



edited by

Thomas A. Field • Laura K. Jones • Lori A. Russell-Chapin

NEUROCOUNSELING

Brain-Based Clinical Approaches



AMERICAN COUNSELING
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*We dedicate this book to everyone who has been working
toward integrating neuroscience into the counseling field
and to the next generation of counselors,
eager to understand the bridge
between brain and behavior.*



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PREFACE

Many therapeutic fields are embracing principles of neuroscience in their practice, and such principles are rapidly influencing best practices. The counseling field is also beginning to consider how neuroscience and neurobiology can inform, explain, and enhance the theory and practice of counseling. Some leaders in the counseling field have already articulated that neuroscientific findings are becoming the “practice standards of the future” (Myers & Young, 2012, p. 21). In recognizing the growing influence of neuroscience on counseling practice, the American Counseling Association, Association for Counselor Education and Supervision, and American Mental Health Counselors Association have each established separate Neuroscience and Neurocounseling Interest Networks that work collaboratively to present a unified vision of how neuroscience can be used to explain and enhance counseling practice. The newly published 2016 Council for the Accreditation of Counseling and Related Educational Programs (CACREP) Standards (CACREP, 2015) contain nearly three times the number of references to neurobiology as the 2009 CACREP Standards (Jones, 2015). In addition, a growing number of counseling texts and national, regional, and state conference presentations have highlighted the integration of neuroscience into counselor practice. In this preface, we underscore how integrating neuroscientific principles related to the central nervous system and physiological processes underlying all human functioning into the practice of counseling can support and advance the profession (Beeson & Field, 2017).



2016 CACREP Standards

With that background in mind, this preface addresses the section of the 2016 CACREP Standards pertinent to the common core area of Professional Counseling Orientation and Ethical Practice (Standard II.F.1.):

- History and philosophy of the counseling profession and its specialty areas (Standard II.F.1.a.)

The preface also addresses the following 2016 CACREP Specialization Standard:

- Role of counselors and counselor educators advocating on behalf of the profession and professional identity (Counselor Education and Supervision, Standard VI.B.5.i.)



Definition of Counseling

Who are counselors? What do they do? What does it mean to be a counselor? How are we similar to and different from other mental health professions? How do advances in the field, such as neuroscience and neurobiology, pertain to counseling?

All of these questions are important to ponder throughout one's career, from new graduate student to experienced practitioner. As counselors consider who they are as professionals, neuroscience provides the information and tools to support their belief in certain core principles as foundational to counseling practice.

The field of counseling is unique among the mental health professions in its historical beliefs about the human condition and how to enhance optimal living. In 2010, a consensus definition of *counseling* was agreed on by multiple stakeholders in what was formally titled 20/20: A Vision for the Future of Counseling. The definition distilled into one sentence how the counseling profession could be defined: "Counseling is a professional relationship that empowers diverse individuals, families, and groups to accomplish mental health, wellness, education, and career goals" (para. 2). This definition identifies several important concepts as foundational to counseling practice: The professional relationship takes precedence; the goal of counseling is to empower people, especially those from diverse backgrounds, and address systemic barriers that prevent optimal health; and counseling assists people to achieve optimal mental health and wellness, not only to alleviate distress and mental disorders.

Neuroscience supports the importance of these concepts and provides models for how to implement them into counseling practice. As the chapters in this book elucidate, neuroscience can help counselors understand how relationships are forged, leading to deeper and more meaningful working relationships with clients; recognize the persisting impact of systemic barriers such as oppression, marginalization, and trauma on clients' ability to achieve their goals; and take a wellness and strengths-based perspective that serves to empower clients and increase optimal performance. In other words, neurocounseling is commensurate with the orientation and identity of the counseling profession.

