loss in each ear (John Hopkins Medicine, 2011). This number has doubled since the mid-1980s and is expected to reach 40 million by 2025. Approximately 3 in every 1000 births results in a child with hearing loss, making it the most frequently occurring birth defect (Centers for Disease Control and Prevention, 2009). Also, approximately 1 in every 1000 births results in a child with a severe to profound degree of hearing loss. Approximately 83 in every 1000 children in the United States exhibit what is termed an "educationally significant" hearing loss that can have lifelong consequences (National Dissemination Center for Children with Disabilities, 2003). The World Health Organization (WHO) website (www.who.int/en/) in 2012 reported that worldwide, 278 million people were believed to have more than mild hearing loss in each ear and that in developing countries, fewer than 1 in 40 people who needed a hearing aid had one.

Classification of Impairment, Disability, and Handicap

When it comes to describing the effects of hearing loss, terminology can be confusing, especially for those who are new to the subject. Terms such as *impaired*, *disabled*, and *handicapped* can seem to overlap in meaning. In 1980, WHO adopted an international classification system in an effort to define and distinguish these terms. It has since been revised (WHO, 2000) and is now used in a variety of disciplines.

The WHO defines **impairment** as a loss of structure or function. As related to audiology, examples of impairments could include trauma to the eardrum, damage to the bones of the middle ear, or damage to the sensory cells in the inner ear. Do all impairments lead to a disability? The answer is "no." WHO refers to the functional consequences associated with a particular impairment as *activity limitation*, or **disability**. For those with hearing loss, examples of disability could include an inability to understand speech in the presence of background noise, difficulty understanding conversations on the phone, or difficulty hearing low-intensity speech sounds. When audiologists guide their clients with treatment recommendations, they are often addressing the person's hearing disability.

Finally, impairment and disability may lead to *participation restriction*, or **handicap**, which is defined as the ability of a person to participate in life situations. Examples here could include hearing loss that makes employment impossible or that interferes with the ability to maintain positive social relationships. It is important to remember that many individuals who have hearing loss do not have a hearing handicap because their loss does not interfere with their ability to participate in life situations. For example, despite problems hearing on the phone or understanding conversations in noisy settings, many people who have hearing loss are well-adjusted, independent, fully participating members of society.

Deafness, the Deaf Community, and Deaf Culture

Our discussion of impairment and disability leads us to a brief discussion about individuals who are deaf. As you will learn in more detail later in this chapter, when a person's hearing loss reaches 90 dB or greater, the loss is categorized as profound, or we say that the person is **deaf**. For those who are not familiar with issues related to deafness, it might seem logical to think that individuals with such significant hearing loss would be most interested in wearing hearing aids or getting a cochlear implant and receiving speech and language services. The truth, however, is that some individuals who are deaf do not see their deafness as a disability but rather see it as a cultural trait. These individuals make up what is referred to as the **Deaf community**, a group who views deafness with a sense of pride that serves to unite its members and positively shape their sense of self-identity.

You might be wondering at this point how deafness could be considered a culture. Consider that a culture is created when a group of people share in a common background of language, traditions, and values. Those who identify with Deaf culture in the United States share a common language, **American Sign Language (ASL)**, which is considered the natural language of the Deaf that serves to foster group cohesion. **Deaf culture** is further characterized by its

rich history, traditions, folklore, and various contributions to the arts, including poetry, dance, and theater. At this point, an important distinction needs to be made between the labels *deaf* with a lowercase *d* and *Deaf* with an uppercase *D*. Individuals who are "deaf" share a common physiological condition: severe to profound hearing loss. In contrast, "Deaf" refers to individuals who are members of the Deaf community.

Think for a moment about recent technological advances that have occurred that allow individuals who are deaf to receive cochlear implants via a surgical procedure discussed in detail later. This surgery has allowed many individuals to receive speech and language information and to develop oral language skills. Although this is a positive development for these individuals, there has been some very heated discussion in the literature about the effect it might have on Deaf culture. As fewer and fewer individuals attend schools for the deaf and greater numbers choose to get cochlear implants, learn oral English, and integrate more fully with hearing individuals, some people fear that the future of the Deaf community and culture may be in doubt. Possibly for this reason, leaders in the Deaf community were originally quite forceful in their opposition to the use of cochlear implants. But as Hossain (2012) notes, as the benefits of cochlear implants have become clearer, the Deaf community has become accepting of the device and more open to the fact that this is a personal choice that should be respected.

Living and working in today's culturally diverse society, it is important for professionals in the fields of speech-language pathology and audiology to develop an awareness and understanding of Deaf culture and to think carefully about the complex and hard-to-answer questions surrounding deafness. Even though many academic training programs have traditionally seen all hearing impairments from a pathological perspective that assumes they need to be treated, those who are considering a career in speech-language pathology or audiology should be aware that this is not the only perspective. Also, in order to use evidence-based practice, we must value and respect the beliefs and preferences of our clients. Our role is not to tell our clients what to do but rather to listen to their goals and priorities and coach them in ways that are consistent with those beliefs and with their culture. We certainly can expose clients to new information and perhaps new ways of thinking, but they must make the final decisions about their communication goals and how to achieve them.

Thought Question

WHAT IS AUDIOLOGY?

The American Speech-Language-Hearing Association (ASHA) defines **audiology** as the discipline involved in "the prevention of and assessment of auditory, vestibular, and related impairments as well as the habilitation/rehabilitation and maintenance of persons with these impairments." (ASHA, 2004, p. 2). Note that audiology consists of work related to both assessment *and* habilitation /rehabilitation. Often, people perceive audiology as a discipline that deals strictly with the diagnosis of hearing loss. Although assessment is a critical part of audiology, treatment and management of a client diagnosed with a hearing problem are equally important. Audiologists must be skilled at providing habilitative/rehabilitative services including counseling, prescribing and fitting **amplification**, and various therapeutic services designed to support communication and improve one's overall quality of life.

Educational Requirements and Employment for Audiologists

According to the American Academy of Audiology website (www.audiology .org), from the 1960s until 2007, the degree that audiologists needed for clinical practice was a master's s degree in audiology. In 2007, a clinical doctorate degree, designated the Au.D., became the entry-level degree for clinical audiology practice. This change in degree requirements was made so that students in audiology programs would be better prepared to meet the broad range of skill requirements that are needed in many employment settings. Most Au.D. training programs require 4 years of study beyond the master's degree. Although the Au.D. degree prepares students to understand research and perform clinical research, students who are primarily interested in performing research and/or working at the college level should pursue a Ph.D. in audiology.

Audiologists are able to find employment in a wide range of settings. A survey of ASHA-certified audiologists revealed that more than half work in nonresidential health care settings (e.g., private practices, community speech and hearing centers, physician's offices), and 27% are employed in hospital settings, 11% in schools, 9% in universities, and a smaller percentage in industry (ASHA, 2010).

FUNDAMENTALS OF SOUND

Several conditions must exist in order for sound to occur and be perceived. For the purpose of this discussion, let's focus specifically on the speech signal. The following must be available: (a) an energy source, such as exhalation of air from the lungs; (b) an object capable of vibrating, such as the vocal folds of the larynx, for the energy source to act on; (c) a medium, such as air, that is capable of conducting the resulting vibrations; and (d) a receptor to receive and interpret the resulting sound.

How is it that sound is able to travel great distances through the air to reach our ears? Let's take a step back and first consider how an object, such as a simple guitar string, vibrates. Vibration can be thought of as a series of rhythmic back-and-forth movements. As the guitar sting is plucked, it vibrates to and fro. As it moves in one direction, an increase in pressure occurs as air molecules that are close to each other are displaced and become compressed or packed together tightly. As the guitar string reverses and moves in the opposite direction, the air molecules that were initially compressed begin to rebound or spread apart, creating a decrease in pressure referred to as a rarefaction. Sound, then, is a series of **compressions** and **rarefactions** that move outward from a vibrating source. It is important to realize that the individual air molecules themselves do not travel from their original position to the listener's ear, but their movement creates the sound wave that travels to the ear.

A vibrating object that moves back and forth from its normal resting position has special qualities. First, the vibrating object travels a measurable distance in either direction. This is referred to as the *amplitude* of the vibration. The amplitude of a sound determines its **intensity**, which is measured in decibels (dB). Second, this back-and-forth movement regularly repeats itself, resulting in a certain number of complete cycles during a specified period of time. This is referred to as the **frequency** of the vibration and is expressed in cycles per second, or Hertz (Hz). Every sound, therefore, can be described in terms of its unique intensity and

frequency characteristics. This information is decoded or interpreted by the auditory system, allowing the listener to differentiate the infinitesimal number of sounds he or she is exposed to throughout the course of a day.

ANATOMY AND PHYSIOLOGY OF THE AUDITORY SYSTEM

Before we can begin our discussion of the various types and causes of hearing loss, a general understanding of the anatomy and physiology of the auditory system is essential. Anatomically, the auditory system can be divided into several general areas. They include the outer ear, the middle ear, the inner ear, the vestibulocochlear nerve, the auditory brain stem, and the auditory cortex of the brain. The first four areas (Figure 12.1) are commonly referred to as the **peripheral auditory system**; the latter two are part of the **central auditory system**. Typically, when we say that someone has a hearing loss, we are referring to a peripheral problem. When someone has a deficit in the central auditory system, we usually say that this person has a processing or an auditory processing problem.

The Outer Ear

The **outer ear** is comprised of the **pinna**, or auricle, and the **external auditory meatus**, or external auditory canal. The pinna is the most visible structure of the auditory system and is made of cartilage covered with skin. If you take a look at someone's pinna, you will note various ridges and depressions; these are important because they provide a natural boost to certain sounds as they enter the ear. The pinna also collects and funnels sound into the ear canal and helps the listener to identify where sound originates in space, a process called **localization**.

The external auditory meatus, which is also called the ear canal, is a tube lined with skin that extends from the bowl-like depression of the pinna, known

Figure 12.1 The peripheral auditory system.
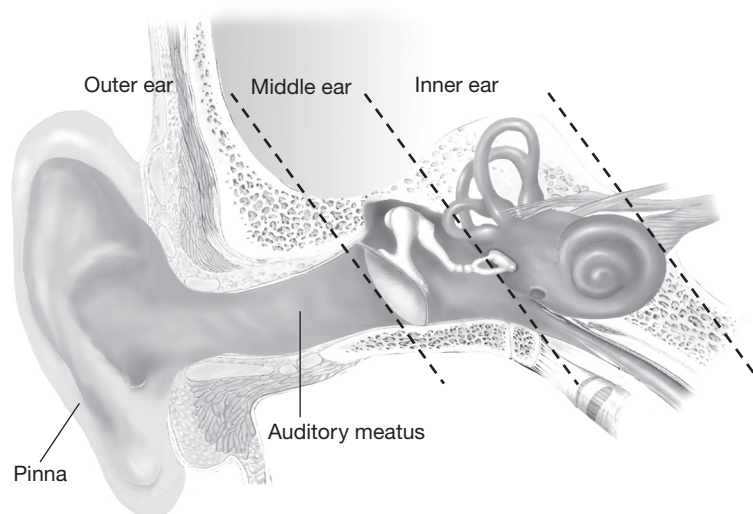
as the **concha**, to the **tympanic membrane** or **eardrum**. The ear canal is approximately 1 inch in length in adults and has a slight "S-shaped" curve as it progresses toward the eardrum. The outer region of the canal contains hair follicles and glands that produce **cerumen**, more commonly known as earwax. Similar to the pinna, the ear canal also enhances certain high-frequency sounds as they travel to the eardrum.

The Middle Ear

The external auditory canal leads to the tympanic membrane, which marks the boundary between the outer ear and the **middle ear**. The tympanic membrane is a thin concave-shaped structure that vibrates in response to sound waves that travel down the canal. Most of the surface area of the tympanic membrane is composed of three distinct layers of tissue. The middle layer is made of fibrous tissue that provides both the strength and elasticity of the eardrum. A healthy eardrum is often described as appearing "pearl gray" in color. Because the eardrum is semitransparent, it is possible to view some of the structures of the middle ear when conducting a visual examination of the eardrum.

Located behind the tympanic membrane is the **middle ear space**. This air-filled cavity is lined with mucous membrane and includes the opening to the **Eustachian tube**. This important tube connects the middle ear with the **nasopharynx**, the space located behind the nose and above the roof of the mouth. The Eustachian tube is normally closed but opens periodically, providing a passageway for air to ventilate the middle ear space and equalize air pressure on each side of the eardrum.

Also located in the middle ear space is a chain formed by three small bones. These bones, called the **malleus**, **incus**, and **stapes**, are collectively referred to as the **ossicles**, or **ossicular chain** (see Figure 12.2). The first bone in the chain,

Figure 12.2 Structures of the middle ear.
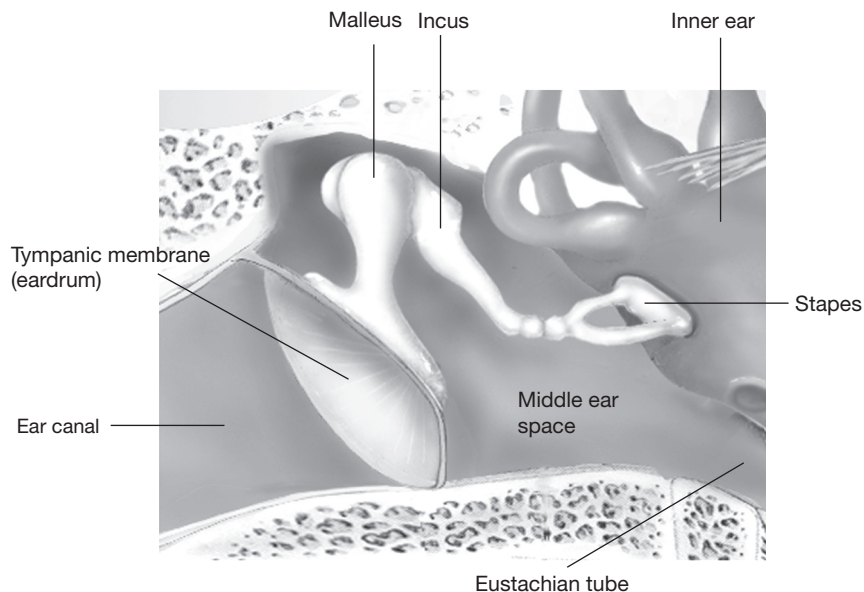
the malleus, is the largest of the three and is embedded in the fibrous layer of the eardrum. The upper portion of the malleus makes contact with the incus, which makes contact with the stapes, the smallest bone in the human body. The footplate of the stapes rests against the **oval window**, a thin membrane that marks the entrance to the inner ear.

The Inner Ear

At this point you should be able to begin to think about how we hear. We now know that sound waves travel through the air, down the ear canal and cause the eardrum to vibrate. These vibrations are then carried across the ossicular chain to the footplate of the stapes, which makes contact with the oval window, which is the entry point to the inner ear. The **inner ear** is a complex structure that serves two important roles. One major component, the **cochlea**, is responsible for providing auditory input to the central auditory system. The other major component, the **vestibular system**, is responsible for supplying information regarding balance.

Let's turn our attention first to the cochlea, a structure the size of a pea that resembles a snail's shell. The cochlea is the portion of the inner ear that contains special nerve cells designed to respond to auditory stimuli; these are referred to as *auditory sensory receptor cells*. The cochlea is composed of two complicated networks of passages, referred to as *labyrinths*. The outer labyrinth is composed of bone and filled with a fluid called **perilymph**; the inner labyrinth is composed of membranous material and contains a fluid called **endolymph**.

Running along the center of the membranous labyrinth is a structure called the **organ of Corti** (see Figure 12.3). The floor of the organ of Corti is formed by the basilar membrane. The **basilar membrane** is narrower, thinner, and stiffer at the base and wider, thicker, and more flaccid at the apex. Think for a moment about a guitar string; the thinner, stiffer strings produced high-frequency sounds and the thicker, looser strings produce low-frequency sounds. Although the process is not completely understood, we know that these anatomical differences of the basilar membrane enable it to respond differently to sounds of different frequencies. That is, the portion of the basilar membrane closest to the stapes responds best to high-frequency sounds, and the portion nearest the tip or apex of the cochlea responds best to low-frequency sounds.

It is very important to note here that located on the basilar membrane are thousands of tiny **hair cells**, which are considered to be the sensory receptor cells of the auditory system. Located on the top of each cell are small hairlike projections called **stereocilia**. Also, forming the roof of the organ of Corti is a structure called the **tectorial membrane**. The tectorial membrane is fixed at one end, while the opposite end is free to move up and down in response to displacement of the surrounding fluid.

At this point, take a look back at the pathway of sound from the sound wave in the air to movement of the stapes in the oval window, described above. Now add to that understanding the following: As the stapes rocks in and out of the oval window, fluid is displaced in the membranous labyrinth. As the stereocilia are bent through the movement of the tectorial and basilar membranes, chemical transmitters are released at the base of the hair cells, and neuroelectric energy is generated and transmitted to auditory nerve fibers that form the acoustic branch of the **vestibulocochlear**, or **VIIIth cranial nerve**. This information is then directed to the brain stem and eventually the brain.

Figure 12.3 The organ of Corti.
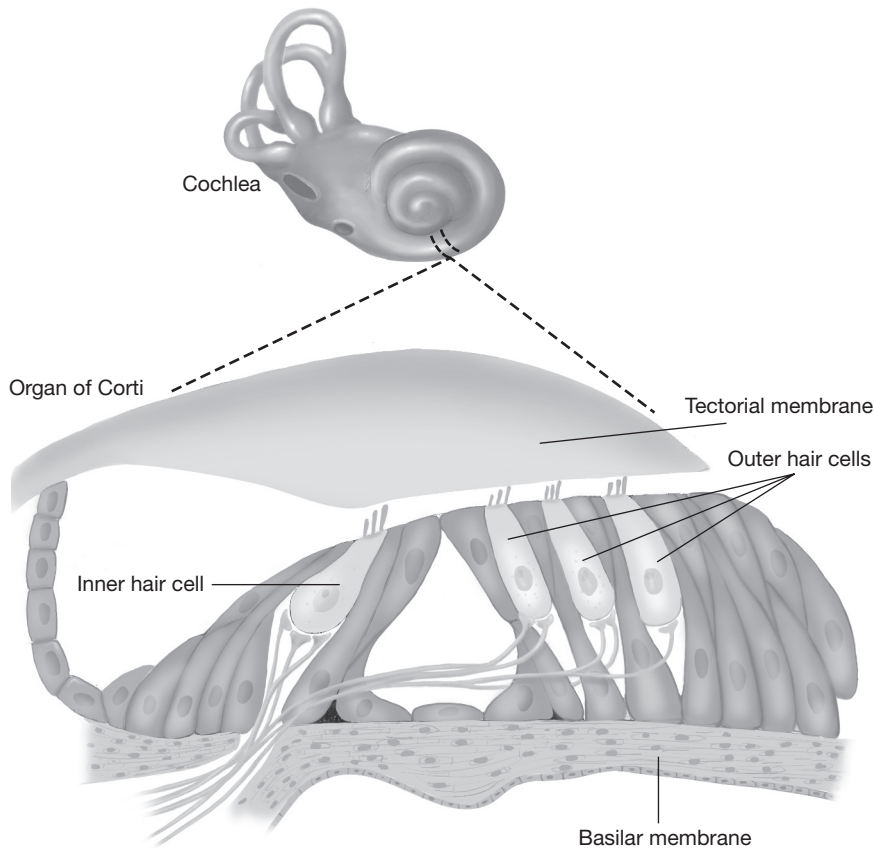
Before we end our discussion of the inner ear, a brief mention of the vestibular system should be made. The vestibular system is also made up of bony and membranous sections and contains sensory receptor cells that sense head movement. Nerve fibers innervating the sensory cells of the vestibular system form the vestibular branch of the VIIIth nerve. Now that you have a better understanding of the anatomical connections that exist between the balance and hearing mechanisms, you can more easily understand why both balance testing and nonmedical intervention of balance disorders are included in the audiologist's scope of practice (ASHA, 2004).

The Central Auditory System

The central auditory system, which consists of nuclei, nerve fibers, and nerve tracts, includes pathways that carry auditory information to the brain (ascending pathway) and pathways that receive information from the brain (descending pathways) Although it may appear that the anatomical structures leading to the brain simply send neural impulses, they actually play a key role in ensuring that information about the frequency, intensity, and duration of the auditory stimuli remains intact until it reaches the auditory cortex for interpretation. Further exploration of the central auditory system is typically presented to students in anatomy and physiology and audiology courses.

Click here to check your understanding of the concepts in this section.

TYPES OF HEARING LOSS AND AUDITORY DISORDERS

The previous section described the ear from an anatomical and physiological standpoint. The outer and the middle ear serve to collect, amplify, and conduct sound to the cochlea. The outer and middle ear, therefore, are referred to as the **conductive system**. The cochlea is the actual sensory organ of hearing, and the auditory branch of the VIIIth nerve is responsible for transmitting the resulting neural signal to the brain stem and eventually to the auditory cortex for processing. The cochlea and auditory nerve, therefore, make up the **sensorineural system**. When audiologists describe peripheral hearing loss, they typically use terms like *conductive* and *sensorineural*. When deficits are noted in the central auditory system, these are typically described in terms of how they impact a person's auditory processing abilities.

Conductive Hearing Loss

A conductive hearing loss occurs as a result of a deformation, a malfunction, or an obstruction of the outer or middle ear. Not all disorders of the outer and middle ear result in a loss of hearing. In many cases, however, problems in these areas reduce or eliminate the ear's natural conduction of sound as it travels to the cochlea. As a result, the intensity of sound arriving at the inner ear is reduced. This usually prevents low- to moderate-intensity sounds from being heard at all and higher-intensity sounds being perceived as much softer than normal. It is important to remember that the primary consequence of conductive hearing loss is a loss of loudness or audibility. As long as the sensorineural system remains intact, sound can be heard without difficulty if it is made loud enough for the individual, such as by turning up the volume of a radio or TV, or by raising the level of one's voice.

There are a few other key things you should remember about conductive hearing loss. First, it does not result in a total loss of hearing. In other words, a person who is considered deaf would not have lost hearing solely as a result of a conductive deficit. Second, most conductive losses are not permanent. Some resolve without any treatment, and most others are medically treatable. In rare cases when medical treatment cannot be given or when the client prefers not to pursue it, a hearing aid or hearing aids may be possible, if medical clearance is given by the physician.

Disorders of the Outer Ear

Several conditions of the outer ear can occur due to the malformation of structures during embryonic development. The first, **microtia**, refers to a small malformed pinna. Microtia alone does not result in a loss of hearing, but with microtia there is an increased likelihood that the person also has some other congenital condition, such as *atresia*. **Atresia** is a disorder in which there is complete closure of the external auditory meatus; because sound cannot travel through the ear canal in the usual manner, hearing loss results. Stenosis, a severe narrowing of the external canal, may occur in some individuals. Unlike atresia, however, stenosis does not result in significant hearing loss unless debris or earwax becomes trapped in the narrow opening. These conditions most frequently occur in conjunction with other craniofacial disorders (see Chapter 11).

A much more common cause of conductive hearing loss in the outer ear is due to impacted wax (cerumen) or a foreign object. Although many people view

cerumen as a problem, it actually protects the ear, at least to some degree, from insects and other foreign bodies entering the canal. It also traps dirt and debris, naturally cleansing the external canal as it migrates outward. Cerumen acts as a lubricant to prevent the skin that lines the canal from drying out and serves as a chemical barrier to bacterial and fungal infection. In view of these positive attributes of wax, the use of cotton swabs or other tools to remove cerumen should be avoided. In fact, aggressive use of cotton swabs often pushes more wax further into the ear canal, which can create a wax blockage that needs to be removed by a physician. In many states cerumen management (removal) is within the audiologist's scope of practice, although it should be conducted with caution and only after proper training.

Disorders of the Middle Ear

Several conditions can occur due to problems in the middle ear, For example, **otosclerosis** is a disorder that affects primarily young adults, particularly females, and in the majority of cases is linked to genetic factors. It is characterized by the replacement of healthy bone with spongy bone in the area of the stapes footplate. This often results in reduced mobility of the stapes and hearing loss. Treatment of otosclerosis usually consists of surgical removal of part or all of the stapes footplate and insertion of a prosthetic device that acts as an artificial stapes.

One of the most common causes of conductive hearing loss, particularly in children, is **otitis media**, an inflammation of the mucous membrane lining the middle ear cavity. Otitis media generally results from **Eustachian tube dysfunction**, which prevents proper ventilation of the middle ear cavity. A normally functioning Eustachian tube opens and closes regularly as one chews, yawns, or swallows, allowing for the equalization of air pressure between the middle ear and the external environment. In children, the Eustachian tube is less efficient than it is in adults and therefore less effective in ventilating the middle ear. Another factor that can interfere with Eustachian tube function and middle ear ventilation is enlarged adenoids.

When the middle ear is not consistently ventilated, oxygen within the cavity is absorbed into the mucous membrane lining, forming a partial vacuum. This, in turn, results in a condition known as *negative middle ear pressure*, which causes the eardrum to retract into the middle ear cavity, reducing its ability to vibrate freely. If this situation goes untreated or does not respond to treatment, the secretion of fluid may occur in the middle ear; this is, a condition referred to as **otitis media with effusion (OME)**. As fluid fills the cavity, sound must be conducted through fluid- instead of the usual air-filled environment. If the fluid is sterile, the condition is classified as **serous otitis media**. However, when bacteria are present, pus may form within the middle ear cavity, causing a condition referred to as **purulent (or suppurative) otitis media**. In these cases, in addition to conductive hearing loss, the child may also experience restlessness, irritability, ear pain, fever, and vomiting. During this process, the tympanic membrane may appear reddish in color or bulging. In some cases, the eardrum may rupture due to the pressure created by the fluid behind it.

Otitis media is not rare. In fact, it is the most frequently diagnosed disorder in the United States in children younger than 15 years. More than 90% of children experience at least one episode by the age of 7 years, with peak incidence generally occurring during the period from 6 months to 2 years of age (Jung & Hanson, 1999).

Treating otitis media is a complex process because no one treatment works best for all children. In some cases, the most appropriate action is to simply wait and monitor the condition because a number of these cases resolve without treatment. In other cases, use of a decongestant or an antihistamine helps resolve the underlying problem of inadequate Eustachian tube function. For children who have acute otitis media with infected fluid, antibiotics such as amoxicillin are frequently used, but this must be done carefully because some children have difficulty tolerating antibiotics, and there is concern among medical professionals about the overuse of antibiotics.

Some treatment options cannot be pursued by a child's pediatrician and require a referral to an **ear, nose, and throat physician (ENT)**. When nonsurgical treatments have been ineffective, ENTs often perform a surgical treatment that research and clinical observation have shown to restore hearing and reduce the likelihood of further middle ear pathology. The procedure, called a **myringotomy**, involves making an incision into the tympanic membrane in order to drain fluid from the middle ear cavity. This is frequently followed by insertion of a **pressure equalization (PE) (**or **tympanostomy) tube** into the tympanic membrane. These tubes serve the same purpose as the Eustachian tube, allowing air to pass into the middle ear space. However, instead of passing from the nasopharynx in the usual manner, air enters the middle ear from the external auditory canal via the open PE tube situated in the eardrum. Images of various outer and middle ear disorders are available on Roy Sullivan's video otoscopy website.

It should be noted that the treatment of otitis media can be stressful for both parents and professionals because resolving the problem is often not an efficient process. From a physician's point of view, it certainly makes sense to choose treatment options that are more conservative first and to gradually move to more aggressive options. But in cases where the treatment is not working, the hearing loss that accompanies the otitis media can remain unresolved for many months in a child who is in a very critical period for speech and language development. This can be of great concern to parents, speech-language pathologists (SLPs), and audiologists. In addition, the fact that some treatment options are only available through an ENT can add more waiting time to this process.

