Acquired Neurogenic Communication Disorders

AN INTEGRATED CLINICAL APPROACH

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Preface

Organization of This Book

Unlike most textbooks on this topic, ours is organized by anatomical systems and locations, not by disorder. We intentionally wanted to emphasize the interrelatedness of speech, language, cognition, and swallowing, and the complexity of presentation when damage to the brain occurs. We believe that students will benefit from understanding co-occurrence of deficits and the impact of deficits upon each other and learning these concepts from the beginning. We understand that this approach is different and may require a shift in the way instructors organize their thoughts and their courses.

This book is not intended to provide in-depth information on assessment and treatment of acquired communication and swallowing disorders. It would be many magnitudes bigger and heavier if it did! Although there are many other texts and resources that provide the level of detail and theoretical background needed for students to be able to put assessment and treatments into practice, our goal is to introduce the disorders and provide enough information about how they are typically assessed and treated to create a full understanding of the disorders.

How to Use This Textbook

Thank you for choosing *Acquired Neurogenic Communication Disorders: An Integrated Clinical Approach*. The intent of this tutorial is to briefly describe and demonstrate the organization of chapters, which integrate speech, language, cognition, and swallowing. Understanding the organization may help both course instructors and students to best utilize the resources.

Our **customized illustrations** help to solidify connections between brain anatomy, functions, and areas of damage. This is accomplished through:

- A variety of views and perspectives (superior/inferior, dorsal/ventral, sections—coronal-transverse-sagittal, frontal/lateral/posterior)
- Resections/Cutaway illustrations to visualize deep, hard to see/visualize structures

- Close-up (magnified) pull-out illustrations of small sections of a structure along with the broader view of the structure itself for context
- Structures in situ (within the larger structure, which is transparent to allow you to see the deeper structure)
- Schematics, depicting sequences or processes, and speech, language, cognition, and swallowing systems or networks
- Illustrations of brain imaging included to provide a basic distinction between neurotypical brains and those with various pathologies
- A variety of etiologies and pathologies included so you can see where damage exists
- Models of speech, language, cognition, and swallowing mapped directly onto brain structures

We have highlighted foundational concepts and terminology by **bolding keywords** throughout, as well as including Latin and Greek word origins and meanings.

Assessment and Intervention Tables: Provide a summary of common assessments and interventions for speech, language, cognition, and swallowing. While these are not intended to be exhaustive, the tables highlight many of the most commonly used approaches.

Concept Tables: Several tables include information about subtypes of disorders, components of complex functions (e.g., prosody, language, executive functions, discourse), and frameworks (e.g., WHO-ICF).

Systems-Based Clinical Approach chapter: This chapter is the cornerstone of the textbook. The idea is to break down the artificial silos created when there are separate courses or book chapters to address acquired neurogenic disorders of speech (e.g., motor speech disorders), language (e.g., aphasia and related disorders), cognition (e.g., cognitive communication disorders), and swallowing (e.g., dysphagia). Since these disorders co-occur in individuals with neurological damage, our integrated structure is purposeful to help readers see the connections and overlaps.

Table 6–2. Treatments for Deficits Associated With Frontal Lobe Damage

Domains	Recommended Practices	Description
Agitation and Behavioral Disinhibition	Validation therapy (Benjamin, 1995, Neal & Wright, 2003)	Affirms the individual's emotional state rather than correcting them. Redirects to a positive interaction or activity.
	Redirection and movement (Ponsford et al., 2023)	In response to agitation, redirect the individual to another activity. Movement through space and to different environments typically reduces agitation as well.
	Routines (Hoepner & Togher, 2022)	Establishing a daily schedule and routine to help with orientation and foster positive behaviors (reduce agitation).
Executive Dysfunction	Environmental modifications	Modify the physical environment to reduce distractions. Train partners to provide scaffolding and reduce demands. Educate staff and partners.
	Metacognitive strategy instruction (Kennedy et al., 2008; Palinscar, 1986; Ylvisaker, 2006)	Break tasks or problems down into smaller steps. Practice strategies in the context of meaningful activities.

BOXES. A place for applying learning.

Key terminology and concepts—Whenever there are numerous key terms necessary to understand broader concepts, a mini-glossary is included to define terms and concepts.