Definition of Neurocounseling

The field of mental health services, including counseling, is rapidly evolving. One of the most important emerging trends in the field has been the integration of neuroscience into counseling practice (Beeson & Field, 2017). This new counseling approach has been termed *neurocounseling* (Montes, 2013). Neurocounseling has been defined as “the integration of neuroscience into the practice of counseling, by teaching and illustrating the physiological underpinnings of many of our mental health concerns” (Russell-Chapin, 2016, p. 93). Neurocounseling has a variety of uses. For example,

- Neurocounseling can be used by clinicians to understand how and why psychotherapy changes the brain (Russell-Chapin, 2016).
- Neurocounseling can help us better understand client concerns, conceptualize cases, and plan treatment by using a brain-based perspective.
- Neurocounseling can help clients understand their experience through brain-based psychoeducation.
- Neurocounseling provides counselors with a more holistic, wellness-based, and mind–body integrative approach to client work.
- Technical approaches such as biofeedback and neurofeedback can be used to determine the physiological and neurological underpinnings of a client’s distress and dysfunction (assessment) and can help clients to modify physiology and brain waves to enhance their functioning and reduce distress and dysfunction (intervention).
- Neurocounseling approaches such as biofeedback and neurofeedback can also be used to improve optimal performance, not only to modify distress and dysfunction.

For some clinicians, neurocounseling can be used as part of what the clinician is already doing, as another tool in the toolbox (i.e., an adjunctive strategy to psychotherapy). However, neurocounseling can also entirely change the way clinicians conceptualize client cases, conduct assessments, and select interventions. For example, Lori A. Russell-Chapin wrote in 2016, “For decades, my goal was to assist clients in changing their unwanted thoughts, feelings and behaviors. Today . . . the overarching goal of all my counseling is to help clients to improve their emotional and physiological self-regulation” (p. 94).

Purpose of This Text

As counselors learn more about neuroscience, they are in need of guidance regarding how to integrate this new brain-based knowledge into counseling practice with clients. The ability to translate complex

knowledge to clients is a separate skill set that requires the ability to distill rather than dilute information. Counselors whose case conceptualizations are becoming informed by neuroscientific knowledge also require guidelines regarding how to apply these concepts in clinical practice.

The purpose of this text is to provide a resource for how neuroscientific concepts can be translated and applied to the counseling field, with the objective of both explaining and enhancing the theory and practice of counseling. In doing so, we hope to provide guidance and facilitate learning about how counselors are integrating neuroscience into their work, with the hope of better understanding and identifying methods for effectively and responsibly incorporating key principles of neuroscience into the profession. To advance this effort, we use the new 2016 CACREP Standards as our markers of learning to ensure that CACREP-accredited programs (and all programs) have the information needed to apply neuroscientific concepts to all the major areas of counseling practice.

While writing and editing this text, we also understood that for some counselors, especially those for whom science and research are not strengths, neuroscience can be an overwhelming and frightening concept. The scientific terminology, complex anatomy, and technology-based brain measurements may seem irrelevant to daily counseling practice with clients who bring forth deep existential human struggles that cannot be easily quantified. The specialized knowledge required to be a neuroscience-savvy practitioner may also seem outside the scope of counseling practice.

With that in mind, the purpose of this text is to provide counselors with guidelines, ideas, and tips on how to become effective and skillful neuroscience-informed counselors. We have purposefully asked each author to convey these concepts in a way that is understandable yet retains important information (distill, not dilute). The chapters are organized so that you will understand foundational neuroscience concepts that inform client case conceptualization (e.g., human development, social and cultural background) before learning how to approach assessment and intervention from a neurocounseling perspective.

We hope that this text will be useful not only to current counseling practitioners but also to current master's-level students in counseling programs. In that regard, the book addresses the 2016 entry-level educational standards of the main accrediting body of the counseling profession, CACREP. Each of the eight common core areas of counseling knowledge and skills are covered (professional counseling orientation, social and cultural foundations, human growth and development, career development, helping relationships, group counseling and group work, testing and assessment, research and program evaluation). We also address several 2016 CACREP Standards that are integrated into the eight common core standards, such as the impact of crises, disaster, and traumatic events; the neurobiology of addic-

tions; wellness and optimal performance; and psychopharmacology. Some chapters also address doctoral-level 2016 CACREP Standards for counselor education and supervision. We are proud that this text is the first publication to discuss the application of neurocounseling and neuroscience to the CACREP Standards specifically. In addition, the text represents the first publication to broadly address the application of neurocounseling and neuroscientific concepts across the core counseling curriculum, an approach that provides a practical, comprehensive model for the integration of neuroscience into counseling practice.