Finally, at this time, there is disagreement in the literature regarding whether early otitis media with hearing loss has negative effects on a child later in life. For example, Zumach and colleagues (2010) found that the early negative effects on receptive and expressive language from otitis media that were measured in children who were 27 months of age disappeared by the time the same children were 7 years old. In contrast, Shapiro and colleagues (2009) found that children who had a history of otitis media prior to age 2 years performed more poorly at age 9 years of age on measures of reading and phonological awareness than did those who did not have this history and those who had otitis media after the age of 2 years. This question of the possible long-term impact of early hearing loss is an important one. If long-term effects do exist, greater efforts to quickly resolve early hearing loss in children who have otitis media will have to become part of our treatment protocols.

Sensorineural Hearing Loss

A second general type of hearing loss, sensorineural hearing loss, results from the absence or malformation of, or damage to the structures of, the inner ear, including the hair cells within the cochlea. Sensorineural hearing loss may be

present at birth or may develop over the course of one's life. It may be sudden in onset, occurring over a matter of hours, or gradual, occurring over a period of years. Some forms of sensorineural hearing loss have a genetic basis; other forms are acquired. Some cases of sensorineural hearing losses may remain stable, some become worse, and some fluctuate. Unlike conductive hearing losses, which are most commonly temporary, sensorineural losses are usually permanent.

Although sensorineural hearing loss may affect hearing sensitivity for any range of frequencies, in most cases, the higher frequencies are affected. Unlike conductive hearing loss, where the problem stems from sound not being loud enough, sensorineural hearing loss can involve both a lack of loudness and a lack of clarity. Not only are certain sounds inaudible or difficult to hear, but sounds that are audible are often perceived as being distorted. To illustrate this point, consider the following example. Talking on your cell phone at a low volume level simulates a conductive hearing loss. That is, sound is softer than normal, making it difficult to perceive. If, however, the volume is increased (i.e., the conductive disorder is resolved), the signal not only becomes easier to hear but the signal also becomes clear. If we now take the same phone but add distortion or static, the signal remains audible but is harder to understand. Increasing the volume makes the distorted signal louder, but it is still not clear.

As you might expect, sensorineural hearing loss can have a negative impact on speech, language, and cognitive development. Factors that influence the effects of the loss on these aspects of development include (a) the degree of the loss, (b) the age of the person when the loss occurred, referred to as *age of onset*, (c) the age of the person when the loss was identified, and (d) the age of the person when appropriate intervention was begun.

Age of onset is usually described as **congenital** (present at birth) or acquired (occurring sometime after birth). Another way of looking at this is to consider whether the hearing loss occurred **prelingually** (i.e., before speech and language skills have developed) or **postlingually** (i.e., after the person has acquired spoken language skills). There is no precise age that defines these two terms, but traditionally hearing loss that occurs prior to the age of 2 years is considered prelingual in onset, and hearing loss that occurs after the age of 5 years is considered postlingual. Think about a child who is born with a moderate hearing loss that is not detected until he or she is 4 or 5 years of age compared to a child whose loss is identified when the child is a newborn. The negative effects on speech and language will be much greater for the first child. For the second child early, intervention services can be provided during a critical time of development to reduce these negative effects.

Disorders of the Inner Ear

Now that we have a general understanding of sensorineural hearing loss, let's take a look at some of the causes, starting with those that are congenital and hereditary. When a hearing loss is due to the absence or malformation of inner ear structures during embryonic development, it is referred to as **aplasia**, or **dysplasia**. There are several types of aplasia, depending on which part of the inner ear is affected. Very often, congenital hereditary sensorineural hearing loss is one component of a group of disorders associated with a syndrome. For example, **Usher's syndrome** is a genetic disorder characterized by significant sensorineural hearing loss as well as degenerative visual changes that result in night blindness and reduced peripheral vision. **Waardenburg's syndrome** is another genetic disorder characterized by mild to severe sensorineural hearing

loss, as well as changes in the coloring of the hair, skin and eyes. Children with **Alport's syndrome** often have sensorineural hearing loss and kidney disease.

Although sensorineural hearing loss may be present at birth, it is not always a result of genetic factors. Instead, an illness or toxic agent experienced by the mother during pregnancy may be the cause. One of the most well-known examples is hearing loss resulting from **maternal rubella** (German measles), which occurred in approximately 10,000 to 20,000 children born in the early to mid-1960s. Although a rubella vaccine is now available, other viruses, such as the human immunodeficiency virus (HIV) and cytomegalovirus (CMV), continue to be major causes of congenital sensorineural hearing loss when contracted by the mother during pregnancy. Sexually transmitted bacterial diseases such as syphilis can seriously damage the central nervous system of a developing fetus, leading to intellectual and developmental disabilities, as well as hearing loss. Sensorineural hearing loss can occur as a result of circumstances encountered at any point during one's lifetime. Acquired hearing loss may be due to viral infections such as mumps or due to bacterial infection such as **meningitis**, an inflammation of the tissue covering the brain that can lead to a severe or profound hearing loss in young children and adults. The structures of the inner ear are vulnerable to damage either from the bacteria that caused the disease or from the high fever that often accompanies the illness. In addition, in some cases bacterial meningitis requires treatment with high doses of strong antibiotics that can be **ototoxic** (i.e., poison to the ear). Hearing loss resulting from ototoxicity may be permanent or reversible. Frequent monitoring of hearing is often recommended for individuals being treated with ototoxic medications so that drug type and dosage can be adjusted if changes in hearing are noted.

Meniere's disease is disorder that can produce hearing loss that is rather sudden in onset. First described by Prosper Meniere in 1861, Meniere's disease is believed to be caused by pressure resulting from the buildup of endolymph fluid within the membranous labyrinth of the inner ear. Both the cochlear (hearing) and vestibular (balance) portions of the inner ear may be involved, or the disorder may be specific to only one region. The classic symptoms associated with Meniere's disease are fluctuating and progressive sensorineural hearing loss, tinnitus, vertigo, and a feeling of fullness in the ear. In addition, symptoms typically come and go unpredictably and may be so severe that the person must lie still until he or she feels better. There is no known cure for Meniere's disease, but drug therapy, surgical intervention, and changes in diet to reduce symptoms have all been used with varying amounts of success.

Another type of inner ear disorder, referred to as **auditory neuropathy spectrum disorder (ANSD)**, has received considerable attention in recent years. In general, ANSD is characterized by normal outer hair cell function (as seen in normal otoacoustic emissions) and abnormal responses from the inner hair cells or auditory nerve fibers (as seen in an abnormal auditory brain stem response). A lack of synchrony in the firing of auditory nerve fibers in response to sound appears to be underlying problem in these cases. Individuals who have ANSD may exhibit pure tone hearing that is anywhere from within normal limits to profoundly impaired, and pure tone hearing does not typically correlate well with their real-world difficulties or their potential to develop language. These individuals also usually have considerable difficulty understand speech, even when their pure tone loss is not significant. According to Berlin and colleagues (2010), hearing aids are helpful to only a small number of these individuals; cochlear

implants have been shown to be helpful to greater numbers of these clients. Some of the challenges in working with individuals who have ANSD is that the diagnosis is often not made in a timely manner (if at all), which means the resulting treatment plan does not provide the needed supports. Also, once the diagnosis is made, there is some disagreement regarding the best treatment approach to use. When working with children who have this disorder, many audiologists start by fitting the child with hearing aids and then monitoring closely the development of the child's auditory behaviors and skills. Lack of progress may lead to a discussion with parents about possible use of a cochlear implant.

Let's now turn our attention to a cause of sensorineural hearing loss that in most cases is avoidable: hearing loss resulting from excessive exposure to high levels of sound (noise). We live in an age where we are surrounded by ever-increasing amounts of noise. From machines at factories and construction sites to common everyday items such as power tools, motorcycles, and musical instruments, it is almost impossible to escape noise. It should come as no surprise then that **noise-induced hearing loss** is one of the leading causes of acquired sensorineural hearing loss in young and middle-aged adults. Now even children are at risk for noise exposure because many of today's popular toys, electronic games, and ear-level personal stereos emit sound levels that are potentially hazardous. Research now reveals some disturbing facts about personal music devices. Overwhelming majorities of both high school and college students own one, nearly 75% of the college students who own one use it every day, and young people, in general, are not well-informed about listening levels that are unsafe (Danahauer et al., 2012; Punch et al., 2011, Vogel et al., 2010). Exposure to high-intensity sound exposes the delicate structures of the cochlea to considerable stress that may lead to irreversible damage.

Hearing loss that occurs from exposure to high levels of noise can be temporary or permanent. **Temporary threshold shift (TTS)** is a term used to describe hearing loss that results from short-term exposure but recovers spontaneously. To understand TTS better, think about the last time you went to a loud concert and later noticed a slight reduction in hearing accompanied by tinnitus (ear or head noises). After several hours of rest, the ringing noise stopped, and hearing returned to normal. You experienced a TTS. Although we have long believed that TTS is not a problem as long as hearing thresholds returned back to normal, research by Truong and Cunningham (2011) suggests that even when hearing ability has returned to normal after TTS, permanent damage to both the cochlea and auditory nerve can be measured.

Now consider the factory worker who is exposed to loud sounds every day? Frequent exposure to high levels of noise over time may eventually lead to **permanent threshold shift (PTS)**. A PTS is typically characterized by a loss of hearing sensitivity in the high frequency range (between 3000 and 6000 Hz). As damage resulting from long-term exposure increases, more hearing is lost, and the ability to understand speech decreases, particularly in the presence of background noise.

The Occupational Safety and Health Administration (OSHA) has attempted to reduce the number of individuals who are at risk for getting PTS; it has established guidelines limiting the amount of time a worker can remain in a high-noise area. In addition, OSHA has policies for the use of hearing protection for workers and the annual monitoring of hearing with hearing testing. Unfortunately, these guidelines are not practical in all cases. For example, military personnel who are exposed to sudden, unpredictable blasts of sound remain at great risk for noise-induced hearing loss.

Finally, most of us will eventually experience some degree of sensorineural hearing loss in our lifetimes through the aging process. This hearing loss is referred to as **presbycusis** and can be due to loss of cochlear hair cells, reduced responsiveness of the hair cells, or loss of auditory nerve fibers. Because changes that occur with age can affect not just the ear but the central auditory system, too, presbycusis may involve not only reduced hearing sensitivity but also deficits in auditory perception. Cruickshanks et al. (1998) estimate that approximately 45% of adults between the ages of 48 and 92 years have some degree of hearing loss, with men demonstrating a higher prevalence than women. Knowing that the elderly population continues to be one of the fastest-growing segments within the United States, it is important that SLPs and audiologists have a good understanding of presbycusis and how it can impact people's lives.

It is very exciting to conclude this discussion of sensorineural hearing loss with information about research conducted by Mizutari and colleagues (2013). Using mice that were deaf, these researchers demonstrated that they could stimulate certain existing cells so that they would function like cochlear hair cells. This resulted in a partial recovery of hearing. Certainly, our hope is that this type of research will one day lead to a cure for hearing loss due to hair cell damage.

Thought Question

Mixed Hearing Loss

The third general type of hearing loss, mixed hearing loss, is the simultaneous presence of conductive and sensorineural hearing loss. For example, an older individual with an age-related sensorineural hearing loss may develop otitis media or impacted cerumen, which temporarily decreases their hearing sensitivity even further. In most cases, the conductive component can be medically treated, leading to some improvement in overall hearing sensitivity. However, because the sensorineural component remains, the person's hearing cannot be restored to normal levels. Audio simulations of different degrees of hearing loss are available on Scott Bradley's website.

(Central) Auditory Processing Disorders

The three types of hearing loss described in the preceding section refer to impairment of the peripheral auditory system or the structures of the ear spanning from the pinna to the auditory nerve. The function of the peripheral auditory system is routinely assessed during a comprehensive audiological evaluation. Because what we hear needs to be processed in order to be useful, audiologists must consider the *entire* auditory system including problems that affect the central auditory system. This can generally be thought of as the auditory structures, pathways, and neural synapses that span from the level of the brain stem to the cortex of the brain (see Figure 12.4). Problems associated with the central auditory system do not typically cause hearing loss; instead, they are characterized by an inability to efficiently and effectively use and interpret acoustic information. This is often reflected in problems such difficulty hearing subtle differences between similar sounding words and misunderstanding of speech when presented in a background of noise. These types of difficulties in an individual who has normal peripheral hearing may be an indication of a (central) auditory processing disorder, or **(C)APD**.

Figure 12.4 Schematic representation of the central auditory nervous system.
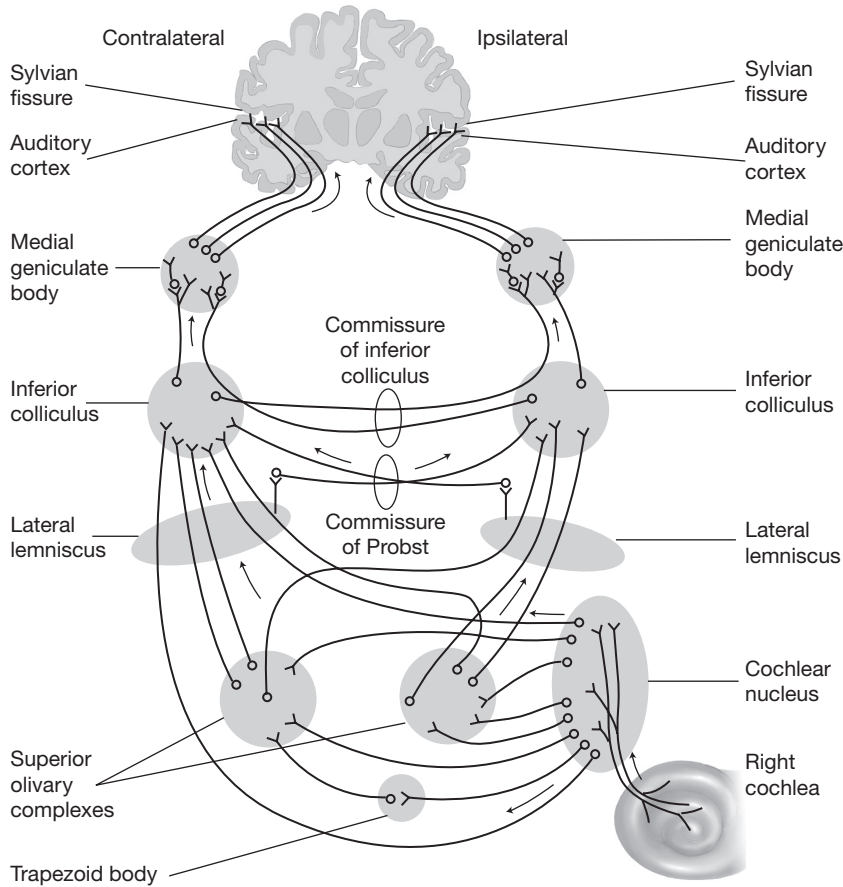
Before talking about CAPD testing as it is most commonly used today, let's review, very briefly, the earlier use of tests of auditory processing. Years ago, before advanced imaging techniques such as CT scans and MRIs were readily available, tests of auditory processing were used with patients to identify what brain regions might be impaired and to provide some information about the kinds of tasks that were challenging to them. A person, for example, with a tumor on the right side of the brain would demonstrate a different pattern of responses on these tests than would someone with a tumor on the left side. Similarly, a person with a temporal lobe problem would perform differently than would someone with a frontal lobe impairment.

Today, tests of auditory processing are used most often by audiologists not on patients with medical issues such as tumors or strokes but rather with school-age children who are experiencing difficulties functioning in the classroom. These children may be demonstrating some of the following: distractibility, difficulty comprehending rapid speech or speech in poor acoustic environments, difficulty following complex auditory directions, difficulty paying attention, slow or inconsistent responses to verbal messages, or increased dependency on visual cues.

Once it has been established that a student with a number of presenting symptoms has normal peripheral hearing, normal cognitive abilities, and no

more than a mild language impairment and is at least 7 years of age, a qualified audiologist can test for CAPD. These behavioral tests can provide information about how a child performed compared to his or her peers as well as help understand what types of tasks will be challenging to the child. It is important to note that it is only by administering a comprehensive battery of appropriate tests that an audiologist can diagnose the presence of CAPD.

Despite the great interest and increased awareness among professionals and the public about CAPD, the disorder remains controversial for a number of reasons. First, individuals who have deficits of the central auditory system often demonstrate a variety of different symptoms, and often those symptoms are the same as or similar to those associated with other disorders, such as learning disabilities and attention disorders. Second, parents and professionals often seek testing on individuals who are not appropriate candidates for the tests and may become upset when they are told that the testing cannot be done. Third, there is a tendency to believe (incorrectly) that CAPD may be the underlying cause of other disorders, such as autism or attention deficits. The important point to note here is that even though individuals with autism and attention deficits frequently display problems in their ability to understand/process auditory information, the fundamental, underlying, neurological cause of their processing difficulty is not auditory. ASHA has stated that CAPD involves "difficulties in the perceptual processing of auditory information by the central nervous system" (ASHA, 2005b, p. 2). Finally, this testing is controversial because there is still a lack of evidence from research regarding how to improve the way the auditory processing system works. It is understandable that this would be frustrating to parents who are seeking to help their children.

One final point should be made about CAPD. The role of an SLP in working with children who have or are suspected of having CAPD is critical because the symptoms of this disorder frequently show up first in the classroom setting; SLPs, many of whom are employed by schools, have a key role in helping to determine whether a child should be referred to an audiologist for additional testing. Also, if a child is diagnosed with CAPD, recommendations are made by the audiologist, but in most cases those recommendations must be implemented into the student's school program by professionals who are not audiologists due to the lack of audiologists employed in educational settings. SLPs are often viewed as the professionals in the school who are most knowledgeable about this disorder and are often essential to this implementation process.

✔ Click here to check your understanding of the concepts in this section.

HEARING LOSS THROUGH THE LIFESPAN

With the information covered at this point about the various types of hearing loss, it should now be clear that our hearing is something that should be attended to at all ages and stages of life, beginning immediately after birth. As discussed, newborns may be at risk for hearing loss due to a number of factors, including difficulties that occur during the birth process, genetic disorders, and syndromes. Over the past two decades, we have seen the development of numerous **early hearing detection and intervention (EHDI) programs** across the United States. Some of these programs are state-mandated and some are voluntary. All these programs are designed to identify significant hearing loss in newborn babies and follow up with prompt audiological intervention services.

As of 2010, in the United States, nearly 98% of babies were being screened for hearing loss within the first month after birth (Centers for Disease Control and Prevention, 2009). The goal is that babies who fail their newborn hearing screening and any follow-up rescreening should have a comprehensive audiological and medical evaluation before the age of 3 months to confirm or rule out the presence of hearing loss. Although the diagnosis of hearing losses that are present at birth is occurring at an earlier age in recent years due to these universal newborn hearing screening programs, this is only the first step in the audiological intervention process. It is equally important that appropriate early intervention services be planned and delivered as soon as possible after a hearing loss has been identified and preferably by 6 months. In fact, research strongly suggests that children who are diagnosed with hearing loss and receive hearing aids and early intervention by 6 months of age develop significantly better language skills than do similar children who are identified after 6 months of age as having hearing loss (Meinzen-Derr et al., 2011; Yoshinaga-Itano et al., 1998). For up-to-date information on the status of early hearing detection and intervention programs in the United States, visit the National Center for Hearing Assessment and Management website.

Both newborns and preschoolers are particularly susceptible to hearing loss due to Eustachian tube dysfunction and otitis media, which can create a temporary, but often difficult-to-resolve, hearing loss that may negatively affect speech and language development. During the school-age years, students with auditory processing disorders often find themselves struggling to process the more complicated language structures that are part of academic learning, particularly when they are in the often poor acoustic setting of the classroom. School-age, adolescent, and college-age students are all now at risk for noise-induced hearing loss due to the widespread use of ear-level music devices that can deliver very intense levels of sound directly to the ear.

By middle age, some adults with a history of early noise exposure begin to experience hearing loss as the effects of noise and aging impact their ability to understand speech. In addition, disorders such as Meniere's disease and otosclerosis are more common in middle- aged individuals. Also, some research suggests that by middle age, listeners may experience changes in their auditory processing abilities, despite having normal hearing.

Finally, in older individuals, age-related changes can affect both the cochlear hair cells and auditory nerve fibers, resulting in reduced speech understanding, sometimes even with good amplification. When these auditory changes combine with changes in memory or cognitive function, the effects on communication can be even greater.

Any discussion of hearing loss through the lifespan must include the possible effect of hearing loss on individuals personally and emotionally. The process of adjusting to and coping with hearing loss can be difficult not only for those who have the hearing loss but also for their families. This period of adjustment can also be challenging for professionals because clients who have not yet accepted the fact that they have a hearing loss often do not follow through on treatment recommendations. People with hearing impairment experience a wide range of psychological, social, and emotional consequences (English, 2002). With children who are hearing impaired, delays in speech and language may be present, along with problems with self-awareness and self-expression, which may lead to difficulties in the development of social skills. Children with hearing loss, even if

only mild in degree, frequently exhibit lower self-esteem and reduced self-worth that may impact interpersonal relationships with their peers and family members (Bess et al., 1998).

Think for a moment about the following surprising statistic: Approximately 95% of children who have hearing loss are born to parents with normal hearing (Mitchell & Karchmer, 2004). Now think about the implications of this for the parents of these children. Most of them have little knowledge or experience related to hearing loss and the challenges it presents when raising a child. The understandable joy, hopefulness, and optimism that parents feel at the birth of a child can quickly turn to feelings of fear and helplessness when their newborn baby is identified as having a significant hearing loss. Parents may feel as if their lives are suddenly spiraling out of control as they face the reality of raising a child who has a disorder. The stages of grief that are usually associated with the dying process are also applicable to those dealing with hearing loss. Parents of children with hearing loss often experience shock, denial, anger, and depression before they are finally able to accept the reality of the situation.

Adults who have acquired hearing loss over the course of their lifetime, whether suddenly or gradually, are certainly also at risk for psychosocial problems. Many go through the same stages of grief as parents of children with hearing loss. An adult with hearing loss who is no longer able to enjoy social activities to the same degree as in the past or understand conversations on the phone, at meetings, or during family gatherings may experience a variety of emotions including anger and frustration that may eventually lead to depression (Mullins, 2004). Having to rely on others can lead to feelings of inadequacy, guilt, decreased self-sufficiency, and reduced self-worth; in addition, family relationships may become strained. It is very important that professionals pay attention to these psychosocial issues to determine the full impact of a hearing problem on an individual client and his or her family members.

AUDIOLOGICAL ASSESSMENT PROCEDURES

Now that we have discussed the basic principles of sound, the anatomy and physiology of the auditory system, the various types and causes of hearing loss and their effect on one's life, we are now ready to take a look at how this knowledge is applied in the assessment of hearing. It is important to stress that no single test can accurately capture the full extent of a person's hearing loss or how that loss may be affecting the person in terms of his or her communication or psychological health. Instead, an audiologist must rely on a battery of tests and other measures, combined with careful questioning of and listening to the client in order to obtain an accurate picture of an individual's hearing problem.

Before continuing, now is a good time to differentiate **assessment**, as we discuss in this section, from **screening**, referred to earlier in this chapter. Screening is the process used to determine which individuals, whether children or adults, are *likely* to have a hearing loss. If you ever had your hearing tested in school, it is likely that you participated in a screening. As previously mentioned, newborn hearing screening programs have been set up across the country in an effort to identify infants who are suspected of having a significant hearing impairment and who therefore should be referred for further testing.

The screening equipment and procedures used vary with different screening programs. For example, a newborn screening performed in a hospital with automated equipment is quite different from a screening program using a traditional audiometer performed at a senior center. In general, individuals who pass a screening are not referred for further testing, and those who fail a screening are. It is important to note that even if someone does not pass a screening, we cannot conclude that he or she has a hearing loss. Screenings are frequently performed in environments where background noise or distractions can interfere with the person's ability to respond accurately. It is not uncommon for students to fail their school hearing screening but have a comprehensive hearing test done in the sound-treated booth find normal hearing. Finally, it is important to be aware that performing hearing screenings is part of the scope of practice of both an audiologist and an SLP.

The remainder of this section focuses on the types of tests that may be included in a comprehensive audiological assessment battery, as performed by an audiologist. For students who one day hope to work as SLPs, it is important to remember that as professionals, you will need to have an understanding of the hearing assessments that have been performed on your clients and how to use this information to better meet their speech and language needs.

Referral and Case History

A number of different people may refer a client for audiological testing, including physicians, school nurses, SLPs, psychologists, teachers, and family members, to name a few. Also, a client may refer him- or herself for testing. Sometimes the person making the referral also provides important background information that gives the audiologist a better understanding of the client's specific challenges.

Before conducting any tests, an audiologist spends time interviewing a client and collecting case history information. This process provides an opportunity to obtain background information from the client's perspective and helps the audiologist gain a better understanding of the client's communication challenges and goals. During this interview, the audiologist may ask questions about why the client has come in for the evaluation, whether he or she has been exposed to noise, whether there is a history of ear infections or ear surgery, and what communication situations are difficult for the client.

Another way to gain valuable information about a client's communication challenges and feelings about his or her hearing loss is by use of published self-assessment questionnaires. For example, a particular item on a questionnaire might ask the client to rate the degree of difficulty he or she experiences when listening in a noisy restaurant. Another item might ask whether the client feels left out of social activities because of his or her hearing loss. Several of these questionnaires contain a companion version that can be completed by the client's significant other or a family member. Obtaining input from someone the client is close to can be very important, particularly if the client is not fully aware of how much he or she is missing and how much others in the family have to change their speaking pattern to accommodate the hearing loss. Finally, when these self-assessment tools are given before and after a hearing aid fitting, they can provide information about improvements that have occurred due to hearing aid use.

Otoscopic Examination

One of the first procedures performed during an audiological evaluation is a visual exam, or **otoscopic examination**. You are most likely familiar with the small handheld device that is used by an audiologist because it is the same device that physicians use to exam the ear canal and ear drum. The device is called an **otoscope**, and the otoscopic exam is an important early step in the assessment process because it alerts the audiologist to any conditions that may interfere with sound conduction during testing, such as excessive cerumen or any conditions that require immediate medical referral, such as drainage from the ear. Another version of this device, called a video-otoscope, projects the image of the ear being viewed onto a television or computer monitor, allowing the client and family members to observe simultaneously. This technology allows the audiologist to print and store images that can then be shared with other medical personnel, such as the client's physician.

Electroacoustic and Electrophysiological Testing

Over the past 40 years, advances in technology and in our understanding of the process of hearing have led to the development of two broad types of specialized tests of the auditory system: electroacoustic and electrophysiological tests. **Electroacoustic measures** record acoustic signals from within the client's external auditory canal; **electrophysiological tests** record neuroelectric responses (nerve impulses) that are generated by the auditory system in response to sound. Both of these categories of tests evaluate the integrity of the peripheral and central auditory systems, without requiring the client to provide any observable behavioral responses, such as repeating words or responding to tones. Because these tests do not assess a client's ability to recognize and use sound, they are not considered true hearing tests. Nevertheless, these tests do provide data that an audiologist can use to make some inferences about the functioning of the client's auditory system and his or her hearing.

The two types of electroacoustic measures that are commonly performed on children and adults are tests of acoustic immittance and otoacoustic emissions.

Acoustic immittance measures are useful in the diagnosis of conductive pathology. Because they can be completed in a short period of time and do not require any behavioral responses, they are frequently used with both children, including infants, and adults. Acoustic immittance testing is performed using an electronic device that consists of a small probe containing a microphone, air-pressure pump, and sound generator connected to a recording instrument. The probe is inserted into the external auditory meatus, creating an airtight seal. During testing, a continuous tone is emitted into the canal as air pressure is systematically increased and decreased. This change in air pressure changes the admittance (or lack of resistance) of the eardrum. The microphone measures these changes by examining changes in the intensity of the tone as it flows through the canal and is reflected by the tympanic membrane. This process results in a graph called a **tympanogram** that displays the admittance of the middle ear as a function of changes in air pressure within the ear canal (see Figure 12.5). Data obtained as part of this process can assist in identifying the presence of conductive pathology and distinguishing between a break in the ossicular chain, otitis media with effusion, or a perforation of the eardrum, for examples.