Clinical cases—Clinical cases that integrate commonly co-occurring speech, language, cognition, and swallowing impairments are sprinkled throughout the book. The intent is to help readers recognize that disorders like aphasia, dysarthria, dysphagia, and cognitive communication disorders don't usually occur in isolation but rather together. Many cases include questions to provoke thinking about the overlap between speech, language, cognition, and swallowing.

Overview of Neuroanatomy chapter: This chapter is not intended to replace a full review of neuroanatomy and physiology; it is meant to serve as a refresher and reference for concepts that are expanded upon in later chapters.

Etiologies and Pathophysiology chapter: This chapter introduces readers to a range of etiologies for various acquired and progressive neurological disorders. Some less common etiologies that provide useful illustrations of cognitive or communication disorders are included along with the more common etiologies that SLPs are likely to have on their caseloads. Accessible discussions of pathophysiology (what the damage looks like and where it is located) help readers to understand potential consequences.

Neurorehabilitation chapter: This chapter is intended to provide frameworks for holistic assessment and intervention that are culturally sensitive and responsive.

System-Based chapters: These chapters organize locations and etiologies of damage by anatomically related systems, including prefrontal, left perisylvian, right perisylvian, posterior cortical, subcortical, brainstem, and cerebellar. Disorders that occur with damage/degeneration of the anatomical region are discussed.

Assessment and treatment for those disorders that are almost always linked to that region are covered (e.g., assessment and treatment of aphasia and apraxia of speech are included in the Left Perisylvian Area chapter).

Assessment and Treatment chapters: These chapters cover cognitive disorders, dysarthrias, and dysphagia, all of which can occur due to damage or disruption of various areas of the brain. Pulling them out reduces redundancies throughout the text, and also highlights to students that these disorders are not localizable.

The order of the chapters attempts to build upon concepts from one chapter to the next. That being said, we went back and forth on the best order several times——while some chapters were easy to place early or later in the sequence, others were a bit tricky. Instructors can choose to assign chapters in the order that best fits their conceptualization and teaching style. Each chapter has cross-references to others for more information, so you can easily find background or in-depth information if you teach the chapters in a different order.

Summary: Each chapter ends with a plain language summary that highlights key concepts within the chapter. Some learners may wish to begin by reading the summary and key concepts before delving into the content, and end by returning to it after reading the chapter.

Key concepts:

1. A bulleted list is included at the end of each chapter to highlight key concepts and learning outcomes.
2. For students: At minimum, you should be sure to understand these key concepts. If you don't, we suggest that you return to the chapter, consult resources provided by your instructor (recorded lectures/screencasts, animations, supplementary readings), and ask your peers/instructors clarifying questions.

References and Further Reading: In some cases, these items were referenced directly in the text, while others are just useful resources to augment your learning.

Disorder Videos: This textbook includes numerous videos of individuals with various acquired neurogenic disorders (e.g., aphasia, primary progressive aphasia (PPA), dysarthria, cognitive-communication disorders) and etiologies (stroke, Parkinson disease, traumatic brain injury) completing speech, language, cognitive, and swallowing tasks. Partners of individuals with PPA were also interviewed, to provide context for the videos of individuals with PPA.

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SYSTEMS-BASED CLINICAL APPROACH

Chapter Overview

Breaking Down the Silos

A disorder-based approach to addressing acquired neurogenic disorders has been the predominant approach for many years. In this approach, specific acquired communication/swallowing disorders (e.g., aphasia, cognitive-communication disorders, executive dysfunction, motor speech disorders, and dysphagia) are discussed independently, in separate courses. While there are benefits to clearly separating out cognitive, language, speech, and swallowing disorders to emphasize the differences between them, it creates challenges for students who need to be prepared for clinical practice. Brain damage, regardless of the etiology, rarely affects language, speech, cognition, or swallowing independently. For instance, clients with a focal left hemisphere lesion rarely have only aphasia; most often they present with aphasia along with apraxia, dysarthria, and/or dysphagia. Likewise, a client with a TBI that causes prefrontal and diffuse axonal injury typically presents with not only executive dysfunction but also dysphagia, dysarthria, visuoperceptual impairments, and language/pragmatic impairments. The traditional siloed, disorder-based

approach can leave students ill-equipped to make connections between concomitant disorders, which places them at a distinct disadvantage when preparing for assessment and treatment.