In addition to being an adjunctive text for all common core courses in the master's-level counseling curriculum, this text can also serve as a primary resource for counseling students (both master's and doctoral level) who are taking specialization courses in neuroscience, neurocounseling, brain and behavior, biological basis of behavior, and so forth. Finally, the text could also be a resource for counselor educators and supervisors who want to learn more about neuroscientific applications to counseling practice. As such, it is broadly designed for practicing counselors in the field, counselor education students in training, and counselor educators and supervisors.

Text Organization and Chapters

The text is divided into five sections. The first section reviews foundational information about neuroanatomy and neurophysiological development across the life span before exploring the impacts of social and cultural issues such as marginalization, oppression, and traumatic stress on neurophysiological functioning. The second section applies foundational knowledge from the first section to counseling relationships and assessments. Chapters emphasize the role of attentional processes in empathy and microskills, along with establishing safety within the counseling environment, neuroscience-informed counseling theory, completing a comprehensive neurocounseling assessment, and assessing for client wellness and enhancing optimal performance.

The third section addresses specialization areas related to neuroadaptation and addiction processes. Chapters examine the neuroscience of substance use and psychopharmacological intervention. The fourth section uses information from earlier chapters to explore a neuroscience-informed approach to specialized counseling modalities such as group counseling and career counseling. The fifth section describes a brain-based approach to conducting research and evaluating neurocounseling programs, and the final chapter provides guidance on integrating neuroscience into counseling practice. Ten tips are provided for counselors, with information from all prior chapters applied to the case study presented later in this preface.

Text Features

As editors, we sought to ensure that each chapter made direct connections between the content and clinical practice. As an anchor for the content knowledge, each chapter references a case study to ensure the material is relevant to client work. This preface starts that trend by presenting a case study that includes reflection questions that are further explored in the final chapter. Reflection questions are integrated throughout each chapter so that you can pause and consider how the content knowledge that has been covered could be relevant to the client case being discussed. We encouraged authors to share their own brain-based approach to the case study presented in their chapter so that you can consider how to use the information presented with clients in your own unique way. A few quiz questions are included at the conclusion of each chapter so that you can test your knowledge. The quiz answers are located at the back of the text. A glossary is also provided at the conclusion of the text so that you can evaluate whether you understand the concepts taught in the chapters. You are encouraged to return to sections of the chapter in which those terms are described if you are not confident in your knowledge.



Clinical Case Study

Muna is a 42-year-old Iraqi woman who is experiencing anxiety at her new job in an accounting firm. Muna lives and works in a metropolitan area of a large U.S. city. She is also struggling with feelings of inadequacy related to her long-standing dating relationship of nearly a decade. Her family lives in Iraq, and she emigrated to attend a U.S. college in her early 20s. She lives in constant dread of her family finding out that she is living with her boyfriend outside of marriage. She has been drinking alcohol to cope, mostly at night (four to five units). Muna also struggles with sleep at night, usually only getting 3 to 5 hours. She sometimes binge eats when she wakes up at night. Muna has a past diagnosis of attention-deficit/hyperactivity disorder and takes 20 mg of Adderall twice a day. In terms of her medical history, Muna was born prematurely at 28 weeks but otherwise has no history of medical issues. When asked about her family history, Muna mentions that she experienced psychological abuse from her father throughout her childhood. She is very warm and engaging during the initial interview, though her nonverbal fidgeting suggests she is somewhat anxious.

Concluding Thoughts

Over the course of the subsequent chapters, you will learn information that will help you conceptualize, assess, and intervene with this client on a deeper level. You will learn possible answers to important questions such as the following:

- How might the client's premature birth be playing into her current struggles?
- Which areas of her brain are being compromised?
- How does anxiety “happen” in the body?
- Why might the client struggle to think her way out of anxiety?
- What is the potential impact of emotional abuse on the client's functioning?
- How can stimulants interact with alcohol?
- How can the client tame anxiety without using alcohol?