Frequently included as a part of the acoustic immittance battery is a test involving the acoustic reflex. The stapedius muscle, which is attached to the stapes, contracts in response to high-intensity sounds, causing the ossicular chain and tympanic membrane

Figure 12.5 Schematic of three common tympanogram patterns: (a) normal middle ear function, (b) somewhat reduced admittance due to otosclerosis, (c) minimal admittance due to otitis media with effusion.
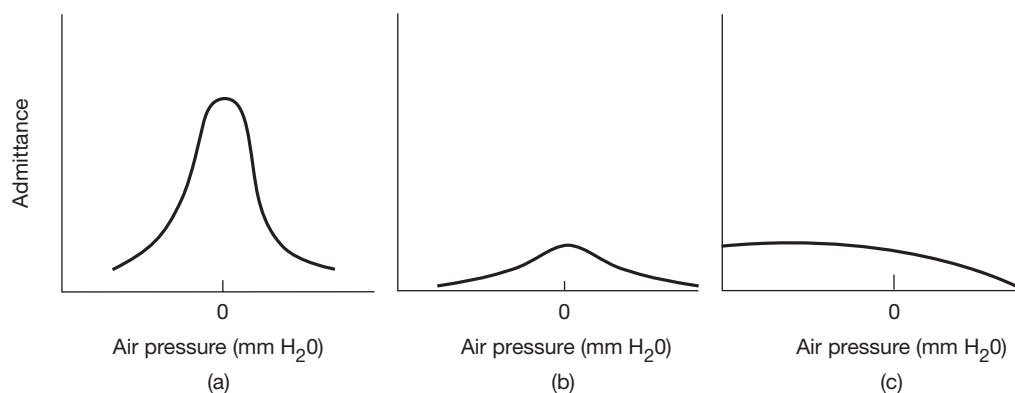
to stiffen, which may provide some natural protection from loud sounds. The same device used to generate a tympanogram is capable of measuring the contraction of the stapedius muscle in response to tones of different frequencies. By analyzing whether the reflex is present, an audiologist is able to make important inferences about the possible site of the disorder.

Otoacoustic emissions (OAEs) are a second type of electroacoustic measure that has received considerable attention during the past two decades. Discovered by David Kemp (1978), otoacoustic emissions are low-intensity sounds, commonly referred to as "echoes," that are generated within the cochlea as a result of movement of the outer hair cells. These tiny emissions move outward from the cochlea, through the middle ear, to the external auditory canal, where they can be recorded by a microphone placed in the ear canal. For clinical uses, otoacoustic emissions are produced by presenting a moderate-intensity acoustic stimulus to the ear canal. The same probe that generates these stimuli contains a miniature microphone that records emissions returning from the cochlea. Generally, when OAEs are present, hearing sensitivity is presumed to be normal or no worse than a mild loss (Glattke & Robinette, 2007). In contrast, reduced or absent OAEs can result from outer hair cell dysfunction or the presence of conductive pathology. Perhaps the most important use of OAE testing is in newborn hearing screening programs. This noninvasive and quick test has provided an inexpensive and efficient way to test millions of newborns each year.

In addition to electroacoustic tests, several electrophysiological tests are available to audiologists. Recall that electrophysiological tests record neuroelectric responses (nerve impulses) generated by the auditory system in response to sound. These responses are collectively referred to as **auditory evoked potentials (AEPs)** and can be further classified based on when they occur (measured in milliseconds), following presentation of a stimulus and the anatomical site(s) where they are generated.

To perform this type of testing, neuroelectric responses are recorded by placing small electrodes on the client at strategic points on the surface of the head while a stimulus is delivered to the ear. These tiny responses are captured and recorded using specialized computer equipment. Once the resulting waveform is

displayed, an audiologist can analyze the amplitude or height of specific peaks of the response, as well as the number of milliseconds it takes to generate the various peaks of the waveform following presentation of a stimulus.

A type of AEP that audiologists commonly use is the **auditory brain stem response (ABR)**. This test measures the neuroelectric activity of the auditory nerve and structures in the lower brain stem. In normal ears, this response is characterized by five to seven distinct peaks in the waveform that occur within the first 5 to 6 milliseconds following stimulation (see Figure 12.6). ABR testing can be used to identify neurological issues, such as a tumor on the eighth cranial nerve. In addition, it can be used to estimate the auditory thresholds in individuals who are unable or unwilling to be evaluated using conventional behavioral techniques, such as infants, young children, and individuals who have developmental delays. Because this testing can often be conducted while a child sleeps, it is often used as part of newborn hearing screening programs.

Behavioral Testing

One major limitation of electroacoustic and electrophysiological measures is that although they provide information about the integrity of the auditory system, they do not provide information on how the individual perceives or responds to sound. For this reason, testing a person with behavioral measures is necessary to fully understand a person's ability to hear and process sound.

Most behavioral tests are administered using a specialized piece of electronic equipment called an **audiometer**, which contains controls that allow an audiologist to select, manipulate, and present various stimuli, such as tone and speech, to assess hearing. Testing is usually carried out in a specially treated sound booth that limits the amount of external and internal noise that can interfere with hearing; this supports the reliability of the test results.

Figure 12.6 Schematic drawing of a typical auditory brain stem response (ABR) waveform for a normal ear.
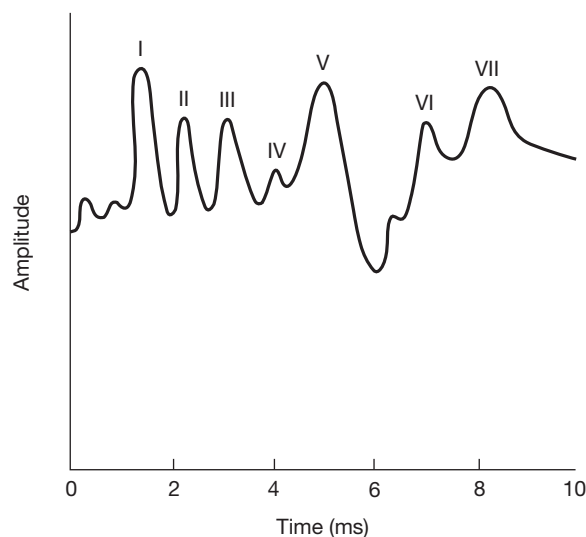
Behavioral Observation Audiometry (BOA)

The most basic form of behavioral assessment used with infants is a process referred to as **behavioral observation audiometry (BOA)**. As the term implies, an audiologist presents a stimulus such as speech or tones through a loudspeaker and observes the child's reaction. Basic responses to sound that the audiologist looks for are gross body movements such as startling, widening of the eyes, and facial grimacing. Although fairly simple to administer, BOA has been criticized for its poor reliability and validity (Hicks et al., 2000). Audiologists often have difficulty making judgments about whether a child's bodily movement was in response to a stimulus or just a random movement. In addition, a child may quickly habituate to the task, losing interest in it after only a few presentations of the stimulus. For these reasons, electroacoustic and electrophysiological measures are preferred over BOA when assessing children younger than 5 months of age.

Visual Reinforcement Audiometry (VRA)

Once a child reaches the age of 5 to 6 months, the natural ability to localize, or turn toward a sound, has developed, and this means an audiologist can use a technique called **visual reinforcement audiometry (VRA)** to test behavioral responses to speech and frequency-specific tones. With VRA, the child is rewarded for turning toward the stimulus. As soon as the child responds, the audiologist activates an animated or lighted toy. This reinforcement helps maintain the child's interest in the task, giving the audiologist more time to collect hearing data. VRA is more reliable than BOA and has been shown to be an effective tool for accurately assessing hearing sensitivity in young children (Diefendorf, 1988). Despite the value of VRA, most audiologists would combine VRA test results with an electrophysiological measure prior to fitting a child with hearing aids.

Pure Tone Audiometry

By 2½ years of age, a child should be able to perform many of the same procedures that are used with adults, but often with some modifications. For example, when testing a child's responses to pure tones, rather than ask a child to raise his or her hand or press a response button, **conditioned play audiometry (CPA)** is often used. This procedure involves the use of toys such as blocks, puzzle pieces, or stacking rings to engage the child in a listening game. The child is conditioned to put a block in a bucket or a ring on a post each time the test signal is heard. After a few demonstrations, most children are able to perform the task, allowing the audiologist to obtain frequency-specific results for each ear. Conditioned play audiometry can be used until a child is able to be tested using conventional pure tone audiometry, which usually occurs somewhere around the age of 5 to 8 years.

A great deal of information can be obtained about a person's hearing through **pure tone audiometry**. In fact, the pure tone test is considered to be one of, if not *the* most fundamental behavioral tests in the standard audiometric assessment battery. **Pure tones** are sounds that contain energy only at a single frequency. Standard practice is to test a range of frequencies from 250 Hz to 8000 Hz so that information is collected about the person's ability to perceive the speech sounds of the language.

The purpose of pure tone testing is to determine a person's threshold at each test frequency for the right and left ears. **Threshold** is defined as the lowest

Watch this **video** to see a demonstration of pure tone testing being conducted by an audiologist with a client in a sound-treated booth.

(quietest) intensity level, measured in decibels, at which a person can just barely detect a given stimulus approximately 50% of the time. An audiologist measures a client's threshold by presenting a single pure tone (e.g., 1000 Hz) for approximately 1 to 2 seconds and looking for a response from the client that indicates whether it was heard. Adult clients are typically instructed to raise their hand or finger or to press a button to signal when they have heard the tone. Through a process of raising and lowering the intensity, based on whether the client has heard a previous tone, the audiologist is able to find the client's pure tone thresholds for different frequencies. These threshold results are recorded by placing symbols on a graph called an audiogram, and the presence or absence of hearing loss is determined by comparing the client's thresholds to normative values for each frequency.

An example of a blank audiogram is shown in Figure 12.7. To help orient the reader to the audiogram, Table 12.1 summarizes some of the intensity and frequency information associated with various environmental and speech-related sounds.

Degree of Hearing Loss

At this point, it will be helpful to discuss briefly the degree of hearing loss. As noted previously in this chapter, when describing a person's hearing loss, audiologists use terminology such as *conductive*, *sensorineural*, and *mixed* to specify the region of the auditory system affected. These terms describe the type of hearing

Figure 12.7 Blank audiogram used to record patient thresholds in pure tone audiometry. Note frequency in Hertz on the *x* axis and intensity in decibels on the *y* axis.
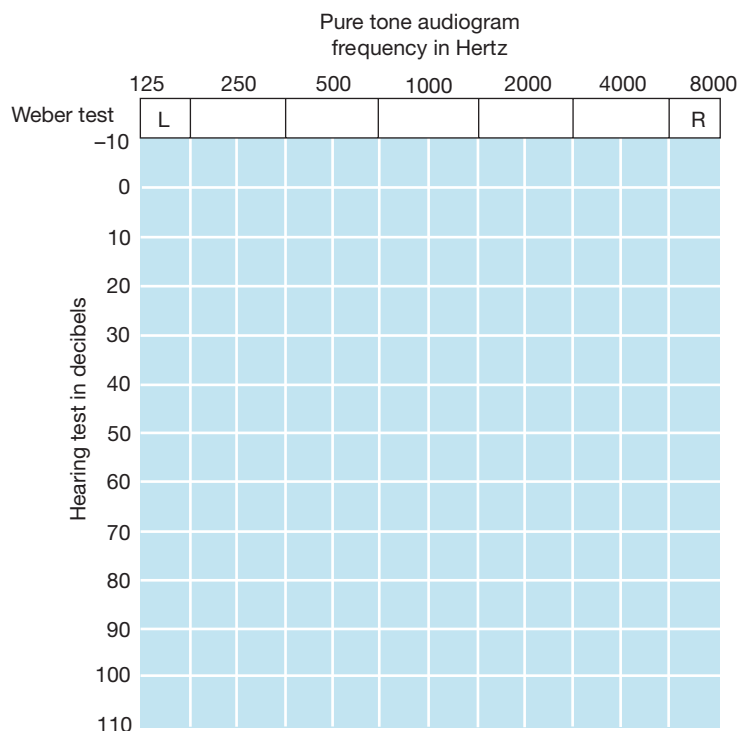
TABLE 12.1

Summary of typical intensity and frequency information for environmental and speech-related sounds

Sound	Intensity in Decibels	Overall Frequency in Hertz
Environmental Sound		
Chirping birds	10–15	5000–6000
Dripping water	15	250
Rustling leaves	5–15	2000
Air conditioner	60	185
Piano	70	1000
Motor cycle	85–95	185
Personal music player	60–105	—
Lawn mower	95–100	250–350
Large truck	100–105	125–185
Jet plane on take off	115–120	375
Live band concert	115–120	1000
Speech-Related Sound		
Whispering	15–30	2000–3000
Conversational speech	45–55	1000
(Fundamental) Frequency of adult male voice	—	125
(Fundamental) Frequency of adult female voice	—	220–250
(Fundamental) Frequency of baby cry at birth	—	450–600
Nasal sounds	25–35	375–1200
Stop sounds	25–42	1800–4000
Fricative sounds	25–52	4300–8500
Vowel sounds	35–60	185–2700
Region containing most information for speech understanding	—	1000–3000

Source: Denes & Pinson (1993); Ferrand (2006); Mueller & Killion (1990); Northern & Downs (2002); Olsen et al. (1997); www
.noisyplanet.nidcd.nih.gov/parents/athome.htm.

loss a person has. Although this is a critical part of the diagnostic process, it is also important to quantify the degree of hearing loss, and this is typically expressed in units called decibels (dB). A decibel is a mathematical unit based on the pressure exerted by a particular sound. The lowest decibel level at which a given sound is barely audible represents a person's auditory threshold. The greater the decibel value required to reach a person's threshold (compared to what is considered "normal"), the greater the degree of hearing loss.

Many audiologists use the terms presented in Table 12.2 to label the degree of hearing loss (HL). Notice that the range considered "normal" is different for children than for adults. Specifically, although adult thresholds up to 25 dB HL are considered within normal limits, the cutoff for children is set at 15 dB HL. Think for a moment about why this makes sense. What is different about the process of hearing for children than for adults? According to Bess and colleagues

TABLE 12.2

Degrees of hearing loss

	Degree of Hearing Loss		
Threshold	**Children**	**Adults**	**Description**
–10 to 15 dB HL	Normal	Normal	
16–25 dB HL	Slight	Normal	Children who are in the process of developing speech and language may miss some of the subtle nuances of speech.
26–40 dB HL	Mild	Mild	Difficulty with faint or distant speech.
41–55 dB HL	Moderate	Moderate	Difficulty following conversational-level speech.
56–70 dB HL	Moderately severe	Moderately severe	Can hear only loud speech.
71–90 dB HL	Severe	Severe	Difficulty understanding even loud speech without amplification.
>90 dB HL	Profound	Profound	Usually considered deaf; without amplification, cannot depend on auditory system alone to obtain information.

(1998), children who are in the process of developing speech and language may miss some of the subtle information found in the acoustic speech signal when auditory thresholds are in the 16 to 25 dB range. Adults, in contrast, typically experience no difficulty with these thresholds because their language is more developed, and they are more able to "fill in" missing pieces of information that they did not hear. They do this using their prior knowledge and experience. This process is referred to as *auditory closure*.

In general terms, individuals whose degree of hearing loss falls within the slight/mild-to-severe range are classified as hard of hearing or hearing impaired. These individuals depend on their remaining hearing (also referred to as *residual hearing*) for receptive communication and for the learning of new concepts. For people whose auditory thresholds fall in the profound range, however, the auditory system provides limited or no access to speech without the use of amplification. As previously mentioned, these individuals are often referred to as deaf.

It is important to note that the descriptors used in Table 12.2 should be interpreted with caution. For example, both research and clinical observation reveal that children with mild hearing losses are more likely to have delays in receptive and expressive vocabulary, phonological awareness, and syntax (grammar). In addition, they are more likely to have reduced speech understanding in noise and are at risk for emotional health difficulties.

Air Conduction and Bone Conduction Testing

It is very important for students to understand that during hearing testing, pure tone thresholds are established by delivering pure tones in two different ways: through **air conduction** and **bone conduction**. Air conduction testing is administered while a client wears either traditional earphones or insert

earphones. Insert earphones contain pliable, foam-like receivers that are placed within the external auditory meatus; traditional or supra-aural earphones are attached to a headset and placed over each pinna. Presenting stimuli by air conduction results in sound traveling to the cochlea via the outer and middle ear. This is the typical way that we hear. Hearing loss resulting from disorders in any of the three major sections of the peripheral auditory system (the outer, middle, or inner ear) will be identified with air conduction testing. Once air conduction testing is completed, the process is repeated using a bone oscillator, a small vibrating device that is positioned against the skull, behind the pinna. When a stimulus is presented through the oscillator, the bones of the skull are set into vibration, and this vibration directly stimulates the cochlea. So, with bone conduction, the person is able to hear the stimulus even though it has bypassed the outer and middle ears.

By comparing the results of air conduction testing to those obtained from bone conduction testing, it is possible to identify the type of hearing loss. Take a look at the audiograms in Figures 12.8 and 12.9. In Figure 12.8, the right ear air conduction thresholds (represented by the circles) fall within the moderate hearing loss range. However, the bone conduction thresholds (represented by the brackets) fall within the normal range of hearing. From this, the audiologist can infer that the client has difficulty hearing sound when it is introduced in

Figure 12.8 Audiogram representing a moderate conductive hearing loss in the right ear. (Note: The symbol used to denote bone conduction thresholds depends on the method used to assess it.)
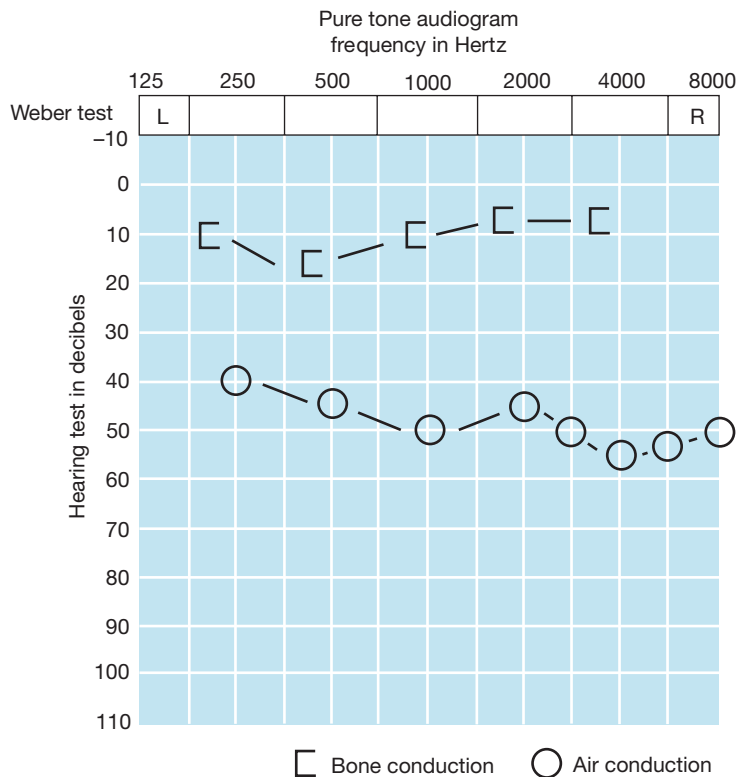
Figure 12.9 Audiogram representing a moderate sensorineural hearing loss in the right ear.
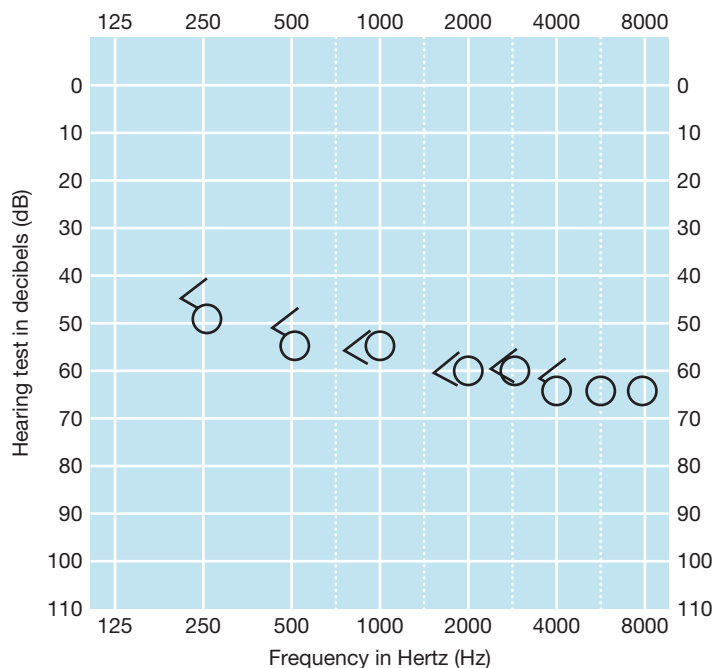
the conventional manner—that is, through the external auditory meatus. Notice, however, that the client has no difficulty hearing sound if the outer and middle ear are bypassed and the cochlea is stimulated directly. Therefore, this client has a conductive hearing loss occurring in the outer or middle ear. In Figure 12.9, both the air and bone conduction thresholds fall outside the normal limits and within the moderate range of hearing loss. Because the results are the same when the inner ear is stimulated by air conduction or by bone conduction, the audiologist can conclude that the inner ear itself must be affected. Therefore, this client has a sensorineural hearing loss.

In Figure 12.10, again both the air and bone conduction thresholds fall outside the normal range. However, the degree of hearing loss represented by the air conduction thresholds is greater than the degree of hearing loss represented by the bone conduction thresholds. In this case, although there is obvious damage to the inner ear, as evidenced by the bone conduction results, the person has the potential to hear better if the outer and middle ear are bypassed. Therefore, there is evidence that both a sensorineural and a conductive hearing loss exist simultaneously. In other words, the client has a mixed hearing loss. You can find the latest information about hearing disorders and hearing loss at the National Institute on Deafness and Other Communication Disorders (www.nidcd.nih.gov) website. Use the search box to the right and type in your topic of interest or choose from several featured topics in the middle of the home page.

Speech Audiometry

Although pure tone audiometry is often considered to be the most fundamental component of an audiological evaluation, we must keep in mind that people

Figure 12.10 Audiogram representing a moderate to severe mixed hearing loss in the right ear.

Pure tone audiogram frequency in Hertz

Bone conduction Air conduction
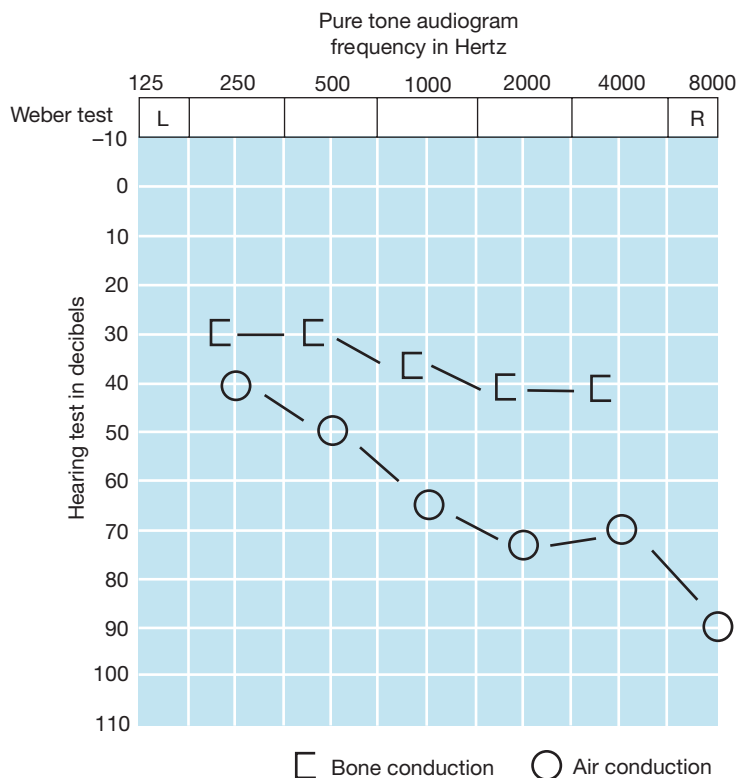
typically seek the services of an audiologist because they are having difficulty understanding speech, not pure tones. It is only natural, then, that we evaluate a client's ability to hear and understand speech as part of the assessment battery.

A variety of tools are available to assess a client's auditory skills for speech. Most are commercially available on compact disc or in digital format, and the stimuli can easily be routed through the audiometer directly to either earphones or speakers. Most authorities on the topic suggest that audiologists use recorded speech materials so that the presentation of the speech stimuli will be consistent from one test administration to the next and among different testers, who all may have different speaking styles. In some cases, such as when testing young children, an audiologist may choose to use his or her own voice rather than recorded speech to administer a test. This process, referred to as *monitored live voice testing*, requires the audiologist to speak into a microphone connected to the audiometer.

Two speech audiometry measures that are typically included in routine hearing tests are the speech recognition threshold and the word recognition test. The **Speech Recognition Threshold (SRT)** is a measure of the lowest (softest) intensity where a person can recognize approximately 50% of the spondee words presented. **Spondees** are two-syllable compound words, such as "hotdog," "birthday," or "cowboy," that are spoken with equal stress on both syllables. Finding the SRT involves a similar process of increasing and decreasing the intensity of

the stimuli used for finding pure tone thresholds. In most cases, the decibel value of the SRT should be consistent with certain pure tone thresholds, and when it is not, it could be an indication that the pure tone results are not accurate.

A second speech audiometry measure that is used routinely is the **Word Recognition Test (WRT)**. The WRT is different from the other procedures discussed so far in that it is not a threshold measure. Instead, the WRT assesses how well a client is able to identify one-syllable words presented at some level above the threshold. The intensity level at which the WRT is administered varies depending on the type of information the audiologist wants to collect. If the goal is to better understand how well an individual understands speech (words) when it is presented at a typical or average level of conversation, then the test is usually administered at an intensity level of 45 to 50 dB HL. If, however, the goal is to determine how well speech is understood when it is presented at a comfortable listening level, the audiologist would find that comfortable decibel level for that client and perform the test at that level. Performance at a comfortable level could help the audiologist understand the general potential for improvement if the client is later fit with hearing aids.

Auditory Processing Assessment

An audiologist is a professional responsible for the diagnosis of (central) auditory processing disorders. However, because other types of disorders may present similar symptoms, the process of assessing an individual for possible (C)APD requires a multidisciplinary approach. Typically, personnel involved in the assessment process include an audiologist who administers specific auditory tests of the peripheral and central auditory pathways, an SLP who assesses the individual's expressive and receptive oral language skills, a psychologist who assesses cognitive function, and, when dealing with children, parents and school personnel, who can provide input on academic performance and the functional impact of the problem.

Both behavioral and electrophysiological tests are available to evaluate whether an auditory processing disorder exists as well as to assess the specific nature of the disorder. Because no single test can adequately assess all levels of the central auditory system or all aspects of auditory processing, a test battery approach is necessary.

One general category of tests used regularly in a CAP battery consists of **dichotic** measures. Dichotic tests involve the simultaneous presentation of different stimuli to each ear. Depending on the specific test, stimuli may consist of digits (numbers), consonant–vowel pairs, words, or sentences. The individual may be asked to direct his or her attention to only one ear and identify what is heard or attend to and identify what is heard in both ears. These types of tasks assess the person's ability to separate or integrate competing signals.

A second general category includes tests of **temporal processing**. These tests are used to evaluate a client's ability to process timing cues associated with speech such as ordering and sequencing. Specific tests may require the individual to identify differences in the duration pattern (e.g., long–long–short or long–short–long) for a series of three tones or clicks, differences in the frequency pattern (e.g., high–high–low or high–low–high) for a series of three tones, or the presence of short gaps separating pairs of tones or clicks.

A third general category of auditory processing measure involves what is referred to as **monaural low-redundancy speech**. These tests are termed

monaural because the stimulus is directed to only one ear at a time. *Low redundancy* means that the stimulus has been altered in some way in order to reduce the speech signal's redundancy. Doing this makes the task harder and taps into those auditory structures that are part of the auditory processing system. Individuals with (C)APD often demonstrate increased difficulty when the signal is compromised in some way, as it would be if the rate of speech were increased or if speech were presented in competing background noise.