Case-based approaches integrate impairments that co-occur in real clients in a manner that is more representative of what we encounter in clinical practice. Instead of isolating communication/swallowing impairments typically addressed in our discipline, cases integrate other impairments typically addressed by related disciplines, such as occupational and physical therapy, respiratory therapy, social work, nursing, and medical subspecialties (Table 1–1). This allows learners to see the client (human being) more holistically. We have selected a couple of types of cases (horses and zebras) to highlight the integration and overlap of motor speech, language, cognition, and swallowing impairments present within the individuals we serve. Horses are the everyday cases that you are likely to encounter in most adult rehabilitation contexts. Zebras are rare diseases/disorders that are less likely to be encountered in clinical practice, but can eloquently demonstrate system overlaps. Case 1–1 represents a horse, as traumatic brain injuries are common. Case 1–2 represents a zebra, as corticobasal syndrome (CBS) is a rare degenerative disease.

Table 1–1. Disciplines Involved in Care of Patients With Neurogenic Disorders

Discipline	Primary Role
Occupational therapy	physical and cognitive abilities required for activities of daily living; body movement, particularly arms and hands
Physical therapy	body movement, particularly legs and back
Speech-language pathology	communication, cognition, and swallowing
Respiratory therapy	respiration, potentially tracheostomy care
Social work	mental & behavioral aspects of functioning, addiction, coordination of care
Nursing	address medical status, intake-output, medication administration, hygiene

Table 1–1. *continued*

Discipline	Primary Role
Neurology	address diagnosis of underlying lesion or disease, some pharmacological interventions
Neuropsychology	cognition, predominantly assessment
Ear, Nose, & Throat (ENT)	assess cranial nerve function in oral, pharyngeal, and laryngeal structures
Gastroenterology	some gastroenterological diseases have a neurological component and vice versa
Radiology	neuroimaging, radiographic/ fluoroscopic imaging for swallowing

As is apparent from these two cases, speech, language, cognition, and swallowing can all be affected by a single etiology or disease process. While these two cases both involve fairly widespread changes, co-occurrence is also common in relatively focal strokes. SLPs need to be aware of not only the variety of potential disorders/impairments related to a disease or location of damage, but also the influence of one impairment on another. As described in Case 1–1, the cognitive deficits (impulsivity and impaired attention) affected both swallowing and language, exacerbating the impact of each of those independently.

Models of Communication Systems

These cases highlight the importance of taking a connectionist, systems-based approach to learning about neurogenic disorders. Cortical and subcortical speech, swallowing, language, and cognitive systems are interconnected. Overlap exists between functional organization of these structures and the white matter tracts that connect multiple systems within the nervous system. This does not even address the complexity of sensory inputs and the reciprocal interplay between those inputs and outputs. Fear not, our intent here is not to scare you off but to try to simplify and integrate contemporary neuroscience and cognitive-linguistic sciences to demonstrate the interconnectedness of cognitive and language systems with motor and sensory systems. Given that connection, we hope to clearly illustrate why damage to brain

Case 1–1. Traumatic Brain Injury (The Horse)

Traumatic brain injuries (TBIs) result in a mix of focal and diffuse brain lesions. Collectively, these pathologies affect many brain structures. As such, many brain systems (motor speech, voice, language, cognition, and swallowing) are impacted.

Case Description: Dennis was an 18-year-old high school graduate when he sustained a TBI in a motorcycle accident. He was taking courses at the local technical college and working for a local concrete mason at the time of his injury. On his way home from work, he collided with a deer, sustaining numerous fractures (legs, arms, ribs, pelvis, jaw) and diffuse axonal injury (DAI). Because he was helmeted, there was no significant focal damage or hematomas, confirmed by an acute CT scan. DAI was presumed and later evidenced on an MRI scan. He was in a coma for a week. When he emerged from the coma his speech was marked by mixed dysarthria and breathiness (at least partially due to traumatic intubation for ventilation). He was disoriented to person (oriented only to self), place, time, and situation. His attention span was less than a minute without redirection from medical staff. He had moderate-to-severe oral and pharyngeal dysphagia, further compromised by his cognitive status and attention impairments. Throughout the following week of rehab, a broader picture of impairments emerged. Along with a lack of cohesive discourse, clearly compromised by cognitive status, he demonstrated frequent anomia and paraphasic errors (both semantic and phonemic). Mobility was impaired, compromised by numerous orthopedic fractures as well as bilateral weakness and incoordination (targeting of movements, timing, proprioception, and troubles gauging velocity and amplitude of movements). Gait could be described as mechanical and stiff (how you might think of Frankenstein's gait). Activities of daily living, including self-feeding and self-care (brushing teeth, combing hair, bathing, etc.), were compromised by weakness, orthopedic fractures, and incoordination.