In the final chapter of this text (“Ten Practical Guidelines for Neurocounseling”), we review each of these questions on the basis of knowledge you will acquire from each of the chapters that precede it.

As Lori likes to say, once you have learned about how the brain works in relationship to physical and emotional health, you cannot go back. We are confident that this knowledge will forever change how you approach case conceptualization, assessment, and intervention in clinical practice. We hope the subsequent chapters will be your starting point on this journey.

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About the EDITORS

The three editors of this text are the three chairs of the respective Neuroscience Interest Networks. Lori A. Russell-Chapin is the chair of the American Counseling Association (ACA) Neurocounseling Interest Network. Laura K. Jones is the chair of the Association for Counselor Education and Supervision (ACES) Neuroscience Interest Network. Thomas A. Field is the chair of the American Mental Health Counselors Association (AMHCA) Neuroscience Interest Network. We are excited about what neuroscience can bring to the counseling field and how it can be used in a manner that both honors its unique professional identity and keeps the field at the cutting edge of client care.

Thomas A. Field, PhD, LMHC (WA), LPC (VA), NCC, ACS, is an associate professor in the Master of Arts in Counseling program at the City University of Seattle. Thom holds a PhD in counseling and supervision from James Madison University. He has 10 years of counseling experience with more than 1,000 clients in a variety of settings, including outpatient, inpatient, schools, and private practice. He maintains a small private practice to inform his work as a counselor educator. His research and clinical interests include the neuroscience of counseling practice, clinical mental health counseling and supervision, and social justice and advocacy issues in counseling. Thom has published on the neuroscience of counseling in peer-reviewed journals and has presented at national conferences on the integration of neuroscience into counselor preparation and practice. Thom is currently part of a research team (Eric Beeson, Thom Field, Laura Jones, Raissa Miller) that is studying the development of an emerging counseling theory called *neuroscience-informed cognitive behavior therapy*. Thom is the current chair of the AMHCA Neuroscience Interest Network and is also a member of the ACA and ACES Neuroscience/Neurocounseling Interest

Networks. He is also the associate editor of the Neurocounseling section of the *Journal of Mental Health Counseling* along with Eric Beeson. In 2013, Thom was the first-ever recipient of the 2013 AMHCA Dissertation Research Award.

Laura K. Jones, PhD, MS, NCC, ACS, is an assistant professor at the University of North Carolina at Asheville. She holds a PhD in counseling and counselor education from The University of North Carolina at Greensboro, as well as an MS in psychology-cognitive neuroscience from the University of Oregon. She uses her training in both disciplines to inform her research, clinical, and pedagogical practices. Laura's primary interest lies in the confluence of neuroscience and counseling, with specific interest in the intentional and informed integration of neuroscience into the counseling field and counselor training programs, as well as in the neuroscience of trauma and recovery as it relates to elucidating the impact of trauma on interpersonal relationships; perceptions of safety following trauma; and efficacious interventions for survivors. She has presented at numerous national and international conferences on the integration of neuroscience into clinical practice and has authored and coauthored publications and book chapters detailing the application of neurophysiology to clinical mental health counseling and trauma and crisis intervention. Laura serves as the chair of the ACES Neuroscience Interest Network, is a member of the ACA Neurocounseling Interest Network, and is coeditor of the monthly column in *Counseling Today* titled "Neurocounseling: Bridging Brain and Behavior."

Lori A. Russell-Chapin, PhD, NCC, CCMHC, LCPC, BCN, is a professor of counselor education at Bradley University in Peoria, Illinois. Lori earned a PhD in counselor education from the University of Wyoming and a master's in counselor education from Eastern Montana College. Currently, Lori teaches graduate counseling courses in Bradley University's campus-based and online brain-based master's programs. She codirects the Center for Collaborative Brain Research, a partnership among Bradley University, OSF Saint Francis Medical Center, and the Illinois Neurological Institute. Lori has authored or coauthored seven books ranging in topic from practicum-internship supervision to neurotherapy and neurofeedback. Lori is the chair of the ACA Neurocounseling Interest Network and coeditor of the monthly column in *Counseling Today* titled "Neurocounseling: Bridging Brain and Behavior." Lori edits the monthly magazine for AMHCA, *The Advocate*. She is an award-winning researcher and teacher at Bradley University and the recipient of the AMHCA Outstanding Counselor Educator of the Year.