Although behavioral tests such as those just mentioned are the most popular means of assessing auditory processing function, some authorities believe that using electrophysiological measures such as auditory evoked responses can also be useful. Others believe that these measures may be useful in the future but are not yet clinically helpful. It is important to remember that all data collected must be interpreted in conjunction with the findings obtained by other specialists on the multidisciplinary team.

Click here to check your understanding of the concepts in this section.

Thought Question

AURAL (AUDIOLOGICAL) HABILITATION/REHABILITATION

After an audiological assessment has been completed and various tests analyzed, it is time to work with the client in creating an appropriate course of treatment. In some cases, this requires a referral to a physician for a medical evaluation. It may also involve various therapy services referred to as **aural (**or **audiological) habilitation/rehabilitation**, which can be defined as "intervention aimed at minimizing and alleviating the communication difficulties associated with hearing loss" (Tye-Murray, 2009, p.2).

Before discussing the specific intervention options available, it is important to differentiate the terms *aural habilitation* and *aural rehabilitation*. **Aural habilitation** refers to intervention conducted with individuals whose hearing loss occurred at an early age and therefore prevented normal development of auditory and spoken language skills. In general, this refers to services and therapies used primarily with children who are prelingually hearing impaired and also their families. In contrast, **aural rehabilitation** refers to services and therapies provided to individuals who have lost their hearing later in life, after spoken language skills have fully developed. In this case, the focus is on preserving and restoring communication skills that have been negatively impacted by a loss of hearing. Frequently, the term *aural rehabilitation* is used to refer to both habilitative and rehabilitative aspects of intervention, as is done in the remainder of this chapter.

An important early step in the aural rehabilitation process is to work with a client to gain detailed information about his or her communication problems resulting from the hearing loss. This can usually be accomplished by synthesizing information obtained from the case history interview, self-assessment questionnaires, and results of the audiometric test battery. In some cases, collaboration with medical personnel, SLPs, special education teachers, teachers of those who are deaf and hard of hearing, psychologists, and vocational rehabilitation counselors may also be needed in order for the rehabilitation plan to be strong. By identifying the specific needs of the individual and selecting treatment methods using principles of evidence-based practice, both the client and the clinician can feel confident that the rehabilitation process will be based on the best available information.

Counseling

At this point, it is important to discuss briefly the critical role of counseling. Although counseling can be used from the very first minute that you meet a new client, it is introduced here because our efforts to help an individual with communication challenges related to a hearing loss (or any communication disorder) can be enhanced considerably if we use effective counseling techniques. Counseling is an essential component of all the audiological services we provide.

Counseling is usually thought of as the process of giving a client information, sometimes referred to as **informational counseling**. Some examples of this include explaining the results of individual tests, providing technical information on the anatomy of the ear, or explaining how hearing loss occurs so the client can better understand the nature of his or her problem. The audiologist might also present possible courses of treatment, including hearing aids and rehabilitation options, to support spoken communication. This type of counseling is critical and requires great skill on the part of the clinician so that information is communicated in a way that is easily understood and remembered. It has been reported that only 50% of the information conveyed by health care providers is actually remembered by clients and that approximately half of this information is remembered inaccurately (Kessels, 2003; Margolis, 2004). For this reason, it is a good policy to provide a written summary of information discussed so that the client can refer back to it. Some clinical providers are now providing clients access to a website where they can find information that specifically relates to their condition.

Although important, informational counseling is only one part of the counseling process. A second broad category of counseling is **personal adjustment counseling**, which involves providing assistance to the client and family in dealing with the emotional consequences of hearing loss. As noted earlier in this chapter, hearing loss can have a profound impact on a person's psychological, social, and emotional well-being. Clients may struggle as they try to come to terms with feelings of anger, anxiety, fear, frustration, and despair that are a direct result of their hearing loss. These feelings are often seen not only in the client but also in others who are in close contact with the individual, such as parents or a spouse. Often, unless these individuals receive support from an empathetic clinician, they cannot move forward to address their communication problems.

Most audiologists and SLPs are comfortable providing informational counseling because they feel confident that they can provide accurate information about the factual aspects of a hearing loss. Personal adjustment counseling is more intimidating to many clinicians because it involves skills that many of us believe are less well developed. It is important to note that the literature on personal adjustment counseling clearly indicates that one of the most important skills we can use as clinicians is to be good listeners. An audiologist, then, must pay close attention to what a client reports and what questions the client asks in an effort to uncover any underlying personal adjustment issues. The audiologist must try to distinguish between the client's request for factual information and the client's need for you to acknowledge some personal feelings he or she is having about the hearing problem (English, 2007).

Personal adjustment counseling involves encouraging the clients to "tell their stories" of what it's like to live with a hearing loss. Eventually, as a rapport develops between a client and an audiologist, the client can be helped to accept and assume ownership of the hearing loss and move forward to solving his or her

communication challenges. Simply telling a client what they should do will not lead to progress if the client does not first acknowledge and accept the fact that a problem exists.

Some final points regarding counseling should be made. First, clinicians must attend to the client's/family's cultural background and linguistic needs so that appropriate and effective communication is used (Scott, 2000). Second, audiologists should provide counseling whenever the opportunity presents itself, not only at the conclusion of a clinical session. Finally, clinicians should always be aware of their professional boundaries. When you suspect that a client is dealing with potential psychological or mental health issues that are beyond those related to the hearing loss, a referral to a qualified professional counselor should be made.

Amplification

Amplification is considered the core of most aural rehabilitation plans. For this reason, one of the first steps in the aural rehabilitation process is the selection, fitting, and evaluation of amplification. In most cases, amplification consists of **personal hearing aids**, although other amplification options, described later, are also available.

Hearing Aids

Hearing aids come in a variety of styles and sizes, ranging from tiny custom-made models that fit entirely in the ear canal to custom in-the-ear models that fit into the concha region of the pinna, to slightly larger instruments that are worn behind the ear (see Figure 12.11). Regardless of the style, every hearing aid contains certain basic components: a microphone, an amplifier, a receiver, and some type of computer processor. The microphone picks up acoustic energy from the environment, converts it to an electrical signal, and sends it to the amplifier. The amplifier increases the voltage of the electrical signal and sends it to the receiver, which, in turn, converts it back into acoustic energy and routes it to the user's ear canal.

There have been numerous advances in hearing aid technology in recent years. Nearly all hearing aids dispensed today incorporate sophisticated digital signal processing. Sound entering the hearing aid is converted into a digital code that can be processed and manipulated in various ways to improve audibility while also reducing unwanted background noise and eliminating acoustic feedback (the annoying "whistle" that hearing aids sometimes create). Most modern hearing aids are programmed by an audiologist using a computer and special software. The primary goal in most hearing aid fittings is to make speech audible to the user to improve intelligibility. This is not a simple task because, unlike with

Figure 12.11 Styles of hearing aids. (Photos courtesy of Oticon Hearing Instruments)

eyeglasses, which, in many cases, can restore a person's sight to 20/20, a hearing aid will not return hearing to normal.

Let's consider for a moment a person whose hearing loss prevents him from hearing some sounds at all and for whom other sounds are softer than usual. Obviously, this will interfere greatly with his ability to understand speech. But if audibility is the main problem, the use of hearing aids should be quite helpful because they amplify the specific sounds that he is missing. Once this person has access to those sounds, he will hopefully understand speech much more easily.

Unfortunately, however, in some cases clients report that their hearing aids have made things louder but not clearer, and they still cannot understand speech. These individuals may be experiencing distortion due to the type of damage they have to their auditory system. The intelligibility issue that results from this is more difficult to resolve, and the audiologist may need to provide strategies and supports to be used in conjunction with the hearing aids to increase speech understanding. In some cases, an SLP can be very helpful in providing communication strategies to address these clients' needs. When a person is considering whether to purchase amplification, he or she must be counseled so that his or her expectations for improvement remain realistic

We mentioned previously in the chapter that most conductive hearing losses can be treated with either medication or surgery. In cases where conductive hearing loss is not medically treatable, such as a chronically draining ear, use of a bone conduction hearing aid may be useful. This device consists of a headband and bone vibrator attached to a conventional hearing aid. With the bone vibrator placed against the skull, sound is converted to mechanical vibration that stimulates the inner ear, bypassing the impaired outer or middle ear. A newer version of this device, called a **bone-anchored hearing aid**, functions in the same manner, but rather than having to wear the device on the head, a small external device containing a microphone and other electronic components attaches to a screw that has been surgically implanted into the skull, directly behind the pinna.

A new and disturbing trend related to hearing aids is the emergence of companies that sell hearing aids on the Internet. In some cases, hearing aids are sent directly to the consumer, along with fitting software, and the client is expected to program his or her own hearing aid! This is certainly not in the client's best interest, and audiologists must continue to educate the public about the role of audiologists in successful hearing aid fittings (Bramble, 2013).

Cochlear Implants

Some people with severe to profound hearing losses receive little or no benefit from traditional hearing aids because these devices fail to provide enough amplification to make sound audible. For this group of individuals, a cochlear implant (Figure 12.12) may be an option. A cochlear implant is a prosthesis designed to bypass the damaged hair cells of the cochlea and directly stimulate the surviving auditory nerve fibers with electrical energy.

A cochlear implant consists of externally worn and internally implanted components. The external components are the microphone and speech processor, which are typically housed in the same behind-the-ear unit, and the external transmitter. The internal components include the receiver–stimulator that is surgically attached to the skull and a group of electrodes that are inserted into the cochlea. The microphone of the cochlear implant picks up sound, converts it

Figure 12.12 Components of an ear-level cochlear implant. (a) Internal and external components of a cochlear implant (b) External components of a cochlear implant positioned on the head and ear: Microphone and speech processor (located behind the ear) and external transmitter (c) Internal components of a cochlear implant: Receiver stimulator (surgically attached to skull) and electrode array inserted into the cochlea

(a)

(b)

(c)
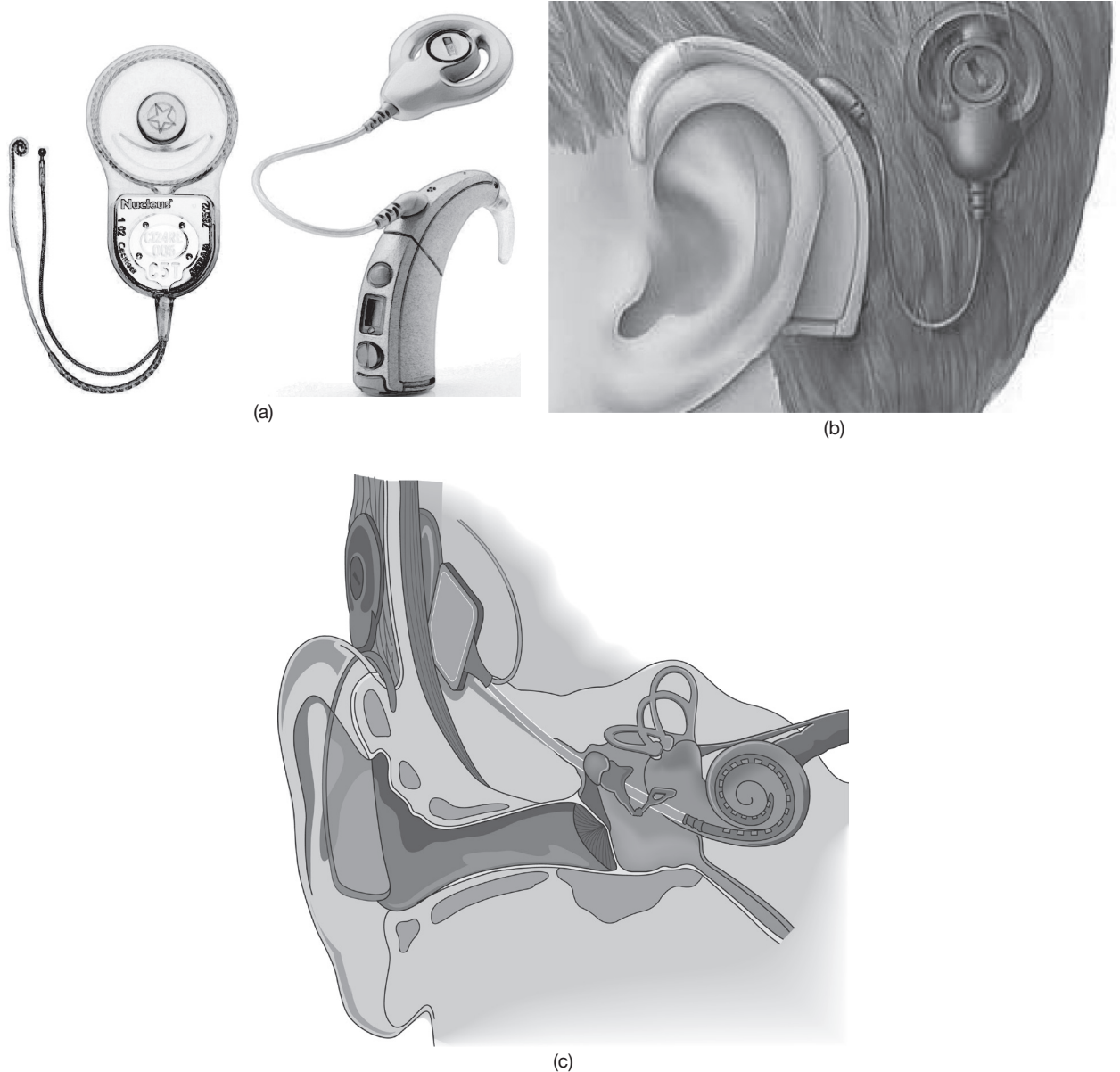
to electrical energy, and transmits it to the speech processor. The speech processor is a sophisticated microcomputer that is programmed for each client so that the information sent to the impaired ear includes those features of the speech signal that are critical to understanding speech. The signal is sent through a cable to the external transmitting coil that is magnetically secured to the head.

Using FM radio waves, the signal is transmitted across the skin to the internal receiver–stimulator and finally to the individual electrodes implanted in the cochlea. Modern cochlear implants contain multiple electrodes that provide electrical stimulation to many sites along the basilar membrane, allowing the client to receive information of different frequencies. The resulting neural impulses are transmitted to the brain in the usual manner, by way of the ascending auditory pathways.

In the past, when the procedure was more invasive, only one ear was selected for implantation, even when there was significant hearing loss in both ears. Today, bilateral implantation has become more common in children and adults. Also, in some cases a client may choose to wear a cochlear implant on one ear and a hearing aid on the other ear. When cochlear implants were originally introduced, only adults who were postlingually deafened were candidates for them. Today, cochlear implant surgery is routinely conducted on children with severe to profound hearing loss who are as young as 12 months—and even younger in certain cases—and adults of all ages, including those with prelingual and postlingual onset. The success of cochlear implants with adults who became deaf postlingually may be related to the fact that they acquired spoken language skills before losing their hearing and are able to use this knowledge when interpreting the auditory cues provided by the device. Children are who deaf do not have this advantage, but they have a different advantage; they do not have the same degree of auditory nerve degeneration because they have been deprived of sound for a relatively short period of time compared to adults (Won & Rubinstein, 2012). Children who are implanted at an early age and receive intensive auditory therapy also demonstrate significant gains in speech perception, language acquisition, speech production, and literacy development (Papsin et al., 2000; Waltzman & Roland, 2005).

Hearing Assistive Technology/Assistive Listening Devices

Although hearing aids and cochlear implants provide benefit in many situations, clients often experience difficulty in specific environments or specific situations where their hearing aids or cochlear implants are less helpful. For example, people who receive considerable benefit from their hearing aids regularly report that they need more help when they are communicating in high levels of background noise or when they are situated at a significant distance from the person they want to hear. Another example is a client who hears speech very well except when talking on the phone. Use of various assistive devices can be helpful in overcoming these problems, and are collectively referred to as **hearing assistive technology (HAT)**.

One of the principles behind assistive devices is to position the microphone of the device close to the sound source. For example, an older person sitting in a noisy dining room at the nursing home where she lives can place a microphone at the center of the table so that the intensity of the speech of her conversation partners will be increased more than the unwanted noise in the background. Similarly, a person who still can't hear the television well even with his hearing aids can attach a small microphone to the TV and place receivers in his ears. The TV signal is then sent directly to the receivers in his ears so he can hear it without the need to have the TV volume increased. Although some assistive devices are

still "wired," meaning that the signal is carried to the listener by a wire, many use wireless technology in which the signal is carried by some other means, such as a radio signal. In addition, often the signal can be delivered directly to the listener's hearing aids or cochlear implant.

One type of assistive device that is very popular, particularly in educational settings, is a personal **FM system**. Such a device operates on the same principle as conventional FM radio. The talker speaks into a lapel or headset microphone attached to a small body-worn transmitter that "broadcasts" on a frequency or channel. The listener receives the FM signal through a receiver tuned to the same FM radio frequency as the transmitter. In cases in which the person uses a hearing aid or cochlear implant, this receiver can be plugged directly into the hearing instrument.

Sound field amplification is similar to personal FM, except that instead of broadcasting the signal to individual receivers, the signal is sent to loudspeakers placed around the room. With sound field systems, all students in a room can benefit from the device, including those with fluctuating hearing loss due to otitis media, those who have attending issues, and those with language impairments.

A number of other assistive devices are available for use with telephone listening. Many clients purchase amplified telephones so that they can adjust the volume of the incoming voice to meet their hearing needs. Individuals with severe hearing losses sometimes rely on a portable keyboard called a **teletypewriter (TTY)**, or text-telephone. This device, which is also referred to as a telecommunications device for the deaf (TDD), allows text conversations to be conducted over regular phone lines. In recent years, the availability of e-mail, text messaging, synchronous chat, and videoconferencing have been very helpful for those who have difficulty using the phone. Shaw (2012) reports that engineers at the University of Washington have developed a new cellphone program called MobilASL that is able to broadcast communication between ASL signers. When available, the program will be able to be used "on any 3G phone and can be integrated into any mobile devices that has a camera on the screen side" (p. 22).

Assistive devices are also helpful for individuals who want to be alerted to sounds occurring from a distance. For example, a new mother who is concerned that even with her hearing aids on she might not hear her crying infant from another room can use a system that will alert her when the baby is crying by activating a flashing light. Such devices are available to visually alert a person of a ringing phone, an alarm clock, and a smoke detector.

Before leaving this topic of assistive technology and devices, brief mention should be made of the term *connectivity*. On a basic level, this term can refer to allowing a person who wears hearing aids to wirelessly access speech from a television or telephone directly into the aids. More broadly, this term refers to being connected not only with other devices but also with other people in ways that were not possible in the past due to hearing loss. As Beck and Fabry (2011) note, advances in consumer electronics have led to the development of new opportunities for individuals who have hearing loss and hearing aids to successfully access new information and new interactions with others. As an extension of this, the term *tele-audiology* refers to the use of electronic and telecommunications technology to provide distance audiology services. This is particularly important for clients who have difficulty getting to an audiologist for services, such as those who have poor health, lack transportation, or live in remote areas.

Auditory Training and Auditory Communication Modality

Once a client has been fitted with an appropriate amplification device, he or she may need to learn (or relearn) how to make sense of what is being heard through some type of guided listening practice. This process is referred to as auditory training. The goal of auditory training is to maximize a person's use of his or her **residual hearing** to enhance the client's perception of speech and non-speech cues (Schow & Nerbonne, 2007). Particularly in young children, improvements in these skills should lead to progress in other areas, including speech and language development, cognition, reading, and learning.

The principle of **neural plasticity** is very important to our understanding of the process of auditory training. Neural plasticity, as it relates to the auditory system, refers to physiological and functional changes within the central nervous system in response to auditory stimulation (Greenough, 1975). By providing certain types of auditory input on a regular basis, we hope to change the way the central auditory system works and thereby improve the individual's ability to make effective use of speech and language information that is delivered by the peripheral auditory system. Because there is a greater likelihood that we can change a younger central auditory system than an older one, early identification and early intervention must remain high priorities in our profession.

Before discussing three cases to illustrate how auditory training might differ with various clients, it is important to note that each of the following clients (or their parents, in the case of children) has decided to pursue a communication modality that is auditory based. In other words, regardless of the degree of hearing loss, these clients (or their parents) have decided that they want their main method of communication (or their child's) to emphasize speaking and listening. Choosing to make use of auditory information is rarely in question for individuals who have mild or moderate hearing losses because hearing aids are usually very successful in giving such clients access to the important speech sounds in our language. But in cases where the hearing loss is severe to profound, some individuals may choose to use a visual communication system, such as sign language, as their primary communication mode. In recent years, as hearing aids and cochlear implants have become more effective and identification of hearing loss has occurred earlier in life, greater numbers of individuals with very significant hearing losses and parents of such children are choosing to develop auditory skills and use oral English. Those who support this choice believe that this will help these individuals integrate more easily into the hearing world and will enhance their social, educational, and employment opportunities. With these concepts in mind, we now discuss three cases to illustrate the application of auditory training programs. As you review these cases, note the importance of the following factors: the age of the client, the degree of hearing loss, and the age at which the hearing loss occurred.

The first case is a child who was born with a severe sensorineural hearing loss in each ear. He was identified by an audiologist at 5 months of age and was fitted with hearing aids by 6 months. He also started receiving speech and language services by 6 months of age. Because of the child's degree of hearing loss and in order to make use of the neural plasticity of the child's system (discussed previously), the aural rehabilitation program will be developmentally based and intense. It will most likely start with basic awareness of environmental sounds and then move to discriminating different sounds. Of course, work will be done

on speech sounds, moving from consonants and vowels to syllables, words, phrases, sentences, and eventually connected discourse. Labeling what is heard will also be part of this training, along with work on comprehension of spoken messages. In some philosophies, this work is done without allowing the child to use any visual cues, like watching the speaker's face; in other approaches both auditory and visual cues are used together. Parents would most likely be given tasks that they could work on at home in the normal course of communicating with their child.

The second case involves a 5-year-old girl who was born with a mild high-frequency sensorineural hearing loss in each ear. Because of the mild nature of the loss, it was not identified until the child was 4½ years old, as part of a pre-K hearing screening. The child also had a speech-language evaluation and exhibited some speech sound errors of the /s/, /t/, and /k/ sounds; some vocabulary deficits; and some delays in the use of certain morphological markers. For this child, two hearing aids would be critical in order to provide her with access to the high-frequency sound she is missing. Also, an FM device would be beneficial in the classroom to help her understand the teacher's voice in noisy conditions and when she is listening from a distance. In addition, speech and language therapy would be necessary to build her vocabulary, work on morphological markers, and provide articulation therapy. Parents would be most likely encouraged to read to their daughter regularly to support vocabulary development. You can see that this program of aural rehabilitation is less intense than that described in the previous case, but note that even this mild loss has negatively affected the child in several ways.

Finally, consider a case involving an adult who was born with normal hearing in each ear but now, at age 74, finds himself with a moderate sensorineural hearing loss, due to his age and a history of noise exposure. Although retired, he is very active, doing volunteer work each week and enjoying a very active social life with friends and family members. This client has become somewhat discouraged at the effect that his hearing loss is having on his life and is now ready to use hearing aids. In addition to use of the aids, his aural rehabilitation program would most likely also include teaching him about barriers in the environment that could interfere with his speech understanding. These include background noise, poor lighting, and distance. He also will need to learn to politely let others know what they can do to improve his ability to understand. For example, he can request that a communication partner speak more slowly or move to a quieter part of a room. He can also ask the speaker to look at him when speaking. Finally, the audiologist will most like talk to this client about the value of using context to support his understanding of speech. By using prior knowledge about the topic of the conversation, he can fill in missing information. With this in mind, the audiologist may suggest that this client ask his communication partners to start conversations by telling him the general topic.

One popular program that has been used with adults who have hearing loss and are wearing hearing aids is the Listening and Communication Enhancement program by Sweetow and Sabes (2006). This program can be used at home on the client's computer and includes practice listening in noise, with rapid speech and when more than one speaker is talking. Research suggests that many individuals who use this program improve their ability to understand speech in various conditions.

Visual Communication Modality

The three cases just discussed were about clients whose focus was to use oral English as their primary means of communication. There are, of course, clients who choose to use a visual system of communication. As noted previously, these clients typically have hearing loss that is in the severe to profound range. This choice could be based on cultural factors related to an allegiance to the Deaf community. For example, some parents who are deaf believe that the use of ASL with their deaf child will help that child gain acceptance into the Deaf community, which will be beneficial to the child's social and emotional development. In other cases, this choice may be made because the client's hearing loss is so great that he or she is not been able to learn oral English sufficiently for it to be a functional and efficient communication system. As noted earlier in the chapter, audiologists and SLPs must respect the choices that their clients make.

A helpful tool for understanding the options and differences among the visual approaches is the continuum found in Figure 12.13. Note that manually coded English signing systems are at one end and ASL is at the other. ASL is a language unto itself, with its own unique set of grammatical rules; it is not a visual form of English. ASL is often described as a conceptual language because a single sign can convey an entire thought. Unlike ASL, which is a natural language, forms of **manually coded English (MCE)** were developed for use in educational settings with children who are deaf to expose them to certain grammatical markers such as *ed* and *ing*. Some believe that this exposure to English language structures, which are not explicitly used in ASL, support the development of English literacy skills and overall academic achievement. In MCE, much of the vocabulary comes from ASL, but the word order is the same as it is in oral English. Because of this, English can be modeled using both visual and auditory modalities at the same time.

Pidgin Signed English (PSE) is usually the type of manual communication taught in basic sign curricula for hearing people interested in learning to sign. New users of PSE tend to communicate using a structure that is more English-like, whereas experienced users tend to incorporate more features of ASL. One final popular form of manual communication to be mentioned is **fingerspelling**,

Figure 12.13 Sign language continuum.

Manually Coded English Signing Systems →		*American Sign Language (ASL)*
Signed Exact English (SEE)	Pidgin Signed English (PSE)	
Word meaning is NOT considered (e.g., the word "right" will have the same sign regardless of context)	Signs used are more conceptual. One word may have many signs depending upon meaning.	Has its own vocabulary, grammar, and sentence structure. One sign may represent an entire thought.
All grammatical markers (articles, auxiliary verbs, plurals, etc.) are signed.	Grammatical markers may or may not be signed.	Does not have specific signs for grammatical markers.
	Facial expression and gestures are incorporated.	Facial expression, body position, space, and repetition are used extensively.

which consists of hand shapes used to visually represent each of the 26 letters of the English alphabet. Although this would not be a very efficient way to communicate, fingerspelling is very helpful when used in conjunction with ASL, PSE, or MCE systems to communicate proper names, technical vocabulary, and other English words that have no known signs.

To view samples of ASL in action, visit the Signing Online website: www.signing online.com. Click on the dictionary tab to the left and enter a word of your choice. Then, on the right side of the page, view a video of that word being signed.

Click here to check your understanding of the concepts in this section.

Treatment and Management of (Central) Auditory Processing Disorders

Think back to our earlier discussion about a (central) auditory processing disorder referring to deficits of the central auditory system that affect a person's ability to use and interpret auditory information received form the peripheral auditory system. Testing for such a disorder can be done only after an audiologist has established that hearing is within normal limits in each ear. The management of (C)APD must be based on the findings obtained as part of the CAPD assessment, combined with input from a multidisciplinary group of professionals, the parents, and sometimes the student him- or herself.

The literature on CAPD indicates that treatment generally includes three areas: environmental accommodations, compensatory strategies, and direct therapy to remediate specific auditory processing deficits.

Environmental accommodations refer to changes we can make to the listening environment that will improve a listener's ability to receive auditory/verbal information clearly. Some examples of environmental accommodations include adding carpeting or drapes to a classroom in an effort to reduce noise and reverberation, seating the individual closer to the sound source, fitting the individual with a personal FM or sound field system, or providing written notes to supplement verbal information. Accommodations may also include instructional techniques such as speaking clearly at a moderate rate, providing clear and concise directions, using familiar vocabulary and age-appropriate sentence structure, breaking multistep directions into smaller segments, and use of hands-on activities that include visual supports.

Work on compensatory strategies is designed to strengthen other broader cognitive areas, such as attention and language. This could include work on using memory and organizational techniques, using linguistic and contextual cues, and developing problem-solving strategies.