Given this background on TBI and this case description, answer the following questions:

1. Identify systems affected by TBI, and any anatomical correlates.
2. Identify disorders that would typically be addressed by a speech-language pathologist. (Hint: think speech, language, cognitive, and swallowing subsystems.)
3. Identify disorders that would typically be addressed by a related profession and include the names of those disciplines (refer back to Table 1–1).

Case 1–2. Corticobasal Syndrome (The Zebra)

Corticobasal syndrome (CBS) is an acquired, neurodegenerative disease that affects cortical and subcortical brain structures. While it is a rare disorder that you may not encounter clinically, it provides a strong model for why it is important to integrate learning about systems, rather than isolating by specific impairments such as speech, language, cognition, or swallowing. CBS is characterized by the following clinical symptoms: asymmetrical motor impairments, prominent apraxia, unilateral muscle rigidity, and focal cortical syndromes (e.g., aphasia, executive dysfunction, memory impairments, sensory loss, and anosognosia). Limbic and homeostatic systems are also involved, resulting in excessive eating or drinking. Behavioral changes such as apathy, irritability, disinhibition, impulsivity, and other personality changes are common.

Case Description: The following case is drawn from a published case study on an individual with CBS and her spousal partner (Hoepner et al., 2015). Margaret was a departmental administrative assistant at a university prior to the onset of CBS. CBS is often characterized by early onset and in this case, Margaret was presumptively diagnosed with CBS by age 57, approximately five years following onset of symptoms. Her first symptoms appeared at age 52. These included vertigo and nausea, symptoms rarely documented in case-based research of CBS. These symptoms increased over time, while other symptoms such as difficulties with spelling, problem solving, short-term memory, and speech fluency began to emerge. Neuroimaging identified mild generalized cerebral atrophy and a stable pattern of diffuse, multifocal white matter disease. Note that such changes are fairly common in imaging of typically aging individuals with or without symptoms. As such, imaging did not aid in differential diagnosis. Within five years of onset, anomia became persistent. By eight years, verbalizations were limited to yes/no responses. At nine years post-onset, yes/no confusion was common and symptoms of anarthria began to emerge. By ten years (age 62), Margaret had no usable speech, could comprehend only simple messages, responded only gesturally (head nod/shake), neglected her right arm, and had limited coordination of her left arm due to apraxia. Her gestural communication was ineffective due to yes/no confusion in her use of head nods/shakes. Other impairments also present included visual and gaze difficulties, alien limb phenomena, and attention impairments.

Given this background on CBS and this case description, answer the following questions:

1. Identify systems affected by CBS, and any anatomical correlates.
2. Identify disorders that would typically be addressed by a speech-language pathologist. (Hint: think speech, language, cognitive, and swallowing subsystems.)
3. Identify disorders that would typically be addressed by a related profession and include the names of those disciplines (refer back to Table 1–1).

structures seldom causes discrete effects to one system (i.e., speech, language, cognition, swallowing). It is not fully possible to map brain regions and networks to cognitive and language functions (see, e.g., Poeppel, 2012) due to the complexity of the systems, interconnectedness of structures, and the limitations of any one mapping technology. Regardless of how structure (neurobiology) and function (speech, language, cognition, swallowing) are mapped (i.e., functional imaging of activation, lesion locations, electrophysiological techniques, streams/networks, long-term potentiation changes to synapse, immunocytochemistry), no single approach captures everything.

What Is the Value in Models?

Models are created to map out and illustrate components of a larger process, such as language or cognition. In some cases, component functions can be linked to brain regions and then used to make predictions that damage to specific brain regions will result in predictable changes in function. Unfortunately, things are not always quite so simple. Here we highlight four models, one each for speech, language, cognition, and swallowing. The purpose is to show the extensive networks involved in each of these processes, and the shared "real estate" as some of the areas involved overlap.