About the CONTRIBUTORS

We are very fortunate to have been able to gather together some of the best minds (pun intended!) within the field of neurocounseling to share with you their expertise related to core counseling content areas. The authors who contributed to this book are listed in alphabetical order.

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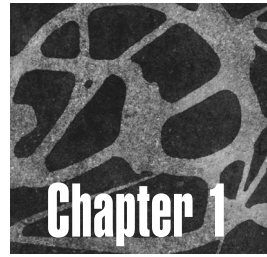
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Part I

FOUNDATIONS OF CASE CONCEPTUALIZATION

The first section of the text reviews foundational knowledge needed to conceptualize client cases from a neurophysiological perspective. You will first be introduced to basic brain anatomy and systems before learning about neurophysiological development across the life cycle and the impact of neurophysiological marginality and traumatic stress on psychological health. This knowledge is considered fundamental to understanding the client's presenting problem from a neurophysiological perspective, leading to more effective counseling relationships, assessments, and interventions.





Anatomy and Brain Development

Laura K. Jones

Learning about brain anatomy and the functioning of related systems may not be the first thing that comes to mind when you think about counselor education and training. Three facial expressions tend to emerge on counselors' faces when anatomy is mentioned: utter terror, complete boredom, or a smaller but growing contingency of expressions akin to fascination. If you are currently making one of the initial two expressions, perhaps you will find yourself, as you begin reading this and later chapters, becoming more engrossed and fascinated by the many wonders of the brain and how this information affects your work as a counselor.

Interest in the application of neuroanatomy to mental health has been long-standing. Sigmund Freud suggested in his classic 1914/2012 paper *On Narcissism* that "we must recollect that all of our provisional ideas in psychology will presumably one day be based on an organic substructure" (p. 78). Since Freud's early conjecture, limitations in technology have hampered understanding of the impact of the workings of the brain on mental health functioning. On April 2, 2013, a paradigm shift in mental health research began with the launch of the National Institute of Health's Brain Research through Advancing Innovative Neurotechnologies (BRAIN) initiative. The mission of this initiative is to understand "the circuits and patterns of neural activity that give rise to mental experience and behavior" (National Institutes of Health, 2014, p. 12) and, in doing so, to cultivate an integrative understanding of brain-behavior processes. This chapter is a first step to introducing you to the inner workings of the brain in an effort to inform your case conceptualizations, treatment plans, and ultimately clinical effectiveness with clients.



2016 CACREP Standards

This chapter addresses sections of the 2016 Council for Accreditation of Counseling and Related Educational Programs (CACREP) Standards pertinent to the common core area of Human Growth and Development (Standard II.F.3.):

- Theories of learning (Standard II.F.3.b.)
- Biological, neurological, and physiological factors that affect human development, functioning, and behavior (Standard II.F.3.e.)

This chapter also addresses the following Specialization Standard:

- Impact of biological and neurological mechanisms on mental health (Clinical Mental Health Counseling, Standard V.C.2.g.)



Clinical Case Study: Rein

Rein is a 12-year-old female preadolescent of Native American descent. Her home environment is intact; she lives with both parents and a brother. Rein describes it as an attentive but conservative home with limited communication regarding emotions, physiological changes to the body, or interpersonal relationships. Her parents scheduled an appointment because of a marked decrease in Rein's grades at school—Rein previously having been a straight-A student—and a noticeable withdrawal from group activities during class. Rein reports feeling very sad and lonely and indicates that she has been feeling increasingly more distant from friends in the past 6 months. Rein denies feeling bullied or victimized, but she does not feel that anyone likes or understands her and has a hard time connecting with others. Her mother confirms that Rein often cries a lot and isolates herself from her family as well. Her mother also shared that Rein recently reached menarche and was concerned that Rein may feel embarrassed about this.