Finally, direct therapy consists of intensive auditory training, designed to attempt to strengthen the specific auditory deficits identified during the assessment. Although some authorities believe that this formal training of specific deficit areas has great potential, currently there is a lack of evidence that such training alone can result in changes in the functional communication abilities of students who have CAPD. For this reason, many of the recommendations made by audiologists focus on improving the listening environment and building other cognitive areas.

The box that follows summarizes some of the evidence-based research that validates the exciting progress being made in audiology for the benefit of children and adults with hearing and balance difficulties.

Thought Question

BOX 12.1 | **Evidence-Based Practice in Audiology**

Universal Newborn Hearing Screening/Early Intervention

- Research strongly suggests that children who are diagnosed with hearing loss and receive hearing aids and early intervention by 6 months of age develop significantly better language skills than do children who are identified after 6 months of age.

Cochlear Implants in Children

- Children who are implanted at an early age and receive intensive auditory therapy demonstrate significant gains in speech perception, language acquisition, speech production, and literacy development.
- Children who receive unilateral implants prior to attending school more frequently perform well academically and are mainstreamed than are those who receive implants after beginning school.
- Adults who receive unilateral implants experience improved speech perception and overall quality of life; there is greater benefit for those whose deafness is postlingual and for those who have a shorter duration of deafness before being implanted.

Hearing Aids in Adults

- Although the type of outcome measure that is used affects the size of the effect, a systematic review and statistical analysis of the literature reveals that hearing aids improve health-related quality of life.

Hair Cell Regeneration

- Using mice that were deaf, researchers stimulated existing cells so that they would function like cochlear hair cells, causing partial recovery of hearing.

Vestibular Rehabilitation

- There is moderate to strong evidence that certain rehabilitation procedures used with individuals who have benign positional balance disorders are safe and effective.

Source: Bond et al. (2009); Chisolm et al. (2007); Hiller & Hollohan (2011); Meinzen-Derr et al. (2011); Mizutari et al. (2013); Papsin et al. (2000); Waltzman & Roland (2005); and Yoshinaga-Itano et al. (1998).

SUMMARY

The profession of audiology is a diverse field that offers opportunities to work with many populations, in a wide variety of settings. An audiologist has the responsibility to assess auditory and vestibular function and to provide aural (audiological) habilitation/rehabilitation services. A hearing loss is caused by an interruption at one or more points along the auditory pathway from the outer ear to the brain. The three types of hearing loss that affect the peripheral auditory system are conductive, sensorineural, and mixed. Audiologists are also concerned with problems affecting the central auditory system, including the auditory areas of the brain stem and brain. Problems along these pathways generally result in inability to use and interpret auditory information efficiently and effectively, referred to as auditory processing disorder.

When describing hearing loss, audiologists use terminology such as conductive, sensorineural, mixed, and central to identify the portion of the auditory system that is affected. Another important set of terms describe the degree of hearing loss measured in decibels. Each degree of hearing loss corresponds to a specific decibel range. Individuals with hearing loss in the slight/mild to moderately severe range are often referred to as hard of hearing or hearing impaired and

depend as much as possible on the use of residual hearing for communication. For people with profound hearing loss, often referred to as deafness, the auditory system provides little or no access to sound without proper amplification.

When evaluating the auditory system, audiologists rely on electroacoustic, electrophysiological, and behavioral measures. They administer a battery of tests to identify the presence of a hearing loss, determine its type, quantify its degree, and assess its impact on communication. Informational and personal adjustment counseling are critical to the process.

Aural (audiological) habilitation/rehabilitation refers to the services and procedures that are designed to minimize and resolve communication difficulties presented by a hearing loss. Aural habilitation refers to therapies that are used primarily with children to teach missing communication skills; aural rehabilitation refers to services provided to those who have lost their hearing later in life, after spoken communication skills have been established. The focus of aural rehabilitation is to help the person recover lost skills and to use compensatory strategies effectively. Areas typically considered in creating an individual aural rehabilitation program are the evaluation and fitting of amplification and hearing assistive technology, auditory training, communication strategy training, and determination of an appropriate mode of communication.

SUGGESTED READINGS

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13

Using Augmentative and Alternative Communication

James Feeney, PhD.

CHAPTER LEARNING GOALS

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

- Define augmentative and alternative communication (AAC)
- Describe various types of aided and unaided AAC systems and ways people access AAC
- Explain how interactive competence is critical in AAC assessment and intervention practices across the lifespan

A t times, all of us use some form of **augmentative and alternative (AAC)** to communicate, although most of us still rely on speech as a primary means of communication. When you text a friend, in essence you are using a form of AAC. Let's focus for a few paragraphs on what AAC use means to individuals who have difficulty using the speech channel.

As much as it is important to understand what AAC is, it is also important to understand what it is not. A common misconception about AAC is that this area of practice in speech-language pathology focuses solely on the things people use to communicate. To be sure, AAC includes how people use things such as *speech-generating devices (SGDs)* to make known their wants and needs. But limiting the scope of AAC to the objects, electronic gadgets, handheld devices such as tablets and smart phones, or any of the other things a person might use to communicate is like watching your favorite music video with the volume off. Without sound, a viewer can only make use of the visual experience offered in the video, but in doing so, the person only *sees* the artist. Without the benefit of the sounds that make the music, the viewer loses the very essence of what makes the artist's song a song—the music. In a similar way, when viewing or defining AAC, it is necessary to consider not just the things a person uses to get a message across but the interplay between the *communication technologies* used to support individuals with *complex communication needs (CCNs)* and the interactive competence of everyday communication partners.

One of the most useful and broad-based conceptualizations of AAC is found in the American Speech-Language-Hearing Association's (ASHA's) definition of AAC from Special Interest Division 12: Augmentative and Alternative Communication. Based on the work of many professionals (Beukelman & Mirenda, 2013; Glennen & DeCoste, 1997; Lloyd et al., 1997), this definition states:

> Augmentative and alternative communication (AAC) refers to an area of research, clinical, and educational practice. AAC involves attempts to study and when necessary compensate for temporary or permanent impairments, activity limitations, and participation restrictions of individuals with severe disorders of speech-language production and/or compensation, including spoken and written modes of communication. (ASHA, 2005a)

As noted in other assessments of communication impairment, assessment for AAC use is a team effort.

In the definition, the terms *activity limitations* and *participation restrictions* relate directly to concepts found in the World Health Organization's (WHO's) International Classification of Functioning, Disability, and Health (ICF) framework (WHO, 2001). This framework is used to inform clinical decision making in assessment and intervention planning. In other words, it helps professionals examine a person's ability to use AAC in relation to their functional abilities, contextual factors that influence functioning, and other variables that play a part in clinical decision making. While a full review of the WHO/ICF framework is beyond the scope of this chapter, there are several excellent online resources that provide comprehensive reviews of the WHO/ICF framework for interested parties; for example, see www.asha.org and www.who.int.

Although ASHA situates its definition of AAC within the WHO/ICF framework, it also states the following on its website (www.asha.org) in response to the question "What is AAC?":

> Augmentative and alternative communication (AAC) includes all forms of communication (other than oral speech) that are used to express thoughts, needs,

wants, and ideas. We all use AAC when we make facial expressions or gestures, use symbols or pictures, or write.

The statement "We all use AAC . . ." provides a clear connection between AAC and the reader's own experiences in communicating with others. This is an important aspect of the definition of AAC, in that it emphasizes how it is not something that only people with communication challenges use to make their wants and needs know. It is a part of any communication culture, community, group, or setting in which people interact. Think of your own life and consider the many ways you use AAC each day—the possibilities are endless!

Who Uses AAC?

It is estimated that approximately 4 million people in the United States are not able to use natural speech to express their wants and needs (Beukelman & Mirenda, 2013). While this number does not provide an exact count of people who use AAC, it suggests that there is a large group of people in the United States alone who have the *potential* to use AAC. Other estimates of the prevalence of AAC use in the United States range from 0.8% to 1.3% of the total population (Beukelman & Ansel, 1995). Expressed differently, of the 313 million people who are estimated to live in the United States (www.census.gov), somewhere between 2.5 and 3.8 million of them are not able to communicate with others using natural speech. With such a large number of individuals in mind, it is clearly important for speech-language pathologists (SLPs) and other helping professionals—possibly you in the future—to remain diligent in efforts to collaboratively serve and advocate for individuals who use, or have the potential to use, AAC systems.

All typical communicators augment speech with other means of communication, such as gestures and facial expression.

Although it is true that we all use AAC in our everyday communication routines in the form of gestures and body movements, texting, and e-mails, it is also important to accept the premise that "there is no typical person who relies on AAC" (see Beukelman & Mirenda, 2013, p. 4). In fact, there are many groups of people who, for some reason, use AAC and also share a common diagnosis or condition. For example, individuals with developmental disabilities such as cerebral palsy (CP), autism spectrum disorder (ASD), or intellectual disability (ID), may have difficulty communicating using natural speech as a result of the physical, cognitive, and communicative limitations associated with the specific disability. Other individuals who might benefit from AAC include, but are not limited to, people with aphasia, people who have experienced a traumatic brain injury (TBI), people who have undergone a glossectomy or a laryngectomy, and people who have motor speech problems (e.g., dysarthria and/or apraxia of speech).

AAC is part of a group of assistive technologies that support the needs of people with disabilities.

Throughout human history, people with disabilities have managed to overcome huge social, cultural, and civil barriers to living independent, productive, and satisfying lives. As technology grows with incredible speed, it is necessary for helping professionals across disciplines to collaboratively support individuals with CCN in their pursuit of *efficient* and *effective* communication with others.

Thought Question

TYPES OF AAC

AAC has long been separated into the two well-conceived and broad categories: *aided* and *unaided systems* (Lloyd et al., 1997). In general, unaided systems have not been considered to involve any external equipment but to rely only on the

individual's body. Aided systems have been considered to include the use of some type of equipment or device and range from very simple to extremely sophisticated options. In more recent AAC taxonomies used to group AAC systems (e.g., Beukelman & Mirenda, 2013; Schlosser, 2003), however, two major distinctions are noted. First, an additional category for *combinations of aided and unaided systems* is offered. Second, *symbols,* or "anything that stands for or represents something else" (Vanderheiden & Yoder, 1986, p. 15), are viewed as central to the process of classifying AAC systems.

Unaided AAC: Gestures and Vocalizations

Any time a person uses a gesture, a body movement, or an observable signal with a communication partner, he or she is using unaided AAC. For example, imagine talking with a friend about a movie. With each gesture, change in tone of voice, or change in body posture, you are using unaided symbols to send messages to your conversational partner. This does not mean, however, that the *intent* of your message(s) is perceived accurately by your partner! That is another area of exploration altogether.

Unaided AAC: Manual Sign Systems

American Sign Language is a language, just as Spanish is a language.

Manual sign language is a highly developed form of communication, as is speech. American Sign Language (ASL), for example, is a language that has its own vocabulary and syntax. Other sign systems in use in the United States are translations of English into sign and include Signed English, Signing Exact English (SEE), and Tactile Signing.
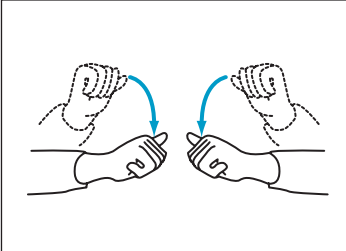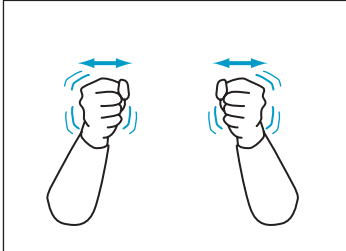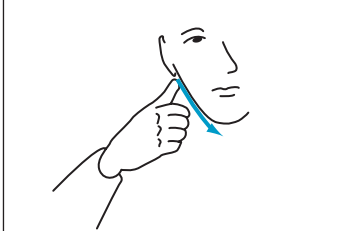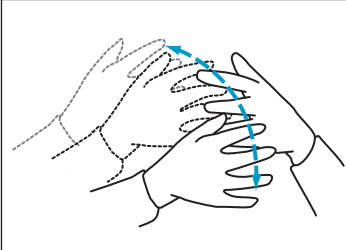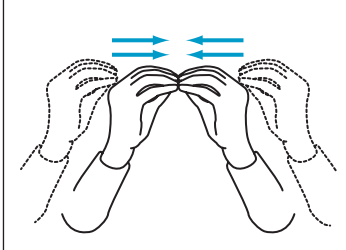
Also in this category is Amer-Ind, a gestural or hand communication system that some nonspeaking individuals use. It is a relatively grammar-free, nonsign system involving 250 concept signals. Almost all gestures in Amer-Ind can be made with one hand, making it easier than ASL and other signing systems for those with hemiplegia (i.e., paralysis on one side of the body) or hemiparesis, (i.e., weakness on one side).

Some signs are easy to comprehend because they look like what they represent. These signs are called *iconic.* For example, the sign for *drink* in most systems is made by miming drinking from a cup. Unfortunately, few signs are of this type. Signs that are easily guessable, explainable, and memorable are called *transparent.* Amer-Ind has a high proportion of transparent signs. Signs, such as the one for *apple,* which are difficult to interpret, are called *opaque.* Examples of iconic, transparent, and opaque signs are presented in Figure 13.1.

Gestural communication systems can be differentiated based on their grammatical structure. As we have discussed, sign languages, including ASL, have their own syntax or grammar, whereas sign systems such as Signed English are based on, and follow, the rules of American English grammar; thus they are not separate languages.

For most deaf signers, fingerspelling is mixed with signs and used for new words or names. Fingerspelling, or the manual alphabet, may be a good alternative for older clients with both good cognitive and fine-motor abilities. The client has ultimate flexibility because any word in the language can be spelled for transmission.

Figure 13.1 Examples of iconic, transparent, and opaque signed English signs.

ICONIC

coat

Make an "A" shape with both hands. With thumbs, trace shape of jacket lapels.

cold *(adj.)*

Make an "S" shape with both hands. Draw hands close to body and shiver.

TRANSPARENT

boy

With hand by forehead, snap a flat "O" shape twice, indicating the brim of a baseball cap.

girl

Make an "A" shape with right hand. Place thumb by right earlobe and move down jaw line.

OPAQUE

gray

Make a "5" shape with both hands, thumbs up, palms facing body. Move hands back and forth with Ⓡ fingers passing between Ⓛ ones.

more

Make a flat "O" shape with both hands, fingertips facing each other. Tap fingertips together twice.

Unaided systems are not appropriate for every individual who needs either to enhance or replace his or her current method of communicating. For example, an individual with severe motor involvement in the limbs, as in some forms of CP may be unable to make the fine motor adjustments necessary for many signs. Another problem with gestural communication systems has to do with the number of communication partners who understand the system. Unfortunately, many individuals in the community (e.g., outside a signer's home or school environments) are not familiar with sign and may not be able to understand what a signer is trying to communicate.

Aided AAC

Aided systems in general range in terms of the representations used within a system, the input and output modes of a system, and the degree to which the symbols in a system are transparent to others. AAC systems also vary according the amount of technology in a particular system, and systems are typically grouped as no-tech, low-tech, mid-tech, or high-tech and can be represented by a continuum of technology (see Figure 13.2). No-tech systems are those that do not involve the use of any technology and use readily available materials (e.g., paper and pencil, writing the letters of the alphabet on a piece of paper so the user can spell out a message). Low-tech systems are those that are fairly simple to use and contain few moving parts (Mann & Lane, 1991). Examples of low-tech AAC systems include such devices as The Chipper, The Sequencer, and VoicePal, to name a few (see www.adaptivation.com, click on "Products," then "Communication Aids" for examples). Mid-tech systems typically use some amount of electrical power, have speech-generation ability, and have limited programming options and capacity to hold stored messages. Examples of mid-tech systems such as the SuperTalker Progressive Communicator and the Cheap Talk 8 can be seen on the Enablemart (www.enablemart.com) website. From the home page click on "Speech and Communication," then click on "Augmentative and Alternative Communication," then click on "Dynamic Communicators." High-tech AAC systems are electronic devices that are considerably more sophisticated, require some amount of training related to programming, and make use of computer technology (e.g., software used for speech production). Examples include such devices as the Maestro, by DynaVox (see www.dynavoxtech.com, click on "United States" and then hover over products and choose a high-tech device to review), Lightwriter, by Toby-Churchill (at www.toby-churchill.com, hover over products and click on Lightwriter), and Accent 1200 by the Prentke Romich Company (see www.prentrom.com, click on "Products" and click on "Accent 1200"), or tablet devices with communication software such as the iPad, by Apple (at www.apple .com, click on "iPad"), or the Surface, by Microsoft (at www.microsoft.com, click on "Products," then "Surface"). Also, for an excellent review of AAC systems, their characteristics, and features, see www.setbc.org. From the home page, click on the "Learning Centre" tab and then click on "AAC Feature Comparison Grid."

Aided Symbols: Tangible Symbols

Tangible symbols include real objects, miniature objects, partial objects, and artificially associated and textured symbols. Much of what we know about using tangible symbols can be captured under the heading *visual schedules,* originally

Figure 13.2 Continuum of aided AAC technology, with examples of each.

No-Tech	Low-Tech	High-Tech
Alphabet board	Light-indicating communication board	DynaVox
Word board	BIGmack communication device	Lightwriter
Paper and pencil	VoicePal Max	Pathfinder
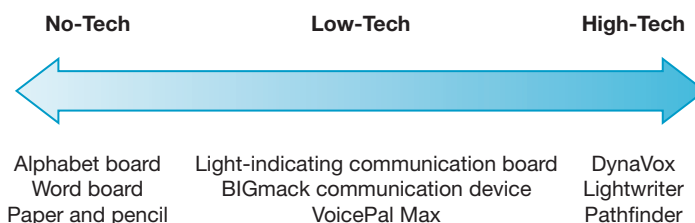
described by Stillman and Battle (1984), in their work with individuals with visual and hearing impairments. Visual schedules that include tangible symbols, such as real objects, are often organized according to the daily activities that occur in an individual's life. Figure 13.3 shows an example of a visual schedule made up of objects and Picture Communication Symbols for an adult with severe intellectual disability. Similarly, with very young children, SLPs may choose to use actual objects, as they are very concrete and may not represent anything beyond the referent displayed. A system called Tangible Symbols (Rowland & Schweigert, 2000) attempts to bridge the gap between actual objects and graphic representations by using objects or pictures that have a clear relationship to the referent. For example, a key might represent *car* or a shoelace might represent *shoe*.

Aided Symbols: Pictorial Symbols

Whether on a communication board or an electronic device, graphic symbols are just as important to aided AAC as words are to speech or signs to signing. Symbols may include pictures, various representational systems, and/or line drawings. Some symbol systems have been specifically designed for AAC use. Graphic

Figure 13.3 Iconography of aided symbol systems.
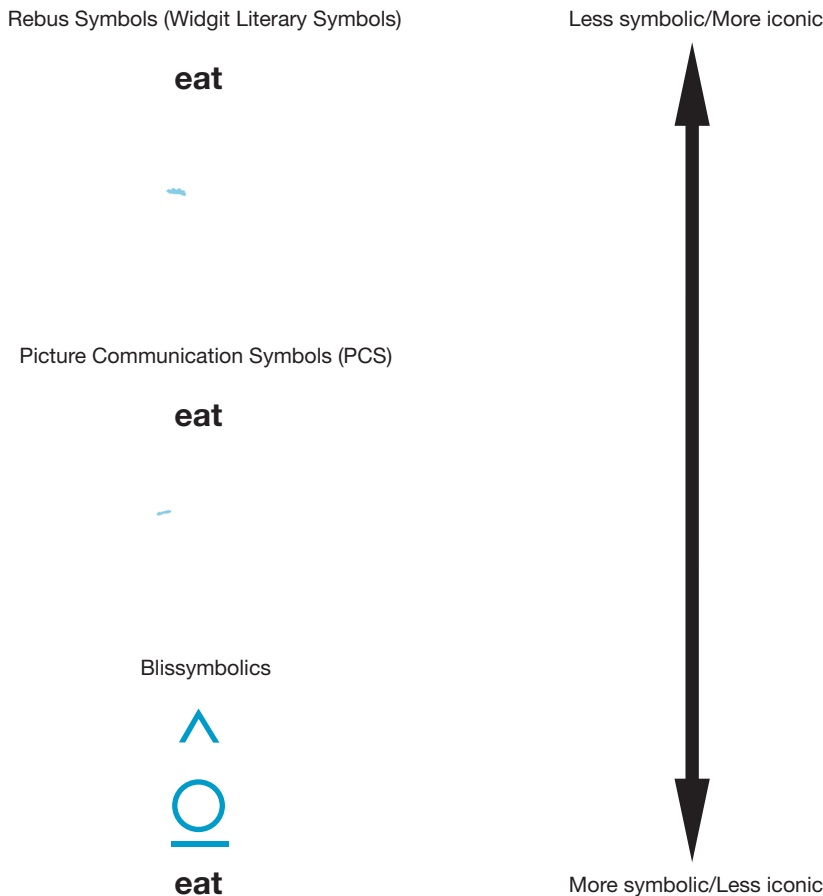
symbol systems include iconic representations, such as Picture Communication Symbols (PCS) and some Rebus Symbols, less iconic representations, such as Pictogram Ideogram Communication (PIC), and opaque symbol systems, such as Blissymbolics or spelling. These are presented in Figure 13.3. Symbolic systems are relatively rule governed and generative, allowing for symbol combination and the creation of new symbols.

Graphic symbol systems may use a variety of means to express different concepts. Rebus symbols are line drawings of both concrete and abstract concepts and of sound sequences, originally developed as an aid for teaching reading. PIC contains ideograms used to represent an idea rather than the way a referent or concept appears in the real world. Ideograms and symbols, such as those used in Blissymbolics, can be used for abstract concepts just as words can. Blissymbols consist of 100 pictographic representations and arbitrary symbols that can be combined to create words.

Aided Symbols: Orthography and Orthographic Symbols

This category of AAC includes such systems as Braille, fingerspelling, writing, and others ways a person uses symbols for language. English orthography, for example, includes the use of the letters of the alphabet to transcribe thoughts and ideas into words in print. Any process like this, regardless of language being transcribed, is considered a type of AAC that involves orthography.

Combinations of Aided and Unaided Systems

Thought Question

If there is a common theme among all definitions and classifications of AAC, it is that it is multimodal. That is, people invariably use multiple methods or modes of communication when interacting with others, and AAC is no exception. For example, a woman with severe physical limitations due to CP may use a high-tech AAC system with synthesized speech to express herself in a business meeting. She may also use a letter board and a partner's assistance to spell a quick message while having coffee with a friend. In both scenarios, AAC is appropriately used to address communication goals.

ACCESS

A person's use of an AAC system invariably involves a selection technique or method to *access* the system. Access might include touching buttons, pointing to symbols, or holding an object. The means of access is especially important, and great care must be exercised in choosing the appropriate interface between a client and a device.

Two primary means of access are *direct selection* and *indirect selection*. With direct selection, individuals may select an item in a selection set directly by pointing with a finger, hand, head pointer, or optical head pointer or by operating a joystick. In cases of severe neuromuscular involvement, eye gaze, sometimes referred to as eye pointing, may be used to select symbols. Most people who use communication boards indicate their message by direct selection.

Pointing may be aided by the use of either hand splints or pointing sticks that strengthen or enable the person's response. Optical head pointers may be

used with both electronic and non-electronic systems. For example, something as simple as a small flashlight, laser pointer, or penlight attached by a headband to an individual's head can be used to access a communication board (e.g., a letter board). An electronic communication device may have sensors built into the device itself. The optical head pointers used with these devices typically utilize infrared (IR) technology. As the optical head pointer moves across the symbol display, the device's sensors light up, indicating to the user what symbol it is on. When the individual gets to the desired symbol, he or she stops for a predetermined period of time (called *dwell time*). Once the user has rested on that location for that period of time, the device "knows" that the user is selecting that symbol. The dwell time on most devices can be set depending on the needs and abilities of the user.

Individuals using eye gaze may look at symbols on a clear acrylic board located between the user and the communication partner. The user gazes at desired symbols, which appear on both sides of the board.

Direct selection methods can be difficult, especially for those with severe motor problems. The main challenge in using direct selection relates to the person's efficiency and effectiveness. *Efficiency* in this context refers to the speed with which a person is able to use an AAC system to send a message to a partner. *Effectiveness* refers to the degree to which a person is able to use an AAC system to achieve his or her communication goal. Difficulty with access will almost certainly slow the communication process (i.e., decrease efficiency) and, in turn, negatively impact a person's ability to say what he or she wants to say (i.e., negatively impact effectiveness). Although word prediction programs, including context-specific prediction, have been proposed to increase efficient use, there do not seem to be statistically significant process and performance differences in actual performance using keystroke-based measures (Higginbotham et al., 2009).

Indirect selection methods or techniques, such as scanning and partner-assisted selection/scanning, may also be used to access AAC systems. *Scanning* is often an available option in mid- to high-tech AAC systems, and it is suitable for individuals with limited motor abilities. With electronic AAC systems, scanning typically involves a process in which an individual assembles a message through a series of switch activations, during which choices are presented sequentially to the user, who then signals when the desired item in a selection set has been presented. In partner-assisted scanning, the options in a selection set are presented by another person, who might be pointing to symbols on a communication board, while the user signals when the symbol/message he or she wants to communicate has been presented. People with motor limitations can use many different types of input—simple pressure switches, devices with touch screens, pneumatic "sip and puff" switches, and eye blink switches. The type of switch an individual uses depends on his or her particular needs and abilities. Often, an SLP, maybe you, along with an occupational therapist (OT), is involved in selecting the most appropriate type of switch for an individual to use to access his or her AAC system.

Auditory scanning works in a similar way, but in addition to the symbols being presented visually, there is also an auditory cue present. For example, imagine a lunch page on which the device has the symbols hamburger, hotdog, and pizza present. For visual scanning, when those symbols are presented, an illuminated frame appears first around the hamburger. If no selection is made, the frame moves to the hotdog, and then if this selection is not made, the frame moves

to pizza. To select pizza, when the pizza symbol is highlighted, the individual activates his or her switch, and the device speaks the message "I'd like pizza for lunch today." If the individual is using auditory scanning, the device works as just described here, but with the addition of an auditory cue. So when the hamburger symbol is highlighted, the device says "hamburger." If no selection is made, the illuminated frame moves to hotdog, and the device says "hotdog." If no selection is made again, the illuminated frame moves to pizza, and the device says "pizza." If the individual activates his or her switch to select pizza, the device speaks the message programmed into that location: "I'd like pizza for lunch today."

As mentioned, scanning is a very effective option for individuals with significant motor limitations. However, it can be an extremely slow and laborious process. The majority of an individual's time is spent waiting while extraneous things are presented. Scanning requires extended concentration and has the potential to be very frustrating, especially when symbols are missed and the process must be repeated.

In many cases, *efficiency,* or the speed with which a person is able to assemble a messaging using an AAC system, can be enhanced by placing symbols so that those that are most frequently used are scanned most frequently. For example, if the cursor or indicator begins at the top of the display and returns there after each symbol selection, then the most frequently used symbols are placed at the top. Obviously, such an arrangement requires that communication partners understand the person's AAC system in order to ensure peak efficiency. Various scanning methods can also increase efficiency (Venkatagiri, 1999). For example, in linear scanning, each possible selection is presented in sequence. In contrast, both row/column and group/zone scanning enable the user to scan larger areas and then refine the scan once the desired area has been highlighted. For example, the user might press the switch to begin the scanning process. Rows are lighted in sequence until the desired one is found. The user presses the switch again, and individual symbols within that row are highlighted, one at a time. Once the system highlights the target word or symbol in the person's message, the user triggers a switch to make a selection. In group/zone scanning, the person scans groups of related symbols (group/zone display), such as food items, from which the AAC user then selects the desired symbol.

Obviously, the type of access method is as important as the symbol system used. In general, an SLP and a client determine the most efficient and accurate access method given the individual's cognitive and physical abilities, along with the environmental, social, and educational demands of the person's life.