While numerous models of communication exist, we chose these four because they are integrative in nature. That is, they do not simply examine speech, sensorimotor, language, or cognitive functions in isolation but as interdependent functions of a unified neurological system. As a starting point, if you can grasp the principles of interdependency and integration across these subsystems, you will have an adequate basis for a clinical speech-language pathologist.

Speech: DIVA (Directions Into Velocities of Articulators)

Contrary to localizationalist models that identify a few discrete brain structures involved in speech, in reality, speech processes depend upon numerous brain structures. This includes motor (planning, initiation, refinement), kinesthetic, auditory, cognitive, and language areas. These structures are interdependent, speaking to the integrated nature of speech. For instance, motoric, phonological production is dependent on lexical access and comprehension, which are sensory and memory dependent.

The DIVA model maps the connections between these systems from the perspective of speech production/motor control (Guenther et al., 2006). Central to this model are three main principles: feedback, feedforward, and monitoring/adjustments (Figure 1–1). This accounts eloquently for the interplay between motor, sensory, and cognition/language systems. The feedback process is central to learning and adjusting. Most feedback is internal to the individual producing and hearing their own speech productions. This includes auditory and proprioceptive/kinesthetic feedback, which allows the individual to determine if the sound targets were produced correctly or if adjustment is needed. Once the auditory and somatosensory (proprioceptive/kinesthetic) targets are met, a map of articulatory placements for the speech sounds is formed. From this point forward, as long as the system does not change, a feedforward

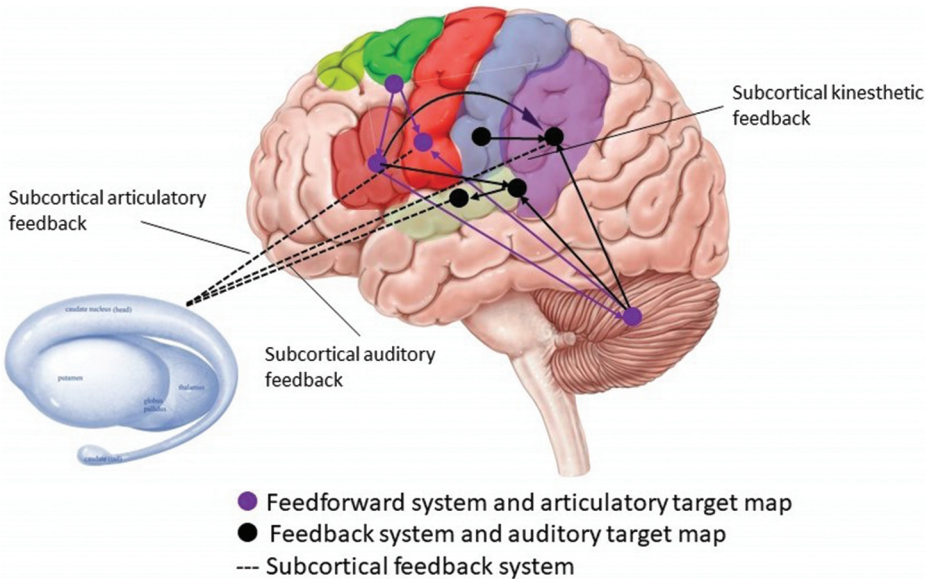

Figure 1–1. DIVA schematic.

mechanism guides articulatory placements. Only when there is a change in the mechanism due to structural or functional changes is there a need to return to feedback and mapping of placements in order to adjust and achieve the somatosensory and auditory target for the sound.

DIVA takeaways:

- Feedback = primarily internal kinesthetic placement feedback to achieve target sound productions
- Feedforward = pre-planning sequences of articulatory placements sensitive to production contexts such as coarticulation
- Monitoring and adjustments = altering articulator placements when there is structural or physiological change

Language: Dual Stream Models

Wernicke–Geschwind's classic model of language processing attempted to isolate a handful of left hemisphere structures as having a role in language comprehension and production (Tremblay & Dick, 2016). This model became obsolete when functional imaging made it evident that sound-based representations of speech are comprehended bilaterally, while both motor and comprehension structures have access to phonological coding.

According to the dual stream model of left hemisphere language (Hickock & Poeppel, 2000), language is processed through two bidirectional pathways, the dorsal and ventral streams (Figure 1–2). The **dorsal stream** carries information about **phonological processing**