The Brain: Structure, Function, and Systems

Despite incredible advances in science, the human brain in many ways remains a mystery. Part of its enigmatic nature rests in its complexity.

Not only are there various internal and external structures of the brain specified for certain functions, but those parts directly and indirectly influence one another by way of various chemical messengers. Further still, several areas of the brain can work in concert to govern other aspects of people's mental and physical functioning. Something seemingly as simple as reading the word *counselor* requires a remarkable succession of processes that involve virtually the entire brain.

In addition, researchers are now discovering more and more about how people's physical health and even the nature of the microbes in their gut influence the functioning of the brain. Some of the paradigms of mental health are now shifting as researchers begin to further investigate the reciprocal functioning of the body and brain, such as the role of inflammation (the process by which white blood cells help to protect people from infection) in depression (Miller & Raison, 2016). As such, I want to share some of what is known about the various parts and coordinated systems of the brain and body.

External Structures

What is your first thought when you hear the word *brain*? Most people think of a gray folded mass that sits inside the skull. This folded mass is the outer layer or lateral part of the brain, called the *cerebral cortex*, or *cortex* for short. You may also know that in the interior of this folded cortex, or more medial (toward the midline) and ventral (toward the base of the brain), are other exceedingly important parts of the brain. These internal and external structures control virtually everything about you. They allow you to think, feel, behave, breathe, and ultimately survive.

The cerebral cortex, or outermost part of the brain, is actually a 2- to 4.5-mm-thick mass of gelatinous tissue (Fischl & Dale, 2000). Even though it is often thought of as gray (and parts of it are called *gray matter*), it is actually pink when it is healthy living tissue, much like other tissue in the body. This folded mass includes the ridges of cortex known as *gyri* (singular, *gyrus*) and the shallower grooves between the gyri known as *sulci* (singular, *sulcus*). *Fissures* are similar to sulci but are deeper and more clearly divide regions of the brain. The gyri, sulci, and fissures help to demarcate different regions of the brain.

Hemispheres

The cortex is made up of two hemispheres, one on the left and one on the right. Connecting these two hemispheres is a thick band of nerve fibers known as the corpus callosum. It is the largest collection of nerve fibers in the entire nervous system, containing roughly 200 million interhemispheric connections (Luders, Thompson, & Toga, 2010). This band of fibers allows the two hemispheres to communicate back and forth and integrate the information being processed on either

side of the brain. A common misperception in popular culture is that individuals are either left brained or right brained. It is accurate that certain functions may be predominantly controlled by brain regions in one hemisphere or another; for example, the area of the brain responsible for language production is typically located in the left hemisphere. However, the notion that a person can be either left brained or right brained is an overgeneralization and a misrepresentation of brain functioning. More often than not, both sides of the brain are working in coordinated action to allow people to more fully perceive, respond, and adapt to their internal and external environments.

Lobes

The cerebral cortex is further divided into four sets of primary lobes, with analogous lobes in each hemisphere. Each lobe is specialized for certain functions, such as sight, somesthesia (e.g., skin senses and proprioception), hearing and language comprehension, motor control, and executive functioning. The four lobes are as follows: occipital lobe, parietal lobe, temporal lobe, and frontal lobe. Figure 1.1 depicts the general location of the four lobes.

Occipital lobe. At the very back of the brain sits the occipital lobe, which is the smallest of the four lobes. This is the visual center of the brain. The occipital lobes piece together the visual components of the surrounding world. This allows people to interpret and understand what their eyes are seeing, such as shape, color, size, depth, and