OUTPUT

Electronic AAC devices almost invariably have a wide range of outputs that are available to the user. Electronic output or transmission may be as simple as a light over or behind a symbol or as elaborate as a voice and printed message. SLPs help client to find the most appropriate output for their needs. Several types of output options exist. In some situations, an individual may need written or printed output. For example, at school a device user may need to submit a hard copy of a speech he or she delivered in class, necessitating written output. In many other situations, spoken output or voice output would be most natural and appropriate.

Voice output communication (VOC) can be either recorded or digitized, synthesized, or a combination of both. Because digitized output is actually

In order for AAC training to generalize to everyday use, important people in a user's life should be included in the intervention.

Click here to check your understanding of the concepts in this section.

prerecorded by a person, it is much more natural sounding, and it is relatively easy to age- and gender-match the voice on the device with the individual using it. However, a disadvantage of digitized VOC is that the only output an individual can produce on his or her device is messages that have already been anticipated and programmed, or stored, in the system's memory. In contrast, synthesized speech has more flexibility but often sounds mechanical or robotic. Instead of recording actual words or phrases, the speech synthesizer contains sounds and rules for combining them. Generally, messages are programmed into a device with synthesized speech by simply typing in the words and phrases/messages. The speech synthesizer then converts that text string into spoken output, using the sounds and rules for combining them contained in its program.

Compared to natural speech, comprehension of synthesized speech, found on devices such as DECtalk1 and VeriVox2, requires increased focused attention by the partner. When attention is divided, partners comprehend significantly less synthesized speech (Drager & Reichle, 2001). In addition, partners tend to respond more slowly to synthesized speech (Reynolds & Jefferson, 1999). Although more research is needed on intelligibility, listeners to synthesized speech can improve their speech-sound perceptions through word recognition training (Francis et al., 2007). Even individuals with severe intellectual disabilities can

> AAC use can change the communication process in ways that are not always predictable.

Figure 13.4 Why AAC facilitates communication better than speech.

Simplification of input
    Irrelevant and parenthetical comments eliminated.
    Slower rate permits more processing time.

Response production advantages
    Pressure to speak removed.
    Physical demands decreased compared to speech.
    Physical manipulation of client's hands or other parts of body by trainer is possible.
    Client observation of physical manipulation facilitated.

Advantages for individuals with severe cognitive impairment
    Limited and functional vocabulary.
    Individual's attention easier to maintain.

Receptive language/auditory processing advantages
    Structure of language is simplified.
    Auditory short-term memory and/or auditory processing problems minimized.

Simultaneous processing/stimulus association advantages
    Visual nature of the symbol makes it more obvious.
    Visual symbols have more consistency.
    Duration of symbol is greater than spoken word.
    Visual symbols more easily associated with visual referents.

Symbolic representation advantages
    Supplement speech symbols.
    Symbols visually represent referents.

Source: Based on information from "Augmentative and Alternative Communication," by L. L. Lloyd and K. A. Kangas (1994). In G. H. Shames, E. H. Wiig, and W. A. Secord (Eds.), *Human Communication Disorders* (4th ed.). Boston: Allyn & Bacon.

become more proficient at recognizing synthetic speech as a result of repeated exposure to it (Koul & Hester, 2006). For preschool children, intelligibility of synthesized speech is increased if single words are placed within longer language units, such as sentences (Drager, Clarke, Serpentine, et al., 2006).

Decisions on the appropriate type of AAC are made only after careful evaluation. As part of this evaluation, it is important for an SLP, in collaboration with an individual using systems, his or her everyday communication partners, and other members of the assessment team to identify an AAC system that will change as the communicative needs of the individual change.

ASSESSMENT CONSIDERATIONS

All members of an intervention team should use an AAC system to provide multiple partners and multiple situations.

Up to this point in this chapter, a great deal of attention has been paid to terms, concepts, and ideas related AAC, without specific case illustrations to link these concepts to real people. There is perhaps no more useful way to show this link than in the area of AAC assessment. It will be your responsibility, as an SLP, to pull together all that you know about AAC and the abilities and needs of each individual client. In AAC assessment, it is paramount that an SLP, along with members of the assessment team, understand an individual's cognitive-communicative strengths, the everyday communication routines of the individual, and the barriers and/or facilitators to the individual's successful communication.

In the interaction described in Box 13.1, Jackie, an individual using AAC to communicate, uses a range of AAC system to communicate. While reading, try to keep track of Jackie's cognitive-communicative strengths, as this is a useful step in the process of selecting an AAC system.

Jackie's story not only provides an appropriately human element to the topic of AAC assessment, it allows us to consider how the interactive competence of her partners varied so drastically and directly impacted her communicative success. The emphasis placed on understanding the *competency* of the person using AAC is well described in the work of Light (1998; 2000; 2003). Light's framework for AAC assessment includes four competencies that relate to a person with CCN: *linguistic competence, operational competence, social competence,* and *strategic competence.* As Jackie's story suggests, each of these competencies can also be connected to the communication partner and can be used in making intervention-planning decisions.

Linguistic competence is a broad term used to describe an individual's language ability across all dimensions of language. This includes, but is not limited to, a person's receptive and expressive language ability, understanding and use of symbolic representations, and use of linguistic codes across contexts. A person's strengths in the area of meta-linguistic awareness and metacognition would also fall in this area, as they directly relate to how an individual uses an AAC system. Understanding linguistic competence also requires that helping professionals understand the interrelationship between AAC and an individual's culture and background. In other words, exploring a person's linguistic competence should invariably include an understanding of the person's culture and background because language and culture are inextricably intertwined.

Vocabulary should reflect a client's current needs and communication potential.

Operational competence has to do with how a person uses an AAC system. For example, a person might need to turn on an electronic AAC system by pressing a button or flipping a switch. Also in this area are procedures such as programming

BOX 13.1 | An Encounter with Jackie

Jackie is a 26-year-old woman with profound physical impairments secondary to CP, a diagnosis of intellectual disability, and profound speech challenges requiring the use of an electronic AAC system to communicate. My first encounter with Jackie occurred when I was walking down a hallway in a vocational day program for adults with developmental disabilities. Jackie was moving toward me in her electric wheelchair, which she controlled by touching any of four small round switches attached to the lap tray on her wheelchair. As she approached, I noticed some pictures taped to her lap tray. They depicted family and friends engaging in a range of social activities. Jackie's arms were straight and rigid, with her hands in fist-like positions. She stopped her wheelchair in front of me, and I noticed that her entire body was flexing and relaxing, causing her facial expressions to change severely as her body tension changed. Hanging off the side of her wheelchair was a metal apparatus which I assumed to be a device that allowed Jackie to use her head to point to objects or to control her electronic communication device. The device was made of lightweight flat metal bars covered with padding, shaped like a hat designed to fit Jackie's head. It also had a large piece of Velcro hanging from it, which looked like a strap for the pointer to be secured to Jackie's head. The apparatus had a large (approximately 24-inch) protruding piece of metal (about the width of a pencil) stemming from its front. As I would learn, when this device was attached to Jackie's head, it allowed her to touch buttons on her electronic communication device. Jackie made eye contact with me and vocalized. Her electronic communication device, a Liberator made by Prentke-Romich, was situated about 2 feet from her face, directly in front of her. It was attached via a metal arm bracket connected to the frame of her wheelchair.

It was obvious that Jackie wanted to tell me something. I asked her if I should place the pointing device on her head, and she responded with a loud vocalization and head movement to indicate "no"— or at least that was my interpretation of her behavior. I looked at her communication device and noticed that it was not turned on. After a series of fruitless interactions with me in which I attempted to guess what she wanted to say and I pointed to pictures of people on her lap tray, I noticed that Jackie was moving her eyes in a well-controlled up-and-down,

side-to-side, and sometimes circular motion. As I observed this behavior pattern, a staff member named Stan, who knew Jackie very well, approached. He said, "She's spelling with her eyes." Jackie smiled and vocalized, apparently confirming Stan's statement. I looked closely at her eye movements and noticed that she was, in fact, moving her eyes to "write" letters in space. After about a minute of "eye spelling" to Stan, he said to Jackie, "You missed the bus?" to which Jackie responded with a smile and a vocalization. Jackie had spelled the word *bus* with her eyes to indicate that she had missed the bus to go home. Interestingly, when Jackie used her eyes to spell words, she did so from her perspective, causing a communication partner to observe eye movements from the opposite perspective of Jackie's. In other words, from a communication partner's perspective, the shapes of letters were reversed as Jackie produced them. Imagine two people standing on either side of a window. One person uses a marker to write messages on the window. The person reading the message from the other side would see letters and words backward, making it extremely difficult to decipher messages.

Stan placed the head pointer on Jackie's head, secured the Velcro strip, and asked her what happened. Jackie assembled a message using her Liberator by touching several icons with her head pointer. Jackie's communication device produced the following message: "Eleanor [a staff person working with Jackie] says I'm sick." Stan responded saying, "Eleanor told the bus driver you were sick, so he left without you?" Jackie smiled and vocalized loudly to confirm Stan's interpretation of her comment.

Clearly, Stan's understanding of Jackie's idiosyncratic communication style (i.e., her use of eye spelling) facilitated their interaction. Stan and Jackie seemed to have a shared communication code as they interacted. That is, they both knew that Jackie's use of eye spelling, an undeniably literate behavior, was the conduit through which communication occurred.

After observing Jackie interact with Stan, I could not help but wonder about the way she learned this unique method of communication. I thought, if Jackie is considered to be a person with intellectual disability, how is it that she learned that she could use her eyes to spell words? I also wondered how Stan learned to interact so competently with Jackie and what I could do to interact competently with her.

Considering all the layers in the interaction described, it is easy to create a list of Jackie's cognitive-communicative strengths. For example, she (a) initiated interaction with an unfamiliar communication partner to solve a problem; (b) demonstrated the ability to solve communication breakdowns with a familiar communication partner and an unfamiliar communication partner; (c) made use of multiple modes of communication in her interaction (e.g., eye gaze, body movements, vocalizations, high-tech AAC system); (d) used her understanding of English orthography to spell single words with her eyes; and (e) used her AAC systems to accurately to convey messages across contexts to communication partners. There are easily 50 more of Jackie's strengths in this interaction.

new vocabulary, changing a recorded message, changing a voice setting on the system, and managing software issues.

Social competence relates to how well a person is able to manage the social aspects of communication, such as turn taking, topic maintenance, and using balanced and reciprocal interaction with a partner. Without doubt, a person's use of AAC invariably impacts the social-interactive dynamic between partners in an interaction. Think about how many times you have quickly and effortlessly used a glance, a wave, and one or two words to respond to a friend saying, "How are you?" or "What's up?" or "Yo!" For individuals using AAC, however, "quick" and "effortless" communication can be very difficult to achieve. In many cases, a person using AAC must use the very same communicative resources a person not using AAC uses to respond immediately (e.g., eye contact, hand movements, vocalizations) to access and use an AAC system to create a message. In other words, many of the natural social interactive routines that we all use for efficient and effective interaction with others are simply not available to many individuals with CCN who use AAC.

Strategic competence relates to a person's ability to solve problems. An individual who uses AAC may experience a range of communication breakdowns that require the use of a strategy to manage the breakdown. A strategy, in this context, is essentially a way to solve a communication problem. For example, a person who uses a mid- or high-tech AAC system might prepare an audible message to be played for unfamiliar communication partners to describe what they can do to help in moments of communication breakdown. Such a message might say, "Please be patient. I use an electronic device to talk, and it takes me a few minutes to say what I want to say. Thank you."

Thought Question

Specific Assessment Considerations

With the emphasis placed on understanding the interactive competencies a person and his or her partners possess, AAC assessments ideally include multi-contextual observations of an individual with CCN. Such observations, along with structured and/or appropriately chosen standardized assessments are used to provide a comprehensive evaluation. As mentioned, a client's current communication

skills are very important. The desire to communicate or to improve communication is often thought to be the basis for AAC intervention and the motivation for learning. Although individuals with severe disabilities have great difficulty making clear and intentional signals, they often create their own individualistic gestures (Chan & Iacono, 2001). The multimodal nature of AAC necessitates a systematic exploration of the roles these gestures and other forms play in communication (Johnston et al., 2004).

As you recall from Jackie's story, one of the roles of an SLP's is to determine the communication method, or methods, currently used by a client. This is often more difficult than it sounds because sometimes the manner in which an individual is communicating is not recognized as communication. For example, a young girl with severe disabilities was frequently observed tapping her cheek after coming in from the playground. It was not until an SLP began to look at that behavior more closely that people realized she was using that cheek tapping to indicate that she wanted a drink. Communication is often demonstrated when an individual engages in a consistent behavior (e.g., cheek tapping) in the same situations over time (e.g., after coming in from the playground). As an SLP, you should attempt to determine the current and future communication needs of a client.

An occupational and/or physical therapist can aid in motor assessment. Of interest are ambulation, or the ability to move about; fine-motor dexterity for signing or pointing; range of movement, especially of the upper limbs; motor imitation skills; and the consistency and accuracy of motor responses. Data in these areas are extremely important in determining the appropriate aided or unaided system and the placement and size of graphic symbols.

For children with good manual motor control, signing may offer a good means of communication.

Visual and auditory acuity and perception are important for system selection and intervention. Vision and motor skills are used to decide the size of graphic symbols. A vision specialist is an invaluable member of the team in assessing these abilities.

Occasionally, the environment will not support the use of AAC. Caregivers may be uncomfortable, feel inadequate, or just not want to be involved. An SLP may need to educate caregivers about the benefits of AAC to the client and to the home or school. Explaining the likely course of intervention may increase caregiver comfort levels.

Caregivers are part of an AAC intervention team.

Finally, an SLP is interested in collecting a list of client preferences and possible symbols to train. Likes and desires of the client are important for intervention. This information can be gathered from client responses or choices, from caregiver suggestions, or through observation of the client. This portion of the assessment can be very positive, with the focus on communication potential rather than on impairment. It is especially important for those with acquired communication disabilities, such as dysarthria, in which the focus tends to be on loss rather than potential (Insalaco et al., 2007). A positive shift is welcome.

The actual assessment is only a first step. An SLP, in coordination with a client's family members and other professionals, such as the occupational and physical therapists, audiologist, vision specialist, psychologist, rehabilitation engineer, and/or classroom teacher, uses the data from the assessment to make decisions on the appropriate AAC method, AAC symbol system, and potential vocabulary. These decisions will be adjusted and modified as the client progresses. A good fit increases the likelihood of success.

Click here to check your understanding of the concepts in this section.

AAC System Selection or Feature Matching

In deciding on an appropriate AAC system or method, an SLP considers a client's motor and cognitive abilities, the potential size of the client's vocabulary, the ease in learning and using the system, the acceptability of the system to the user and potential communication partners, and the flexibility and intelligibility of the system. For example, unaided systems are very portable and can be expanded easily without concern for limited storage or display space but allow for no permanent record, thus necessitating use of some graphic system for purposes such as doing homework. Many graphic symbols appear with the printed word, making them easy for communication partners to use, but these same symbols require the partner to concentrate on the graphic message, to the exclusion of the user's face.

The potential user's motor abilities are very important in determining the best system to use. Individuals with severe motor impairments in their upper extremities may be poor candidates for unaided systems. However, poor pointing skills need not deter an individual from using a communication board or a device and accessing it via head pointing or eye gaze, or with an assistive device like a T-stick that allows the individual to hold the pointer in both hands while the bottom leg of the "T" serves to point to the desired symbol or location. In addition, poor motor abilities may dictate the use of certain selection methods (e.g., scanning) to access an electronic communication device.

Everyday communication partners must also be able to provide input into the assessment process. In some cases this is to express a concern about the lack of portability in an AAC system or to report their embarrassment about using the AAC system with someone in a social setting. No matter what the challenge, communication partners play a critical role in assessment and intervention planning.

The selection of an AAC system includes the consideration of several features that might be suitable to a particular person. These include, but are not limited to, aesthetics of the system, overall size of the system, arrangement and size of the symbols, placement and organization of the symbols, and the output of the system.

AAC Symbol Selection

Decisions related to choosing an appropriate symbol system flow naturally from the method of communication chosen. If signing is deemed to be the appropriate method, an SLP must make decisions about the best gestural or sign system to use. In addition to the cognitive and motor abilities of the potential user, the SLP might consider the gestural or signing system used most frequently in the client's school or workplace and in the local community, the availability of teaching materials, and the ease in using these materials.

Selection of aided symbol systems may be guided by the potential user's cognitive abilities, the ease of learning different graphic AAC systems, and the willingness of potential communication partners. Aided symbols form a continuum from actual objects, which may represent only themselves, to letters that can be used to spell words. As we move from concrete objects to abstract symbols and letters, the client gains increased communication flexibility. Although not all clients can spell or use an encryption code, potential partners may be uneasy with

> AAC system selection is much more than merely matching a client and a system

interpretation of pictures, photographs, or other symbols. If we expect a client to use a system at home or in school, then these partner concerns must be considered when planning intervention.

AAC Vocabulary Selection

The vocabulary chosen for an AAC system will likely have a significant impact on future communication, language, and/or literacy development (Clendon & Erickson, 2008). Decisions about potential vocabulary will continue to be made as long as the client uses AAC. The best guideline is to select vocabulary that reflects the user's needs, desires, likes, and preferences and is functional or useful, based on observation of the client and the communication environment. The resultant vocabulary should be highly individualized.

Several lists of potential vocabulary are available and may serve as a guide when matched with a client's communication needs (see Dark & Balandin, 2007). These lists may also suggest various communication intentions and semantic categories of language that are important for early language development with presymbolic clients. Individuals with acquired speech and language impairments may have very different needs and rarely must relearn language.

The order of teaching signs or symbols must also be guided by a client's immediate needs. In addition, the iconicity and transparency of different signs/symbols must be considered. Selecting appropriate and useful vocabulary can make or break the success of an AAC system for an individual (Yorkston et al., 1990). The impact of vocabulary selection on AAC use cannot be underestimated.

Thought Question

INTERVENTION CONSIDERATIONS

Although intervention is a team effort, it is important for services not to become fragmented (Beukelman & Mirenda, 2013). Rather, a coherent, holistic approach is needed—one that includes the user's natural environment and communication partners. Family members, whether parents of a child with a developmental communication impairment or spouses and children of an adult with an acquired communication impairment, must be integral members of the intervention team.

As discussed previously, an SLP must be concerned with linguistic, operational, social, and strategic competence in an individual using AAC and his or her partner. It is not enough, however, for an individual with CCN to have assistive technology and the skills to operate it. A child needs to be able to communicate spontaneously in family interactions and in everyday settings (Granlund et al., 2008).

AAC users may have other needs that call for the use of additional assistive technologies.

Some important considerations for you as an SLP are as seemingly simple as the location of symbols on a communication board, whereas others involve the teaching of complex syntactic constructions. For example, both typically developing children and those with Down syndrome like drawings that share a color and are clustered together to create a subgroup, such as clothing or food, to facilitate both the speed and accuracy of locating the target symbol (Wilkinson et al., 2008).

Children with ID do not seem to induce English word order rules from the language spoken around them and apply these rules to their sign output (Grove & Dockrell, 2000; Morford et al., 2008). Occasionally, they change the form of the signs creatively, such as performing the sign for *hit* in the location where a blow

occurred, to indicate changes in meaning. In this way, signs are used more as gestures (Grove & Dockrell, 2000; Woll & Morgan, 2012).

Production of longer grammatical utterances is slow if users are forming them from single symbols. One option for increasing the rate of production is to prestore potential utterances in a device. The disadvantage of this approach is that the utterance may not fit a communication situation exactly. However, partners seem to prefer these less-than-precise but more quickly produced messages (McCoy et al., 2007).

Modeling is one method for teaching production of multisymbol messages (Binger & Light, 2007). With modeling, an SLP points to two symbols on a child's AAC device, such as *mommy* and *eat,* while providing a grammatically complete spoken model, such as "Mommy is eating." This teaching can be enhanced by the use of matrix strategies in which all actions needed are combinable with all objects and by milieu language teaching strategies (Nigam et al., 2006). In milieu teaching, an SLP might perform an action while asking, "What am I doing?" If a child fails to respond or responds incorrectly, the SLP models the correct response and then asks again. A sample matrix is presented in Figure 13.5.

Intervention must include both the short-range and long-range needs of a client (Beukelman & Mirenda, 2013). As users move beyond the school years, there is a need for easily accessible vocabulary that reflects socially valued adult roles, such as being a college student or engaging in intimate relationships (Nelson Bryen, 2008).

Although many of the good intervention practices described in Chapter 2 are equally important when working with individuals using AAC, other intervention considerations you will need to keep in mind apply more specifically to AAC (Cunningham et al., 2005; Erickson, 2003; Granlund et al., 2008; Koppenhaver, 2000; Schlosser, 2003). These include, but are not limited to, the following:

- Establishing a positive AAC culture
- Understanding AAC as being critical in literacy development, especially for children

Figure 13.5 Possible matrix format.

	Pencil	Book	Wagon	Car	Cocoa	Tea
Drop	Drop pencil	Drop book				
Pick up	Pick up pencil	Pick up book				
Push			Push wagon	Push car		
Pull			Pull wagon	Pull car		
Drink					Drink cocoa	Drink tea
Make					Make cocoa	Make tea

- Using everyday experiences as a teaching context
- Individualizing the content as discussed earlier
- Teaching partners to modify their interaction style
- Considering positioning for those with severe motor impairments
- Making communication based on meaningful interaction

Although individual client factors are important, two external factors that contribute to positive outcomes are community support and parent and family support (Lund & Light, 2007a). Such environmental support is very important. Abandonment of AAC technology usually is related to loss of facilitator/partner support rather than to rejection of the technology (Angelo, 2000; Louise-Bender et al., 2002).

Creating a positive AAC culture is very important and highlights the need to have others, such as caregivers and teachers, involved. An AAC system should be used by others, and aided systems should always be available for a user. We are reminded of one teacher who constructed a huge communication board on a wall of her classroom so that she could use it when addressing the entire class. Naturally, integration into the classroom requires a collaborative strategy involving both the classroom teacher and maybe you as an SLP. AAC training for the entire educational team—teachers, instructional aides, SLPs, and parents—is a key element in success with children (Soto et al., 2001).

Intervention will be maximally effective if caregivers also use AAC, along with speech. Caregivers can be taught a few simple signs, or they can learn to use an individual's communication board and point to a symbol while speaking their message. For individuals using an electronic device, caregivers can and should learn to use the device, and again, pair what they are saying with using the voice output of the device. This is referred to as *augmented input,* and it serves as a model for use of the communication device (Romski & Sevcik, 1996).

Caregivers are sometimes fearful that they will be expected to sign as if they are interpreting for a deaf audience. Nothing could be further from reality with most clients. Signs or graphic symbols can be used as gestures for important words in an utterance as the caregiver continues to speak.

One unintended consequence of AAC use by nonsymbolic children with profound multiple disabilities is that over time, a child becomes more and more dependent on one or two skilled interaction partners within the family. As a result, the child is less likely to interact with a range of partners within the family (Wilder & Granlund, 2006). This is especially true if a child learns to use an AAC mode, but family members do not develop sufficient skills in that mode (Thunstam, 2004). As much as possible, we want to plan intervention so that a client has multiple competent partners, in multiple situations to increase social integration, especially among peers. In one classroom, we trained partners to interact with AAC users and reinforced them when they did. Educators can also organize clubs and experiences, such as an integrated dramatic arts program, to promote AAC use (McCarthy & Light, 2001).

In short, as an SLP, you must identify opportunities for communication, create a need for communication, and maximize the instructional benefit of these opportunities (Sigafoos, 2000). Partners will need instructional support if they are to function as effective communication partners for AAC users.

One method that holds some promise for children with ASD is *aided language modeling (ALM),* which consists of engaging children in interactive play

activities and providing models of AAC symbol use during play (Drager, Postal, et al., 2006). ALM is implemented in a natural play context in which the child is provided models of use of the AAC symbols on a communication board.

Clients with acquired communication impairments may elect, if possible, to continue to work. Self-reports indicate that access to appropriate AAC systems is an important factor in facilitating continued employment (McNaughton et al., 2001). In addition, job-related social networks can be maintained by e-mail and the Internet (Nelson Bryen, 2006).

Everyday events and routines provide *scripts,* or personalized event sequences, that enable each of us to participate. When circumstances are modified, as in the use of AAC, we rely heavily on a script to help us. Use of a script frees "cognitive energy" to be applied to other aspects of the situation. In addition, the use of everyday events teaches a client to use AAC as the need arises. An SLP must use instructional strategies that integrate AAC into the different communication environments of a user (Ball et al., 2000; Rainforth et al., 1992). Even children using low-tech communication boards can have ample opportunities to use their AAC systems to communicate during the school day in greetings, academics, snack, sharing, and recess (Downey et al., 2004).

Acceptance of AAC is the degree to which a system is integrated into the life of a user (Lasker & Bedrosian, 2000). Optimal use occurs when AAC is used willingly and at every opportunity. Community-based training approaches in which the client becomes more comfortable and efficient using AAC in public may lead to optimal use (Lasker & Bedrosian, 2001). In these approaches, venues such as the post office, grocery store, and fast-food outlets are identified. Training begins with scripted interactions that are modified gradually to more spontaneous communication.

In some situations, well-meaning communication partners may assume too active a role in their interaction with an AAC user. In such cases, it is particularly important to include the partner in the assessment process, with the intent of identifying specific interactive competencies, choice-making routines, and environmental supports that can be used to facilitate the person's communicative success. Communication partners may learn or teach others how to interact with the individual using AAC in order to offer real choices, to acknowledge the user's communication attempts, and to allow time for the user to express his or her message.

Often because of the size, location, and other aspects of an AAC system, communication takes place at a very close distance, with the partner near or in the AAC user's personal space. Fortunately, there are a number of ways AAC intervention plans can address such issues. For example, a person could be involved in creating orientation materials for unfamiliar communication partners that describe what helps and what does not help facilitate meaningful communication. A person might engage in other self-advocacy efforts, such as making an orientation video, a book, or a presentation to share with others. The use of self-advocacy projects to help the person understand their strengths and weaknesses and to help others know how to interact successfully was originally described by Ylvisaker and Feeney (1998), in their work with individuals with traumatic brain injury (see also Feeney & Capo 2002).

Because communication partners may be unfamiliar with AAC, it is important that systems and their purpose be explained carefully and demonstrated (Cress, 2001). Partners should also be taught to use AAC expressively—not

because they need AAC to be understood but because they can help the user acclimate to this method of communication. Communication partners should be consulted for their observations, suggestions, and ideas for intervention. As members of the intervention team, they become invested in the outcomes for the client.

For clients with severe motor impairments, such as CP, positioning is very important and can often be the determining factor in successful motor movement. Control of the head, shoulders, spine, and hips and alignment along the midline are essential.

Finally, a user of AAC must be involved in real communication that is versatile and has meaningful outcomes. Otherwise, for individuals with progressive disorders such as ALS and Parkinson's disease, communication becomes solely a means of regulating the behavior of others for basic needs and wants (Fried-Oken et al., 2006). It is all too easy for intervention to evolve into drill in which the client touches objects or pictures with no real outcome except a reinforcing word by an SLP or another partner. Ideally, person-centered and context-sensitive interventions are employed to promote real communication choices, not just performance of a sign or locating a symbol. With meaningful communication, the grief and sense of loss that accompany acquired communication impairments and laryngectomy and glossectomy can be replaced by a sense of empowerment (Fox & Rau, 2001).

For more information related to AAC assessment, intervention, policies, and laws, please take a look at the resources in Table 13.1.

Evidence-Based Practice (EBP) in AAC

Schlosser and Raghavendra (2004) describe EBP as:

> the integration of best and current research evidence with clinical/educational expertise and relevant stakeholder perspectives to facilitate decisions for assessment and intervention that are deemed effective and efficient for a given stakeholder. (p. 3)

Each client seen by an SLP is unique, and those with AAC needs are especially so. This, plus the relatively small number of users seen by any one SLP, makes conducting clinical research especially difficult. As a result, many studies include only a single subject or a very small number of subjects, resulting in conclusions that cannot be generalized to most users. Table 13.2 provides a list of some current topics in AAC intervention in which integrated reviews are available.