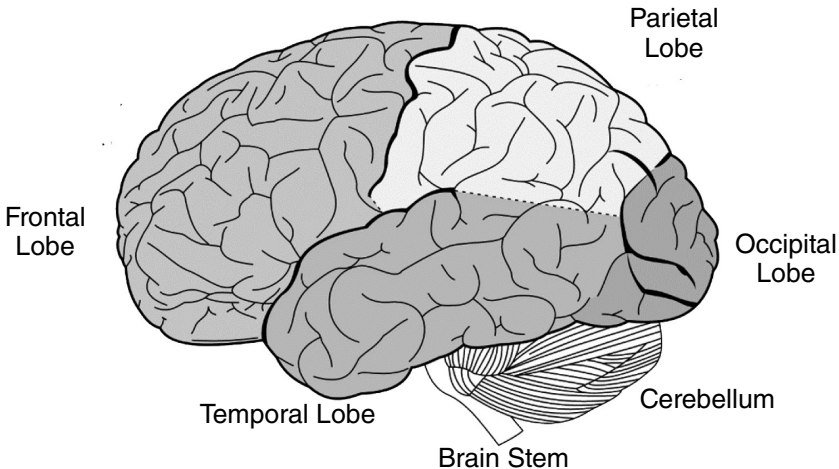


FIGURE 1.1

Lobes of the Brain

Note. From *Anatomy of the Human Body* (20th ed., Plate 728), by H. V. Carter, 1918, New York, NY: Lea & Febriger. In the public domain. Vectorized by Mysid, 2008, via Wikimedia Commons.

motion. However, visual processing is limited, meaning that people cannot process everything in the world around them. Visual perception is determined by several factors, including how many objects are present, how long the objects are in the visual field, and to which objects people allocate their attention.

Parietal lobe. The parietal lobe is located approximately halfway between the frontal lobe and the occipital lobe. This part of the brain contains the primary somatosensory cortex, which regulates the sensations that are perceived by the physical body, such as touch (e.g., temperature, pressure, pain), and the awareness of bodily movement and the orientation of the body in space (i.e., proprioception). The most anterior (i.e., toward the front) gyrus of this cortex (i.e., the postcentral gyrus) extends across both hemispheres and contains a map of one's entire body. For example, regions of this gyrus represent the thumb, tongue, arm, stomach, and even pinky toe. Every part of the body that one can feel is allocated a certain area of cortex on this gyrus, with the number of sensory receptors on the skin of that area governing how much of the cortex it represents. For example, the hands, face, and tongue are all represented by very large areas of cortex because people need to have very refined sensations of touch for these areas. The body maps are also contralateral (as opposed to ipsilateral), meaning that the right side of the body is mapped onto the left postcentral gyrus and vice versa.

Temporal lobe. The temporal lobe is located just behind the ears, below the parietal lobe and between the frontal lobe and the occipital lobe. The primary function of the temporal lobe is hearing and language comprehension. This region of the brain allows people to put together and comprehend all of the various sounds that are coming into their ears. Wernicke's area is the region of the temporal lobe that allows people to process spoken language. The temporal lobes are also involved in memory. The hippocampus is located in the medial (i.e., interior) region of the temporal lobes and is responsible for the formation of long-term memories.

Frontal lobe. The front section of the brain consists of the largest cortical lobe—and the largest of any mammal—which covers nearly half of the entire cortex. Aptly named the frontal lobe, this area is also the most extensive in terms of the functions that it controls. The most posterior (i.e., toward the back) gyrus of the frontal cortex (neighboring the parietal lobe) contains the primary motor cortex. Like the postcentral gyrus, this area contralaterally maps out the entire body, not for the purpose of feeling those parts but for the purpose of moving them. So, as you reach to turn the page of this book, neurons in the upper left side of this gyrus (right side if you are using your left hand) are firing. At the base of this primary motor cortex, extending down and forward and typically in the left hemisphere, is an area called *Broca's area*, which is responsible for language production. Note that

the area for language comprehension is different from that for language production. Broca's area is located at the base of the primary motor cortex because that is the area of the cortex responsible for the movement of the face and mouth. The functioning of this area can actually be affected by experiences of extreme traumatic stress, which is further discussed in Chapter 4. Given that counseling most often consists of "talk therapy," especially with adults, any altered functioning of Broca's area may have notable clinical implications.