While an exhaustive list of the outcomes stemming from evidence available in the field of AAC is beyond the scope of this chapter, consider the following:

- Little long-term research in AAC exists. Longitudinal studies are needed that focus on everyday communicative routines of children and adults who use AAC.
- Improved speech intelligibility coming from high-tech systems doesn't necessarily lead to a person's participation in social interactions. Therefore, in-context intervention designed to promote generalization and transfer must be considered.
- Scanning as an access option is especially difficult for young children. Direct selection is often easier to teach.

TABLE 13.1

Online resources related to AAC

Name of Resource and Website	Description
Closing the Gap (www.closingthegap.com)	Closing the Gap has an online, searchable version of its resource directory for computer-related products for people with special needs, including software and hardware. It also has an online archive of articles from *Closing the Gap Newsletter*.
Center for Literacy and Disability Studies (www.med.unc.edu)	The Center for Literacy and Disability Studies is a unit within the Department of Allied Health Sciences, School of Medicine, at the University of North Carolina at Chapel Hill. There are a vast number of resources on this website related to helping people with complex communication needs address communication, language, and literacy issues.
Center for Technology and Education (CTE) (http://cte.jhu.edu)	CTE hosts an interactive discussion board for members of the Maryland Assistive Technology Network (MATN). There is an online version of the Status Report, as well as an archive of some back issues.
The International Society for Augmentative and Alternative Communication (ISAAC) (www.isaac-online.com)	ISAAC provides excellent information about AAC, conferences, educational resources, evidence-based practice, and many other connections to people and groups involved in AAC around the world.
Rehabilitation Engineering Research Center (http://aac-rerc.psu.edu)	The AAC-RERC functions as a collaborative research group dedicated to the development of effective AAC technology. AAC refers to methods (other than speech) that are used to send a message from one person to another.
Quality Educators for Assistive Technology (QIAT) (www.qiat.org)	QIAT is "a nationwide collegial endeavor dedicated to the Development and Implementation of Quality Indicators for Assistive Technology Services in School Settings," managed by Joy Zabala. Check this site for excellent resources on quality indicators for assistive technology. Sign up for the QIAT listserv for quality information and discussion regarding assistive technology.
RESNA Technical Assistance (TA) project (www.resna.org/taproject/index.html)	This project provides information and consultation to assistive technology programs in states and territories funded under The Technology-Related Assistance for Individuals with Disabilities Act Amendments of 1994 (P.L. 103-218). Locate the AT program in your state and read articles related to legislation and assistive technology.
Resource on laws related to AAC/AT SpeciaLaw from EDLAW, Inc. (www.edlaw.net)	Full texts of statutes, regulations, and administrative interpretations.
AACIntervention.com (http://aacintervention.com)	This site is full of great tips and strategies for using AAC with children. Make sure to check out the Tips, Tricks, and Cheat Sheets as well as the Tip of the Month. Software setups and other products from Caroline Musselwhite and Julie Maro are available from this site.

TABLE 13.2

Evidence reviews in AAC

Focus of Review	Author(s)
AAC and people with developmental disabilities	Schlosser & Sigafoos, 2006; Sigafoos et al., 2003
Individuals with severe cognitive disabilities	Snell et al., 2006; Snell et al., 2010
Literacy, AAC, and individuals with physical and developmental disabilities	Machalicek et al., 2010
AAC and infants and toddlers with disabilities	Branson & Demchak, 2009
AAC and individuals with chronic severe aphasia	Koul & Corwin, 2003
Use of AAC with individuals on the autism spectrum	Osser et al., 2013

- For children with ASD or intellectual disabilities, AAC intervention does not impede speech production. Most studies report an increase in speech production, albeit rather modest in most cases. These results indicate that SLPs must help families and clients to have realistic expectations about speech gains.

- For children with ASD, the gains in overall communication from the use of sign are modest.

- Although many individuals who use AAC can comprehend and express a wide range of grammatical structures, they tend to produce shorter utterances when they use graphic symbol-based AAC systems.

- Few studies have investigated the effectiveness of AAC-specific aspects of intervention in a family context, making it difficult to draw any empirically based conclusions about the effectiveness of these interventions in family environments.

Source: Based on Beukelman & Mirenda (2013); Binger & Light (2007); Granlund et al. (2008); Lund & Light (2006, 2007a); Millar et al. (2006); Schlosser & Wendt (2008); Schwartz & Nye (2006); Snell et al. (2006).

Click here to check your understanding of the concepts in this section.

SUMMARY

Put simply, augmentative and alternative communication (AAC) includes anything that supplements an existing communication system. It takes many forms, is based on the interactive competence of a person and a partner, and includes the strategies and methods individuals use to meet their communication needs. AAC may enhance or augment an individual's speech, or it may become a person's primary means of communication.

Although the specific goals of AAC intervention vary with each individual user, treatment aims include the following:

- Assist individuals with their everyday communication needs.
- Help facilitate the development of speech, language, and literacy.
- Help facilitate the return of speech and language in cases where there is a temporary loss of speech.

Decisions related to the appropriate type of AAC for a specific person typically include a feature-matching process (Beukelman & Mirenda, 2013) that may need to be revised as the user's abilities or needs change. People using AAC may also employ multiple types of systems for successful communication that require others in their environment to learn about ways to facilitate maximum efficacy. Involvement of everyday communication partners in the assessment and intervention planning process cannot be overstated. An SLP, in coordination with a client's family members and other professionals, uses the data from an assessment to make decisions about the appropriate AAC method, AAC symbol system, and potential vocabulary.

In planning interventions to address both the short-range and long-range communication needs of a client, an SLP must be concerned with the linguistic, operational, social, and strategic competencies of a person using AAC and his or her partners.

SUGGESTED READINGS

Beukelman, D. R., & Mirenda, P. (2013). *Augmentative and alternative communication: Supporting children and adults with complex communication needs* (4th ed.). Baltimore: Paul H. Brookes.

Lloyd, L. L., Fuller, D. R., & Arvidson, H. H. (1997). *Augmentative and alternative communication: A handbook of principles and practices.* Boston: Allyn & Bacon.

Reichle, J., Halle, J. W., & Drasgow, E. (1998). Implementing augmentative communication systems. In A. Wetherby, S. Warren, & J. Reichle (Eds.), *Transitions in prelinguistic communication* (pp. 417–436). Baltimore: Brookes.

Professional Organizations

AMERICAN SPEECH-LANGUAGE-HEARING ASSOCIATION (ASHA)

ASHA is a nonprofit organization of speech-language pathologists, audiologists, and speech and hearing scientists that was founded in 1925. As of 2012, ASHA represents 155,000 speedh-language pathologists, audiologists, and speech scientists from throughout the United States and the world. It is the largest association for those concerned with communication disorders. ASHA's mission is to empower and support speech-language pathologists, audiologists, and speech, language, and hearing scientists by:

- Advocating on behalf of persons with communication and related disorders
- Advancing communication science
- Promoting effective human communication (ASHA, 2009c)

Scientific Study of the Processes and Disorders of Human Communication

ASHA encourages study of typical and disordered communication by mandating a curriculum of study for prospective speech-language pathologists and audiologists. In addition, ASHA provides financial grants to individuals who are engaged in research that furthers our knowledge of communication and assessment, treatment, and prevention of pathologies. ASHA works closely with governmental agencies that sponsor relevant scientific investigation.

To dispense knowledge among professionals, ASHA publishes several scholarly periodicals: *Journal of Speech, Language, and Hearing Research*; *Language, Speech, and Hearing Services in Schools*; *American Journal of Speech-Language Pathology: A Journal of Clinical Practice*; and *American Journal of Audiology: A Journal of Clinical Practice*. ASHA also holds an annual convention at which members and others share information and learn through scientific sessions, exhibits, seminars, and short courses. Additional institutes, workshops, conferences, and teleseminars are held throughout the year. ASHA fosters continuing education for professionals through these activities.

Clinical Service in Speech-Language Pathology and Audiology

Programs that provide clinical services to people with communicative disorders may be accredited by ASHA. This means that representatives of ASHA will review the procedures that are used in diagnosis and treatment. A site visit will ensure that equipment, materials, and record keeping adhere to the highest professional standards. Clinical service will be the responsibility of individuals who meet ASHA standards for the Certificates of Clinical Competence-Speech Language Pathologist (CCC-SLP) or Certificates of Clinical Competence-Audiologist (CCP-A).

Maintenance of Ethical Standards

To ensure that the highest moral and ethical principles are followed in the professions of speech-language pathology and audiology, ASHA provides a code of ethics, which is found on the ASHA website. The basic principles are as follows:

1. The welfare of the persons served by communication disorders specialists is paramount.

2. Each professional must achieve and maintain the highest level of professional competence. The ASHA Certificates of Clinical Competence (CCC) are considered the minimal achievement for independent professional practice. Clinicians should provide service only within their own areas of competence. Professional development and continuing education should be ongoing. New technology requires that speech-language pathologists and audiologists continually update their skills in order to safely and accurately address patient needs.

3. Professionals must promote understanding and provide accurate information in statements to the public.

4. Professionals are responsible for ensuring that ethical standards are maintained by themselves, colleagues, students, and members of allied professions. All members of ASHA are responsible for the monitoring and maintenance of ethical standards throughout the profession (ASHA, 2010).

Advocacy for Individuals with Communicative Disabilities

ASHA is active in encouraging members of Congress and state legislatures to pass legislation that provides for appropriate services for communication-impaired individuals. Bills such as the Individuals with Disabilities Education Act and the Americans with Disabilities Act became law in part because of the extensive promotional activities of ASHA and other organizations.

The needs and characteristics of people with speech, language, and hearing disabilities are clarified and publicized by ASHA on radio, on television, and through print media. In May, which is "Better Speech and Hearing Month," you are especially likely to hear public service announcements that advocate for understanding, prevention, and treatment of communication disorders.

RELATED PROFESSIONAL ASSOCIATIONS

Although ASHA is the largest organization for communication disorder professionals, other groups are also active and worthwhile. Some speech-language pathologists and audiologists belong to several associations. Table A.1 lists some of the ones that are most closely affiliated. Prospective speech-language pathologists and audiologists are advised to take courses in biology, psychology, and sociology to better understand their clients and to work more effectively with professionals from other disciplines.

TABLE A.1

Selected professional associations relevant to communication disorders

Academy of Dispensing Audiologists	American Auditory Society	National Hearing Conservation Association
Academy of Rehabilitative Audiology	American Speech-Language-Hearing Association	National Student Speech-Language-Hearing Association
American Academy of Audiology	Audiology Foundation of America	Orton Dyslexia Society
American Academy of Otolaryngology–Head and Neck Surgery	Canadian Association of Speech-Language Pathologists	Stuttering Foundation of America
	Council on Education of the Deaf	

Acoustic immittance The term used to refer to either the flow or opposition to the flow of energy through the middle.

Acquired Occurring after birth.

Acquired immunodeficiency syndrome (AIDS) A viral disease in which a person becomes susceptible to an assortment of other illnesses.

Acute laryngitis Temporary swelling of the vocal folds, resulting in a hoarse voice quality.

Addition In articulation, the insertion of a phoneme that is not part of the word.

Affricate A combination of a stop and fricative phoneme.

AIDS See *Acquired immunodeficiency syndrome.*

Air conduction A method of evaluating hearing by transmitting sound to the inner ear via the outer ear and middle ear.

Allophone A phonemic variation.

Alport's syndrome A hereditary disorder characterized by kidney disease and bilateral progressive sensorineural hearing loss.

Alveolar Related to the alveolar, or gum, ridge of the mouth. In speech, alveolar consonants are those produced with the tongue on the alveolar ridge.

Alveolar pressure Pressure inside the lungs.

Alzheimer's disease (AD) A cortical pathology that affects primarily memory, language, or visuospatial skills as a result of diffuse brain atrophy; presenile dementia.

American Sign Language (ASL) A complex nonvocal language that contains elaborate syntax and semantics. Proficiency in its use is one of the primary methods by which a deaf individual becomes part of the Deaf community.

Amplification Technology such as hearing aids, cochlear implants, and assistive listening devices that improve access to sounds by electronically increasing their intensity.

Amyotrophic lateral sclerosis (ALS) Commonly called Lou Gehrig's disease, a rapidly progressive degenerative disease in which an individual gradually loses control of his or her musculature. It is characterized by fatigue, muscle atrophy or loss of bulk, involuntary contractions, and reduced muscle tone. Speech in the later stages is labored and slow, with short phrasing, long pauses, hypernasality, and severely impaired articulation.

Anatomy The study of the structures of the body and the relationship of these structures to one another.

Aneurysm A type of hemorrhagic stroke that results from the rupture of a sac-like bulging in a weakened artery wall.

Anomic aphasia A fluent aphasia characterized by naming difficulties and mild to moderate auditory comprehension problems.

Aphasia An impairment due to localized brain injury that affects understanding, retrieving, and formulating meaningful and sequential elements of language.

Aplasia (or dysplasia) Hearing loss due to the absence of the inner ear structures during embryonic development.

Approximant Sometimes called a semivowel, an oral consonant that is produced with less constriction than the obstruents; includes glides and liquids.

Arteriovenous malformation A poorly formed tangle of arteries and veins that may result in a rare type of stroke in which arterial walls are weak and give way under pressure.

Articulation Rapid and coordinated movement of the tongue, teeth, lips, and palate to produce speech sounds.

Articulatory/resonating system Structures used during sound production, including the oral cavity, nasal cavity, tongue, and soft palate.

Aryepiglottic folds The membrane and muscle that connect the sides of the epiglottis to the arytenoid cartilages in the larynx.

Aspiration Inhalation, especially the inhalation of fluid or food into the lungs; in phonology, a puff of air that is released in the production of various allophones.

Assessment of communication disorders The systematic process of obtaining information from many sources, through various means, and in different settings to verify and specify communication strengths and weaknesses, identify possible causes, and make plans to address them.

Assistive listening devices (ALD) The general term applied to electronic devices designed to enhance the reception of sound by those whose hearing is impaired.

Ataxic cerebral palsy A congenital disorder characterized by uncoordinated movement and disturbed balance. Movements lack direction, and hypotonic muscles lack adequate force and rate and have poor directional control.

Ataxic dysarthria A motor speech disorder involving a combination of muscle weakness or reduced

tone or hypotonia and problems and muscle coordination. Little or no paralysis exists, and the problem involves the accuracy, timing, and direction of movement. Speech is characterized by excessive and equal stress and imprecise articulation, especially in repetitive movements.

Atresia A congenital disorder resulting in complete closure of the external auditory meatus.

Attention-deficit/hyperactivity disorder (ADHD) Hyperactivity and attentional difficulties in children who do not manifest other characteristics of learning disabilities.

Audible nasal emission Perception of nasal air flow during speech. Commonly occurs in individuals with cleft palate.

Audiologist A professional whose distinguishing role is to identify, assess, manage, and prevent disorders of hearing and balance.

Audiology Professional discipline involving the assessment, remediation and prevention of disorders of hearing and balance.

Audiometer A device used to regulate and deliver pure tone and speech stimuli during audiometric testing.

Auditory brain stem response (ABR) A type of electrophysiological test that records neural responses along the ascending auditory pathways occurring within the first 5 to 6 milliseconds following stimulus presentation.

Auditory evoked potentials (AEPs) Small neuroelectric responses to auditory stimulation by the ascending auditory pathways leading from the cochlea to the cortex of the brain.

Auditory neuropathy spectrum disorder (ANSD) Condition characterized by normal outer hair cell function with abnormal cranial nerve VIII function.

Auditory-oral A training method for hearing-impaired persons that emphasizes the use of residual hearing and speech reading (lipreading).

Auditory training Listening activities designed to maximize a hearing-impaired person's ability to detect, discriminate, identify, and comprehend auditory information.

Augmentative and alternative communication (AAC) Gestures, signing, picture systems, print, computerized communication, and voice production used to complement or supplement speech for persons with severe communication impairments.

Aural (audiological) habilitation/rehabilitation Services and procedures designed to improve communication deficits that result from hearing loss.

Authentic data Information about an individual that is based on real life.

Autism spectrum disorder (ASD) Term used to characterize individuals at the severe end of the pervasive developmental disorder (PDD) continuum. ASD is an impairment in reciprocal social interaction with a severely limited behavior, interest, and activity repertoire that has its onset before 30 months of age.

Automaticity The ease with which a person uses a particular skill without apparent thought.

Babbling Single-syllable nonpurposeful consonant–vowel (CV) or vowel–consonant (VC) vocalizations that begin at about 4 months of age.

Basal ganglia Large subcortical nuclei that regulate motor functioning and maintain posture and muscle tone.

Baseline data Information about client performance before intervention begins.

Basilar membrane The membrane that forms the floor of the organ of Corti. It is nonuniform in width, thickness, and stiffness, and it responds differently to different frequencies of sound (tonotopically). The basilar membrane contains thousands of hair cells, the receptor cells for the auditory system.

Behavior modification A systematic method of changing behavior through careful target selection, stimulation, client response, and reinforcement.

Behavioral observation audiometry (BOA) A method of assessing infant hearing by presentation of different stimuli and watching for any changes in activity that signals a response.

Bilabial Pertaining to two lips, as phonemes produced with both lips.

Blend Create a word from individual sounds and syllables.

Bolus A chewed lump of food ready for swallowing. Or, the substance to be ingested when eating or drinking.

Bone-anchored hearing aid A type of amplification in which some of the components are surgically implanted into the temporal bone of the skull, stimulating the cochlea via bone conduction.

Bone conduction A method of evaluating hearing by transmitting sound to the inner ear by mechanically vibrating the bones of the skull.

Booster treatment Additional therapy, based on retesting, offered after treatment has been terminated.

Bound morpheme A morpheme that must be attached to a free morpheme to communicate meaning; grammatical morpheme.

Breathiness Perception of audible air escaping through the glottis during phonation.

Broca's aphasia A nonfluent aphasia that is characterized by short sentences with agrammatism; anomia; problems with imitation of speech because of overall speech problems; slow, labored speech and writing; and articulation and phonological errors.

Broca's area Located in the left frontal are of the brain and responsible for working memory and enabling the motor cortex for speech.

(Central) Auditory processing disorder (C)APD A disorder resulting from impairment to the auditory structures leading from the brain stem to the cortex of the brain.

Central auditory system Part of the auditory system that includes structures beyond the auditory nerve and extending to the auditory cortex.

Central nervous system (CNS) The brain and spinal cord.

Cerebellum A lower brain structure consisting of two hemispheres that smoothly regulates and coordinates the control of purposeful movement, including very complex and fine-motor activities. The cerebellum revises the transmission from the cortex's motor strip to produce accurate, precise movements. It is also important for motor skill learning.

Cerebral arteriosclerosis A type of ischemic stroke resulting from a thickening of the walls of cerebral arteries in which elasticity is lost or reduced, the walls become weakened, and blood flow is restricted.

Cerebral palsy (CP) A heterogeneous group of neurogenic disorders that result in difficulty with motor movement; were acquired before, during, or shortly after birth; and affect one or more limbs.

Cerebrovascular accident (CVA) Stroke, the most common cause of aphasia, results when the blood supply to the brain is blocked or when the brain is flooded with blood.

Cerumen (or earwax) A substance produced by glands in the ear canal that provides lubrication and protects the ear from the invasion of insects and other foreign objects.

Chin tuck A posture with the chin down that is helpful with some patients who have a swallowing disability.

Chorea A form of hyperkinetic dysarthria characterized by rapid or continual, random, irregular, and or abrupt hyperkinesia. Speech, when affected, may be characterized by inappropriate silences caused by voice stoppage; intermittent breathiness, strained harsh voice, and hypernasality; imprecise articulation with prolonged pauses; and forced inspiration and expiration resulting in excessive loudness variations.

Chronemics The study of the effect of time on communication.

Chronic laryngitis Vocal abuse during acute laryngitis that leads to vocal fold tissue damage.

Closed syllable A syllable, or basic acoustic unit of speech, that ends in one or more consonants.

Cluttering Disfluent speech that is characterized by overuse of fillers and circumlocutions associated with word-finding difficulties, rapid speech, and word and phrase repetitions. Cluttering does not seem to contain the fear of words or situations found in stuttering.

Cochlea The portion of the inner ear that contains the sensory cells of the auditory system. It is composed of two concentric labyrinths. The outer one is composed of bone and the inner one of membrane.

Cochlear implant An electronic amplification device that is surgically placed in the cochlea and provides electrical stimulation to the surviving auditory nerve fibers.

Code switching The process in which bilingual speakers transfer between two languages, based on the listener, context, or topic.

Cognitive rehabilitation A treatment regimen for individuals with traumatic brain injury that is designed to increase functional abilities for everyday life by improving the capacity to process incoming information.

Communication An exchange of ideas between sender(s) and receivers(s).

Communication disorder An impairment in the ability to receive, send, process, or comprehend concepts of verbal, nonverbal, or graphic symbol systems.

Compression Part of the sound wave where the displaced molecules are in close proximity to each other.

Concha The deep bowl-like depression on the pinna.

Conditioned play audiometry (CPA) A method of assessing the hearing of children ages 2½ to 3 years and older by instructing them to put a block in a bucket, place a ring on a peg, or carry out another action whenever they hear the test signal.

Conduction aphasia A fluent aphasia in which the individual's conversation is abundant and quick. Characterized by anomia, auditory comprehension that is impaired mildly if at all, extremely poor repetitive or imitative speech, and paraphasia.

Conductive hearing loss A loss of auditory sensitivity due to malformation or obstruction of the outer ear and/or middle ear.

Conductive system Part of the auditory system made up of the outer and middle ears.

Congenital Present at birth.

Congenital laryngeal webbing Extraneous tissue on the anterior aspects of the vocal folds that can interfere with breathing and is present at birth.

Consistent aphonia Persistent absence of voice.

Consonant A phoneme that is produced with some vocal tract constriction or occlusion.

Contact ulcer A benign lesion that may develop on the posterior surface of the vocal folds.

Conversion aphonia Psychologically based loss of voice.

Conversion disorder A condition in which emotion is suppressed and transformed into a sensory or motor disability.

Correlate Something that tends to exist in the presence of something else or be associated with it, but without a demonstrated causal relationship.

Cranial nerves The 12 pairs of nerves in the peripheral nervous system that innervate the muscles of speech production, as well as mediate the sensations of vision, hearing, balance, smell, and touch from the face.

Craniofacial anomalies Congenital malformations involving the head (*cranio* = above the upper eyelid) and face (*facial* = below the upper eyelid).

Critical literacy A reader's ability to actively interpret between the lines, analyze, and synthesize information and to able to explain content.

Criterion referenced An evaluation of an individual's strengths and weaknesses with regard to specific skills.

Deaf Term used to describe a person whose hearing loss is in the severe to profound range.

Deaf community A group of persons who share a common means of communication (American Sign Language) that facilitates group cohesion and identity.

Deaf culture A view of life manifested by the mores, beliefs, artistic expression, understandings, and language (ASL) that is particular to members of the Deaf community.

Decibel (dB) A mathematically derived unit based on the pressure exerted by a particular sound vibration.

Decoding Breaking or segmenting a written word into its component sounds and then blending them together to form a recognizable word.

Decontextualized Outside a conversational context. When we write, we construct the context with our writing rather than having it constructed by our conversational partner(s).

Dementia An acquired pathological condition or syndrome that is characterized by intellectual decline, especially memory, due to neurogenic causes. Additional deficits include poor reasoning or judgment, impaired abstract thinking, inability to attend to relevant information, impaired communication, and personality changes.

Developmental disfluency Whole-word repetitions and other self-conscious nonfluency that is apparent in many young children.

Diagnosis A statement distinguishing an individual's difficulties from the broad range of possibilities.

Diagnostic therapy Ongoing assessment and evaluation as intervention takes place.

Dialect A linguistic variation that is attributable primarily to geographic region or foreign language background. It includes features of form, content, and use.

Dialogic reading Picture book interactive sharing between a caregiver and a young child, in which parents try to get children involved in the reading process by asking them questions about the story or allowing a child to tell the story.

Dichotic The simultaneous presentation of different stimuli to each ear.

Diphthong Two vowels said in such close proximity that they are treated as a single phoneme.

Diplophonia The perception of two vocal frequencies.

Disability The functional consequence of an impairment.

Distinctive features The attributes of phonemes that differentiate one from another on the basis of a binary principle.

Distortion In articulation, a deviant production of a phoneme.

Double swallow A technique in which the patient swallows more than once per bolus.

Dynamic Characterized by energy or effective energy, changing over time.

Dynamic assessment A nonstandardized assessment approach that can take the form of test–teach–test to determine a child's ability to learn.

Dynamic literacy A reader's ability to interrelate content to other knowledge through both deductive and inductive reasoning.

Dysarthria One of several motor speech disorders that involve impaired articulation, respiration, phonation, or prosody as a result of paralysis, muscle weakness, or poor coordination. Motor function may be excessively slow or rapid, decreased in range or strength, and have poor directionality and timing.

Dysphagia A disorder of swallowing.

Dysplasia See *aplasia*.

Dystonia A form of hyperkinetic dysarthria that is characterized by a slow, sustained increase and decrease of hyperkinesia involving either the entire body or localized sets of muscles. As a result, there are excessive pitch and loudness variations, irregular articulation breakdowns, and vowel distortions.

Ear, nose, and throat physician (ENT) Medical doctor specializing in diagnosis and treatment of diseases of the ear, nose, and throat.

Early hearing detection and intervention (EHDI) programs Public health initiative designed to facilitate early detection of hearing loss through universal hearing screening, followed by appropriate referral for diagnostic testing and early intervention as necessary.

Eardrum See *Tympanic membrane*.

Echolalia An immediate imitation of another speaker. Among children with ASD, it may represent the storage and production of unanalyzed whole units of language.

Edema Swelling due to an accumulation of fluid.

Effectiveness The probability of benefit to individuals in a defined population from a specific intervention applied to a given communication problem under *average everyday* clinical conditions.

Efficacy The probability of benefit to individuals in a defined population from a specific intervention applied for a given communication problem under *ideal* conditions.

Efficiency Application of the quickest intervention method involving the least effort and the greatest positive benefit, including unintended effects.

Electroacoustic measures Tools that record acoustic signals from within the client's external auditory canal.

Electrolarynx A battery-powered device that sets air in the vocal tract into vibration.

Electropalatography (EPG) A technique used to teach correct placement of the articulators for speech production. It uses an artificial palatal plate fitted in the client's mouth that contains electrodes. The electrodes are connected to a computer. When the tongue contacts the electrodes during speech production, the articulatory patterns can be viewed on a computer screen.

Electrophysiological tests Tools that record neuro-electric responses (nerve impulses) that are generated by the auditory system in response to sound.

Embolism A blood clot, fatty materials, or an air bubble that may travel through the circulatory system until it blocks the flow of blood in a small artery. If it travels to the brain, it may cause a stroke.

Endolymph The fluid that fills the membranous labyrinth of the cochlea and vestibular system.

Endoscope A lens coupled with a light source that is used for viewing internal bodily structures, including the vocal folds.

Episodic aphonia Uncontrolled and unpredictable occasional loss of voice.

Esophageal atresia The absence of a normal open passageway from the esophagus to the stomach.

Esophageal speech Speech that is produced by using burping as a substitute for the laryngeal voice.

Esophagostomy A surgical hole in the esophagus through which a feeding tube may be inserted.

Etiology The cause or origin of a problem; also the study of cause.

Eustachian tube The tube that connects the middle ear cavity with the nasopharynx.

Eustachian tube dysfunction Condition in which the Eustachian tube does not adequately equalize middle ear pressure; commonly results in pathology of the middle ear.

Examination of the peripheral speech mechanism Sometimes called oral peripheral exam, assessment of the structure and function of the visible speech system.

Executive function An aspect of metacognition used in self-regulation and including the ability to attend; to set reasonable goals; to plan and organize to achieve each goal; to initiate, monitor, and evaluate your performance in relation to that goal; and to revise plans and strategies based on feedback.

Explicit Clearly defined.

External auditory meatus (or **canal)** The tubular structure that extends from the concha of the pinna to the tympanic membrane.

External error sound discrimination Perception of differences in the production of the target phoneme in another person's speech. Also known as interpersonal error sound discrimination.

Extrapyramidal tract Motor tract fibers involved in unconscious modulation of motor movements, and the regulation of reflexes, posture, and tone; also known as the indirect activation pathway or indirect motor system.

Failure to thrive The absence of healthy growth and development.

Fasciculations Involuntary localized twitches due to spontaneous motor unit discharges seen in denervated muscle.

Fast mapping A process in which a child infers the meaning of a word form context and uses it in a similar context at a later time. A fuller definition evolves over time. Fast mapping enables preschool children to expand their vocabularies quickly by being able to use a word without fully understanding the meaning.

Fetal alcohol syndrome (FAS) Overuse of alcohol during pregnancy that severely impairs the neurological and physical development of the fetus, resulting in growth deficiencies, craniofacial disorders, central nervous system dysfunction, limited cognitive development, and, in some cases, sensorineural hearing loss.

Fiber-optic endoscopic evaluation of swallowing (FEES) A laryngoscopic technique for viewing swallowing.

Figurative language Nonliteral phrases consisting of idioms, metaphors, similes, and proverbs.

Filler Utterances such as "er," "um," and "you know" that are used in productions. Sometimes characteristic of disfluent speech and/or stuttering.

Fingerspelling A form of manual communication consisting of 26 distinct handshapes that visually represent the letters of the English alphabet.

Flaccid dysarthria A speech disorder caused by weak, soft, flabby muscle tone, called hypotonia. May result in hypernasality, breathiness, and imprecise articulation.

Fluency Smoothness of rhythm and rate.

Fluent aphasia Speech characterized by word substitutions, neologisms, and often verbose verbal output. Also called Wernicke's aphasia.

FM system A type of hearing assistive technology that transmits sound to a hearing-impaired person via FM radio waves. The system consists of a microphone, a transmitter, and a wireless receiver.

Free morpheme The portion of a word that can stand alone and designate meaning; root morpheme.

Frequency An acoustical term that refers to the number of sound wave cycles that are completed within a specific time period. Subjectively, it is perceived as the pitch of a sound.

Fricative A consonant phoneme that is produced by exhaling air through a narrow passageway.

Fundamental frequency The lowest-frequency component of a complex vibration.

Gastroesophageal reflux (GER) Movement of food or acid from the stomach back into the esophagus.

Generative Capable of being freshly created; refers to the infinite number of sentences that can be created through the application of grammatical rules.

Glide A phoneme in which the articulatory posture changes from consonant to vowel.

Global, or mixed, aphasia A profound language impairment in all modalities as a result of brain damage.

Glottal Relating to or produced in or by the glottis, the space between the vocal cords.

Grammar The rules of a language.

Granuloma A nodular lesion due to injury or infection. May occur on the vocal folds and may be caused by a breathing tube being placed through the glottis.

Habitual pitch The basic frequency level that an individual uses most of the time.

Hair cells Auditory receptor cells located in the organ of Corti that are responsible for encoding auditory information.

Handicap The psychosocial consequence of a disability.

Hard glottal attacks Abrupt initiation of voicing using hypertensive vocal fold adduction.

Harmonics Frequencies in a complex sound that are integer multiples of the fundamental frequency.

Head-back position A posture with the head held back that is useful for some clients with swallowing disability.

Head rotation A posture with the head turned toward the impairment, used for some clients with a swallowing disability.

Head tilt A posture with the head away from the impairment, used for some individuals with a swallowing disability.

Hematoma Blood trapped in an organ or skin tissue due to injury or surgery.

Hemianopsia Blindness in the left or right visual field of both eyes caused by lesions on the temporal or lower parietal lobe.

Hemiparesis Muscle weakness on one side of the body, resulting in reduced strength and control.

Hemiplegia Paralysis on one side of the body.

Hemisensory impairment Loss of the ability to perceive sensory information on one side of the body.

Hemorrhagic stroke A type of stroke resulting from the weakening of arterial walls that burst under pressure.

Hertz (Hz) The number of complete vibrations or cycles per second.

Hesitation A pause before or between parts of utterances. If used excessively, it may be considered a sign of disfluency or stuttering.

HIV/AIDS See *Human immunodeficiency virus* and *Acquired Immunodeficiency Syndrome*.

Hoarseness A voice quality that is characterized by a rough, usually low-pitched quality.

Holistic Pertaining to the whole; multidimensional.

Human immunodeficiency virus (HIV) The organism responsible for AIDS.

Huntington's chorea An inherited progressive disease also known as Huntington's disease, that results from a genetic defect on chromosome 4.

Hyperadduction Excessive movement toward the midline, often resulting in a tense voice quality.

Hyperfluent speech Very rapid speech found in people with fluent aphasia and characterized by few pauses, incoherence, inefficiency, and pragmatic inappropriateness.

Hyperkinetic dysarthria A speech disorder characterized by increased movement, such as tremors and tics, and by inaccurate articulation.

Hyperlexia A mild form of pervasive developmental disorder (PDD) characterized by an inordinate interest in letters and words and by early ability to read but with little comprehension.

Hypernasality Excessive nasal resonance.

Hypoadduction Reduced movement toward the midline of the vocal folds, often resulting in a breathy voice quality.

Hypokinesia Abnormally decreased motor function or activity.

Hypokinetic dysarthria A speech disorder that is characterized by a decrease or lack of appropriate movement as muscles become rigid and stiff, resulting in monopitch and monoloudness and imprecise articulation.

Impairment A loss of structure or function.

Implicit Assumed but not directly expressed.

Inappropriate pitch Pitch judged to be outside the normal range for age and/or sex.

Incidental teaching Use of a natural activity to train targets.

Incus The middle bone of the ossicular chain in the middle ear. It articulates with the malleus at the top and has a projection that is joined to the stapes at the bottom.

Infarction Death of bodily tissue due to deprivation of the blood supply.

Informational counseling The process of imparting information to clients and their families.

Inner ear The interior section of the ear, which contain the cochlea and vestibular system. It supplies

information to the brain regarding balance, spatial orientation, and hearing.

Intellectual disability Substantial limitations in intellectual functioning; significant limitations in adaptive behavior consisting of conceptual, social, and practical skills; and originating before age 18.

Intelligibility The ability to understand what has been detected auditorially.

Intensity A measure of the magnitude of a sound, generally expressed in decibels.

Intentionality Goal directedness in interactions, which is first demonstrated at about 8 months of age, primarily through gestures.

Interdental Between the teeth; see *Linguadental*.

Internal error sound discrimination Ability to judge the accuracy of one's own phoneme production. Also known as intrapersonal error sound discrimination.

Interpersonal error sound discrimination See *External error sound discrimination*.

Intonation Pitch movement within an utterance.

Intrapersonal error sound discrimination See *Internal error sound discrimination*.

Ischemic stroke A cerebrovascular accident resulting from a complete or partial blockage or occlusion of the arteries transporting blood to the brain.

Kinesics The study of bodily movement and gesture. Also known as body language.

Labiodental Pertaining to lips and teeth; phonemes produced with lip and tooth contact.

Language A socially shared code for representing concepts through the use of arbitrary symbols and rule-governed combinations of those symbols.

Language impairment (LI) A heterogeneous group of deficits and/or immaturities in the comprehension and/or production of spoken or written language.

Language sample A systematic collection and analysis of a person's speech or writing. Sometimes called a corpus; used as a part of language assessment.

Laryngeal cancer Carcinoma of supraglottal, glottal, or subglottal structures.

Laryngeal papilloma A wartlike growth on the vocal folds.

Laryngeal system Structures of the larynx used for sound production.

Larynx The superior termination of the trachea that protects the lower airways and is the primary sound source for speech production.

Lexicon An individual's personal dictionary of words and meanings.

Linguadental Pertaining to tongue and teeth; phonemes produced with tongue and tooth contact.

Linguistic intuition A language user's underlying knowledge about the system of rules pertaining to his or her native language; linguistic competence.

Liquid Refers to the oral resonant consonants /r/ and /l/.

Literacy Use of visual modes of communication, specifically reading and writing.

Localization The process of determining where sound originates in space.

Loudness variation Speaking too loudly or too softly for a particular vocal situation.

Lungs A pair of air-filled elastic sacs that change in size and shape and allow us to breathe.

Maintaining cause The perpetuating cause that keeps a problem from self-correcting; for example, parents of an 8-year-old considering a lisp "cute."

Malleus The largest of the ossicles. It is fastened to the eardrum and articulates with the incus, the next bone in the chain.

Manually coded English (MCE) Sign communication systems designed to duplicate spoken English manually for teaching children who are deaf.

Maternal rubella German measles contracted during pregnancy that may result in various disorders in the developing fetus.

Maximal contrast A minimal pair in which the differing phonemes differ in more than one distinctive feature, such as *say* (/se/) and *bay* (/be/).

Mean length of utterance (MLU) The average length of utterances, measured in morphemes. In English, this is an important measure of preschool development because language becomes more complex as it becomes longer.

Meniere's disease A condition resulting from excessive endolymph in the inner ear, involving vertigo, tinnitus, aural fullness, and sensorineural hearing loss.

Meningitis An inflammation of the meninges, or layers of tissue covering the brain and spinal cord.

Metacognition Knowledge about knowledge and cognitive processes, including self-appraisal.

Metalinguistic skills Abilities that enable a child to consider language in the abstract, to make judgments about its correctness, and to create verbal contexts, such as in writing.

Metaphon approach An approach to phonological therapy that is based on the premise that phonological disorders in children are developmental language learning disorders.

Metaphonological skills The ability to analyze, think about, and manipulate speech sounds.

Microtia A congenital disorder that results in a small malformed pinna or ear canal.

Middle ear The section of the ear containing the ossicles. It is bounded laterally by the tympanic membrane and medially by the cochlea.

Middle ear space (or tympanic cavity) The cube-shaped area between the outer and middle ear that contains the ossicles.

Minimal pair Two words that differ in a single phoneme, such as *say* (/se/) and *bay* (/be/).

Mixed hearing loss The simultaneous presence of conductive and sensorineural hearing loss.

Modified barium swallow study An X-ray procedure that is used to visualize the swallowing process. Also known as videofluoroscopy.

Monoloudness A voice lacking normal variations of intensity that occur during speech.

Monopitch A voice that lacks normal inflection in tone.

Monotone A voice that is produced without varying the fundamental frequency.

Morpheme The smallest meaningful unit of language.

Morphology An aspect of language concerned with rules governing change in meaning at the intraword level.

Morphophonemic contrast Change in pronunciation as a result of morphological changes.

Motor cortex Located in the posterior portion of the frontal lobe of the brain and responsible for signaling the muscles of motor movement.

Mucosal tissue Pinkish tissue that lines the inside of the mouth.

Multiple oppositions approach A phonologically based therapy approach that targets multiple sound errors at one time, using phoneme word pairs that are maximally contrasted (i.e., differ according to place, manner, and voicing).

Multiple sclerosis (MS) A progressive disease characterized by demyelinization of nerve fibers of the brain and spinal cord.

Multiview videofluoroscopy Motion picture X-rays recorded from various angles.

Myelination Development of a protective myelin sheath or sleeve around the cranial nerves.

Myringotomy A small surgical incision made in the surface of the tympanic membrane.

Nasal A phoneme that is produced with nasal resonance.

Nasalance score A numerical score that reflects the magnitude of hypernasality measured by a nasometer.

Nasogastric tube (NG tube) A tube placed into the nose and then through the pharynx and esophagus by which liquefied food may be fed.

Nasometer A commercially available device that is used to measure nasality.

Nasopharynx The space within the skull that is behind the nose and above the roof of the mouth.

Neural plasticity Physiological and functional changes within the central nervous system in response to auditory stimulation.

Neurogenic stuttering A disorder of fluency associated with some form of brain damage.

Neuron The basic unit of the central nervous system, consisting of the cell body, axon, and dendrites.

Noise-induced hearing loss Hearing impairment that results from exposure to high levels of occupational or recreational noise.

Nonfluent aphasia Characterized by slow, labored speech and struggle to retrieve words and form sentences

Nonvocal Without voice.

Norm referenced A comparison that is usually based on others of the same gender and similar age.

Obstruent In articulation, refers to speech sounds that are produced with a significant amount of constriction in the vocal tract (stops, fricatives, affricates); also called nonresonant phonemes.

Omission In articulation, the absence of a phoneme that has not been produced or replaced.

Open syllable A syllable, or basic acoustic unit of speech, that ends in a vowel.

Organ of Corti The intricate structure that runs along the center of the membranous labyrinth of the cochlea and contains the auditory sensory receptor cells.

Ossicles (or ossicular chain) The small bones—the malleus, the incus, and the stapes—housed within the middle ear.

Otitis media Inflammation of the middle ear.

Otitis media with effusion (OME) Inflammation of the middle ear with fluid.

Otoacoustic emissions (OAEs) Measurable low-level sounds or echoes that occur either spontaneously or in response to acoustic stimulation, due to outer hair cell motility within the cochlea.

Otosclerosis A disorder characterized by the formation of spongy bone in the region of the stapes footplate, resulting in a progressive conductive hearing loss.

Otoscope A small handheld device used to visually inspect the external auditory canal and tympanic membrane.

Otoscopic examinations Visual examination of the ear canal and eardrum using an otoscope.

Ototoxic Refers to drugs and chemical agents that are potentially damaging to the inner ear.

Outer ear The section of the ear comprised of the pinna and the external auditory meatus, or ear canal.

Oval window A small oval membrane located on the lateral wall of the cochlea, behind the stapes footplate.

Palatal Refers to the front area of the roof of the mouth. In speech, palatal consonants are produced with the tongue touching or approximating the hard palate.

Palatal lift A prosthetic device for a weak or immobile soft palate.

Palatal obturator A plate that covers a portion of the soft palate. It is useful for individuals who have had palatal surgery.

Parkinson's disease A progressive neurogenic disorder that is characterized by resting tremors, slowness of

movement, and difficulty initiating voluntary movements. Speech may be rapid, breathy, and reduced in loudness, pitch range, and stress.

Pedunculated polyp A polyp that appears to be attached to the vocal fold by a stalk.

Perilymph The fluid that fills the bony labyrinth of the cochlea and vestibular system.

Peripheral auditory system Part of the auditory system that includes the outer, middle and inner ears as well as cranial never VIII (the auditory nerve).

Peripheral nervous system (PNS) The cranial and spinal nerves that receive and transmit information from the brain to the body.

Perpetuating cause See *Maintaining cause*.

Permanent threshold shift (PTS) A permanent change in hearing acuity associated with exposure to high-intensity noise.

Personal adjustment counseling The process of assisting clients and their families in dealing with the emotional consequences of hearing loss.

Personal hearing aid A personal amplification device ranging from tiny completely-in-the-canal models to those worn behind the ear.

Pharyngostomy A surgical hole in the pharynx through which a feeding tube may be placed.

Phonation Production of sound by vocal fold vibration.

Phonemic awareness Ability to manipulate sounds, such as blending sounds to create new words or segmenting words into sounds.

Phonetically consistent forms (PCFs) Consistent vocal patterns that function as meaningful "words" for an infant. PCFs are a transition to words.

Phonics Sound–letter or phoneme–grapheme correspondence.

Phonological awareness (PA) Knowledge of sounds and syllables and of the sound structure of words.

Phonology The study of the sound systems of language.

Phonotactic The study of the way in which phonemes are combined and arranged in syllables and words of a particular language or dialect.

Physiology The branch of biology that is concerned with the process and function of parts of the body.

Pidgin Signed English (PSE) A sign system that incorporates ASL signs while maintaining English word order.

Pierre Robin syndrome A congenital condition resulting in a small mandible, cleft lip, cleft palate, and other facial abnormalities.

Pinna The funnel-shaped outermost part of the ear that collects sound waves and channels them into the ear canal.

Pitch The perceptual counterpart to fundamental frequency associated with the speed of vocal fold vibration.

Pitch breaks Sudden uncontrolled upward or downward changes in pitch.

Postlingually After the development of speech and language.

Posttherapy testing Assessment following intervention.

Pragmatics The use, function, or purpose of communication; the study of communicative acts and contexts.

Precipitating cause Factors that trigger a disorder (e.g., a stroke).

Predisposing cause Underlying factors that contribute to a problem (e.g., a genetic basis).

Prelingually Prior to the development of speech and language.

Presbycusis Hearing loss incurred as a result of the aging process.

Pressure equalization (PE) tube (or tympanostomy tube) A small-diameter tube that is surgically placed in the eardrum to provide ventilation of the middle ear space via the external auditory meatus.

Prevalence The total number of cases of a disorder at a particular point in time in a designated population.

Primary motor cortex A 2-centimeter-wide gyrus immediately in front of the central sulcus of the brain that controls voluntary motor movements.

Primary progressive aphasia A degenerative disorder of language in which other mental functions and activities of daily living are preserved. There is no marked dementia or loss of cognitive functioning.

Print awareness Knowledge of the meaning and function of print, including recognition of words and letters and terminology, such as letter, word, or sentence.

Prognosis An informed prediction of the outcome of a disorder.

Prolongation In fluency analysis, the process of holding a phoneme longer than is typical; for example, "sssssso."

Prolonged speech A group of speech rate reduction techniques (e.g., prolonged, continuous phonation; gentle voicing onsets; light articulatory contacts) used to treat stuttering and establish stutter-free speech.

Proxemics The study of physical distance between people.

Psychogenic Caused by psychological factors.

Pure tone audiometry A procedure that is used to assess hearing sensitivity at discrete frequencies.

Pure tones Sounds that contain energy at only a single frequency, such as 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, and 8000 Hz, and are used in pure tone audiometry.

Purulent (or suppurative) otitis media Pus formation and discharge by the tissue of the middle ear cavity.

Pyloric stenosis A narrowing of the sphincter connecting the stomach to the small intestine, resulting in a blockage to the intestines.

Pyramidal tract Descending motor fibers that arise from motor cortex and mediate rapid, discrete, skilled volitional movement; also known as the direct activation pathway or direct motor system.

Range of motion The extent of movement of a joint from maximum extension to maximum flexion.

Rarefaction Part of the sound wave where the displace molecules are far from each other.

Rate The speed at which something occurs. In speech this may be the number of words or syllables in a given period of time.

Recurrent branch The branch of the 10th cranial nerve that innervates muscles of the larynx.

Reduplicated babbling Long strings of consonant–vowel syllable repetitions, such as "ma-ma-ma-ma-ma."

Reformulation An adult response to a child's utterance in which the adult adds to the child's utterance to provide a more complex example of what the child has said.

Reinforcement A procedure that follows a response with the intent of perpetuating or extinguishing it; used in conditioning.

Repetition In fluency analysis, the process of repeating a word or a part of a word, as in "the-the-the" or "b-b-ball."

Representation The process of having one thing stand for another, such as a piece of paper used as a blanket for a doll.

Residual hearing Any hearing that remains following the onset of hearing loss.

Resonant A consonant phoneme that is produced with resonance occurring throughout the vocal tract; refers to nasals, liquids, and glides.

Respiratory system Structures, including the lungs, bronchi, trachea, larynx, mouth, and nose, that are used in breathing for life and for speech.

Resting tidal breathing Breathing to sustain life.

Right hemisphere brain damage (RHBD) A group of neuromuscular, perceptual, and/or linguistic deficits that result from damage to the right hemisphere of the brain and may include epilepsy, hemisensory impairment, and hemiparesis or hemiplegia.

Scintigraphy A computerized technique for measuring aspiration during or after a swallow.

Self-monitoring The ability to recognize one's own errors and correct them.

Semantic features Pieces of meaning that come together to define a particular word.

Semantics The study of word and language meaning.

Sensorineural hearing loss Permanent hearing loss that results from absence, malformation, or damage to the structures of the inner ear.

Sensorineural system Part of the auditory system made up of the inner ear and cranial nerve VIII.

Sensory-motor approach Articulatory training that emphasizes tactile and proprioceptive sensations and sound, syllable, and word production.

Serous otitis media Inflammation of the middle ear with sterile fluid.

Sessile polyp A polyp with a broad-based attachment to the vocal fold.

Silent aspiration The entrance of food or liquid into the airway that is not accompanied by coughing.

SLP See *Speech-language pathologist*.

Sociolinguistics The study of influences such as cultural identity, setting, and participants on communicative variables.

Sound field amplification A type of assistive listening device that transmits sound from a microphone to loudspeakers that are strategically placed within a room.

Spasmodic dysphonia (SD) A voice disorder characterized by hyperadduction of the vocal folds, resulting in strained/strangled voice production with intermittent stoppages.

Spastic cerebral palsy A congenital disorder that is characterized by increased muscle tone such that when a muscle contracts, the opposing muscle may react abnormally to stretch by increasing muscle tone too much. Muscle movements are described as jerky, labored, and slow.

Spastic dysarthria Speech that is characterized as slow, with jerky, imprecise articulation and reduction of the rapidly alternating movements of speech because of stiff and rigid muscles.

Specific language impairment (SLI) A language impairment in the absence of hearing, oral structural or functioning, cognitive, or perceptual deficits.

Speech bulb obturator An obturator that fills the velopharyngeal space, closing the velopharyngeal portal.

Speech-language pathologist (SLP) A professional whose distinguishing role is to identify, assess, treat, and prevent speech, language, communication, and swallowing disorders.

Speech Recognition Threshold (SRT) A test procedure used in speech audiometry that measures the lowest (quietest) level at which a person can recognize approximately 50% of the spondees presented for a given number of trials.

Speech sample A systematic collection and analysis of a person's speech, a corpus; used in language assessment.

Spina bifida A congenital malformation of the spinal column.

Spinal nerves Any of the 31 pairs of nerves in the peripheral nervous system, containing sensory and

motor fibers that arise from each side of the spinal cord to innervate the body.

Spondees Two-syllable compound words that are spoken with equal emphasis on both syllables and used in Speech Recognition Threshold testing.

Spontaneous recovery A natural recovery process that proceeds without professional intervention.

Stapes The third and smallest of the ossicles in the middle ear.

Stereocilia Small hairlike projections situated on the top of the hair cells in the organ of Corti.

Stimulability The ability to imitate a target phoneme when given focused auditory and visual cues.

Stimulus Anything that is capable of eliciting a response.

Stoma A small opening, such as a surgical hole in the external neck region that extends into the pharynx to permit breathing following laryngectomy.

Stop A consonant phoneme produced by building air pressure behind the point of constriction.

Story grammar Common elements and event sequences in narratives.

Strain and struggle Difficulty initiating and maintaining voice.

Stridor Noisy breathing or involuntary sound that accompanies inspiration and expiration.

Stroke A cerebrovascular accident (CVA), the most common cause of aphasia, which results when the blood supply to the brain is blocked or when the brain is flooded with blood.

Stuttering A disorder of speech fluency characterized by hesitations, repetitions, prolongations, tension, and avoidance behaviors.

Subcortical aphasia Fluent aphasia that results from lesions in the thalamus and basal ganglia below the level of the cortex.

Substitution In articulation, the production of one phoneme in place of another.

Support group Individuals with similar problems who meet together to share feelings, information, and ideas.

Suppurative otitis media See *Purulent otitis media*.

Synapse The minuscule space between the axon of one neuron and the dendrites of the next, where "communication" between neurons occurs.

Syntax How words are arranged in sentences.

Symbolization Use of an arbitrary symbol, such as a word or sign, to stand for something.

Tardive dyskinesia Involuntary, repetitive facial, tongue, or limb movements that sometimes occur as a side effect of certain medications.

TBI See *Traumatic brain injury.*

Tectorial membrane The gelatinous tongue-shaped structure that forms the roof of the organ of Corti.

Teletypewriter (TTY) A portable keyboard used for remote text conversations over regular phone lines by those who are deaf.

Temporary threshold shift (TTS) A temporary change in hearing acuity followed by spontaneous recovery that is associated with short-term exposure to high-intensity noise.

Threshold The lowest (quietest) presentation level (measured in decibels) at which a person can barely detect a stimulus 50% of the time it is presented.

Thrombosis The formation or presence of a blood clot within a blood vessel of the body. It may result in an ischemic stroke.

Tics Involuntary, rapid and repetitive, stereotypic movements.

Trachea A cartilaginous membranous tube by which air moves to and from the lungs.

Tracheoesophageal shunt (TEP) A device that directs air from the trachea to the esophagus for esophageal speech.

Tracheostomy tube A tube that is inserted into the trachea to relieve a breathing obstruction.

Traditional motor approach An articulation treatment approach that emphasizes discrete skill learning, beginning first with auditory discrimination of the error sound, followed by production training of the sound in isolation, in nonsense syllables, and then in words, phrases, sentences, and conversation.

Transcortical motor aphasia A nonfluent aphasia that is characterized by impaired conversational speech, good verbal imitative abilities, and mildly impaired auditory comprehension.

Transcortical sensory aphasia A rare fluent aphasia that is characterized by word substitutions, lack of nouns and severe anomia, and poor auditory comprehension but featuring the ability to repeat or imitate words, phrases, and sentences.

Transient ischemic attack (TIA) Sometimes called a mini-stroke, it is a condition that occurs when blood flow to some portion of the brain is blocked or reduced temporarily.

Traumatic brain injury (TBI) Damage to the brain that results from bruising and laceration caused by forceful contact with the relatively rough inner surfaces of the skull or from secondary edema or swelling, infarction or death of tissue, and hematoma or focal bleeding.

Treacher Collins syndrome An inherited disorder that is characterized by excessive muscle tone in the face and jaw.

Tremor Involuntary, rhythmic movement of a body part.

Tympanic membrane (or eardrum) The thin cone-shaped structure composed of three layers of tissue located at the end of the external auditory meatus. It is set into vibration as acoustic energy strikes its surface.

Tympanogram A graph generated during acoustic immittance testing that depicts compliance of the eardrum relative to changes in air pressure.

Tympanostomy tube　See *Pressure equalization (PE) tube.*

Ultrasonography　See *Ultrasound.*

Ultrasound (or ultrasonography)　A technique that uses high-frequency sound waves to visualize internal bodily organs.

Unilateral hearing loss　Loss of hearing on one side.

Usher's syndrome　A hereditary disorder characterized by sensorineural hearing impairment and progressive blindness.

Uvula　A small, pendulous structure suspended from the soft palate.

Variegated babbling　Long strings of consonant–vowel syllables, in which adjacent and successive syllables in the string are not identical

Velar　Refers to the posterior area of the roof of the mouth. In speech, velar consonants are produced with the tongue touching or approximating the velum or soft palate.

Velopharyngeal closure　Contact of the velum with the lateral and posterior pharyngeal walls, thus separating the oral and nasal cavities.

Velopharyngeal inadequacy (VPI)　Inability of the velopharyngeal mechanism to separate the oral and nasal cavities during swallowing and speech.

Vestibular system　Structures of the inner ear that are responsible for supplying information to the brain regarding balance and spatial orientation.

Vestibulocochlear nerve (or VIIIth cranial nerve)　The cranial nerve that runs from the base of the cochlea to the cochlear nucleus of the brain stem. It is composed of the vestibular and cochlear branches.

Videofluoroscopy　See *Modified barium swallow study.*

Visual reinforcement audiometry (VRA)　A method of hearing assessment in which a child is rewarded for localizing to a test signal through the use of moving toys and/or flashing lights.

Vocal abuse　Any of several behaviors, including smoking and yelling, that can result in damage to the laryngeal mechanism.

Vocal fold paralysis　Immobilization of the vocal fold, usually due to nerve damage.

Vocal hygiene　Proper care of the voice.

Vocal nodules　Localized growths on the vocal folds that are associated with vocal abuse.

Vocal polyp　A fluid-filled lesion of the vocal fold that results from mechanical stress.

Vocal tremor　Variations in the pitch and loudness of the voice that are involuntary.

Voice　Vocal tone and resonance.

Vowel　Any of several voiced phonemes that are produced with a relatively open vocal tract.

Waardenburg's syndrome　A hereditary disorder characterized by pigmentary discoloration, particularly in the irises and hair; craniofacial malformation of the nasal area; and severe to profound hearing impairment.

Wernicke's area　Located in the left temporal lobe of the brain and responsible for processing of language

Wernicke's aphasia　A fluent aphasia that is characterized by rapid-fire strings of sentences with little pause for acknowledgment or turn taking. Content may seem to be a jumble and may be incoherent or incomprehensible, although fluent and well articulated.

Word Recognition Test (WRT)　A test procedure used in speech audiometry to measure an individual's ability to recognize single-syllable words presented at a predetermined level above their auditory threshold.

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