Beyond these functions, the frontal lobe is involved in problem solving, decision making, planning, moral reasoning, attention, emotion regulation, and even priming in memory. The frontal lobe also plays a role in one's personality. This was famously demonstrated by the case of Phineas Gage, a railroad worker who experienced significant damage to the most anterior region of his frontal lobe. An explosion sent a metal spike diagonally through his skull, from around his ear up to the opposite top side of his skull. He not only survived the accident but was walking around and talking minutes later. The most striking consequence of this accident was his change in personality and behavior. Before the accident, Phineas was seen as a friendly, polite, and even-tempered fellow. Afterward, he was reported to be angry, cantankerous, and even violent, often using considerable profanity and lacking in impulse control (Macmillan, 2002). The portion of his frontal lobe that was most notably affected was a region called the *prefrontal cortex*. The prefrontal cortex serves as the "executive control" center of the brain and is in charge of rational thinking. Much like a corporate executive, the prefrontal cortex helps people decide or judge what is best for them, plan for the future, work toward goals, and discriminate between varying options. It also regulates their emotions, attention, and social functioning. Put simply, it allows people to think through situations and behave in a deliberate, goal-directed manner.

Just underneath the outer surface of cortex in the frontal lobe, near the confluence of the frontal, parietal, and temporal lobes, lies an area of cortex called the *insula* (insular cortex). This area helps people translate the emotions that they feel in their body into their cognitive understanding of those emotions, or what is known as feelings. Yes, emotions and feelings are actually different things, processed by different areas of the brain (Damasio, 2001). The insula is the area of the brain that acts as a bridge between these two, converting emotions into feelings, or helping people to understand and put words to their bodily sensations. This sense of having an awareness of one's internal bodily state is known as *interoception*. Given the ability of the insula to facilitate awareness of one's emotional state, it is also a key brain region involved in consciousness and empathy (Craig, 2009; Decety & Lamm, 2006).

The cingulate cortex also lies underneath the outer surface of the cortex. This band of cortex extends lengthwise from the frontal to

the occipital lobes of the brain, following the shape and curve of the corpus callosum. The job of the cingulate cortex is quite varied, given its role in learning, memory, reward, and social and emotional processing, with the anterior (frontal) and posterior (back) sections controlling different functions. The anterior cingulate cortex (ACC) is responsible for emotional processing and regulation, empathic responding, and socially driven interactions, with the dorsal (top) ACC (what is also called the *middle cingulate cortex*) participating in more cognitive aspects and the rostral (front) ACC participating in more affective aspects of such processes (Lavin et al., 2013; Stevens, Hurley, & Taber, 2011). The functioning of the posterior cingulate cortex (PCC), however, is a bit more elusive. Recent research has determined that it appears to play a role in internally directed cognition, retrieval of autobiographical memories, and planning for the future (Buckner, Andrews-Hanna, & Schacter, 2008; Leech & Sharp, 2014; Raichle et al., 2001). Such research has also identified the PCC as a central node of the default mode network, a system of functionally connected brain regions that become engaged when the brain is in a resting state and not involved in a specific attention-demanding, goal-oriented task.

Cerebellum and brain stem. In addition to these four primary lobes, two other key features of the exterior portion of the brain are the cerebellum and brain stem. The cerebellum, meaning “little brain,” is the cauliflower-shaped structure at the back base of the brain. Like the cerebral cortex, the cerebellum is also divided into two hemispheres. It contains more neurons than the cortex—nearly 3.6 times as many (Herculano-Houzel, 2010). The cerebellum was originally thought to govern only motor control, such as posture and balance; fine-tuned motor learning (i.e., riding a bike); and the coordination of the fluid movements of multiple muscle groups. Researchers have more recently begun to recognize the integral role of the cerebellum in a range of functions related to cognition, emotion, sensory perception, attention, threat, and pleasure (Strick, Dum, & Fiez, 2009; Turner et al., 2007).

The brain stem is the structure of the brain that extends from the base of the brain to the spinal cord. It consists of the midbrain, the pons, and the medulla oblongata. The brain stem connects the brain to the rest of the body and is vital to survival. It regulates many of the nonconscious (not consciously directed) processes that keep people alive, such as breathing, heart rate, blood pressure, and circadian rhythms, including the sleep cycle.

Cranial Nerves

Extending directly from the brain out to various organs, muscles, and sensory systems are the 12 pairs

Reflective Question

Which cortical areas seem related to Rein's symptoms?