

Rik Carl D'Amato
Andrew S. Davis
Elizabeth M. Power
Eleazar Cruz Eusebio *Editors*

Understanding the Biological Basis of Behavior

Developing Evidence-Based
Interventions for Clinical, Counseling
and School Psychologists

 Springer

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This book is dedicated to my sons and their families, Michael and Charissa, and David and Lizzie. Thank you for demonstrating the power of love in your lives. It is the most important emotion that can positively change the world. Each day of your lives you make me proud.

–Rik Carl D’Amato

This book is dedicated to my friend and mentor, Dr. Rik Carl D’Amato, who helped me realize that I had the potential to become a scholar.

–Andrew S. Davis

To my parents, Sue and Tom, and my siblings, Tom, Kate, and Maureen. This book is also dedicated to my closest friends, especially my strong female warriors.

–Elizabeth M. Power

To my beautiful sons, Asher and Bodhi. You are my life’s greatest inspiration.

–Eleazar Cruz Eusebio

Foreword

For too long, clinical neuropsychology has been thought of as a set of tests or intervention techniques. It is not, and this work demonstrates this fact clearly. Neuropsychology is the study of brain-behavior relationships, and clinical neuropsychology is the application of this knowledge base to the clinical problems of individuals. What this means is that clinical neuropsychology is a way of thinking about and conceptualizing behavior and related clinical presentations. In this sense, all tests are neuropsychological tests if interpreted from this framework—just as all interventions are neuropsychological if conceptualized from the same framework. As my colleague Dr. Erin Bigler is fond of reminding us all, *every behavior has an anatomy*. Not all schools of thought in psychology would agree, but neuropsychology would, and as our study of neurobiology of behavior advances, we see more and more evidence that this is so.

This work captures the fundamental conceptual basis as well as the evidentiary basis that underlies neuropsychological practice. Clinical neuropsychology is presented not as a set of techniques, but as a way of understanding behavior and how to be a more effective change agent where a brain-behavior perspective is the best avenue of thought. It is then appropriate that the foundations part of the book focuses on neurobiology, both normal and abnormal in its development and how we currently study it, emphasizing advances in neuroimaging, an area that is moving remarkably quickly and at times astounding in what it promises to reveal in the near future. Each chapter in this part does a good job of staying focused on why this is important to conceptualizing our practice.

This is not a book for the journeyman neuropsychologist – rather it is a work focused on the original clinical specialties of psychology (clinical, counseling, and school) and how to conceptualize and understand the neurobiology of behavior and apply it to everyday problems of practice, using science as the basis for our work as opposed to faddish adoption of the newest catchphrase related to the brain and improving its function. Links to practice in each of these areas of specialization are emphasized throughout the work generally and then tied together in the concluding

part of the work. I do think if read early enough in one's career, it will inspire more clinicians, established and in training, to move to neuropsychology as a field of study and practice.

This is also an optimistic work – it not only gives us a foundation of thinking but links it to science and to practice – and takes the position that we can have a positive impact on patient outcomes in all spheres of our practice, whether as a treatment provider or consultant to other healthcare providers, if we understand the impact of the patient's neurobiology on their behavior and stay close to our science. I agree.

Kudos to all involved in this work—well accomplished.

Cecil R. Reynolds
Austin, TX, USA
September 2020

Preface

The field of clinical neuropsychology has given greater focus to the influence of biological variables in research and in the clinical practice of psychology. Along with several professional organizations, the field has supported the study of our biological aspects of behavior. In fact, all doctoral psychology programs approved by the American Psychological Association (APA) must include a course concerning the biological aspects of behavior. This book has been developed to meet the need as an introductory neuroscience, neurobiology, and neuropsychology text for health service psychologists, including clinical, counseling, and school psychologists-in-training, as well as for related health service practitioners.

Within the last several decades, clinical neuropsychology has gained wide recognition with relevance to family medicine, behavioral neurology, psychiatry, as well as clinical, counseling, and school psychology. Although the history of neuropsychological practice is rooted in its efforts to develop techniques to assist in differential diagnosis comparing functional to organic causes of behavior, contemporary neuropsychology has begun to redefine its role, seeking the scientific knowledge and tools to be able to answer more practical questions related to positive psychology and health as well as pathology and evidence-based behavioral change. The growth of neuropsychology has led to the development of new subspecialties including pediatric neuropsychology, school neuropsychology, geriatric neuropsychology, forensic neuropsychology, pediatric psychology, and rehabilitation neuropsychology. Many texts focus on a single subject such as forensic neuropsychology or a *single* age group such as pediatric or school neuropsychology. One goal of this book is to evaluate and offer information for clinical psychologists, counseling psychologists, and school psychologists who serve clients of **all ages** in a variety of professional **settings**, such as schools, hospitals, colleges/universities, business/organizations, and clinics. The application of neuroscientific findings must be our focus in all human service practice areas including psychology.

Current approaches to neuropsychological services focus on rehabilitation where the most commonly used intervention strategies generally target environmental modifications, compensatory strategies, mental health behaviors, or restorative counseling approaches. Because brain injuries often affect multiple systems, inter-

vention typically includes a variety of these approaches. In all situations, engaging the client and their support system (i.e., family) in a collaborative relationship to develop meaningful measurable functional goals is critical. Environmental modifications are used to address elements of the client environment to reduce the impact of the impairment.

Several influences will likely continue to shape the future of clinical neuropsychology. Specific advances in neuroimaging, psychopharmacology, and neurofeedback have dramatically affected the scope of neuropsychological practice. In addition, rehabilitation neuropsychologists are faced with increasing pressure to demonstrate empirically based practice that is ecologically valid for unique populations. With this understanding of the neurological aspects of many behaviors, current intervention options have significantly expanded. In addition to shaping the role of clinical neuropsychologists, scientific advancements have provided researchers and practitioners with new techniques to study developmental changes in the brain to understand neuroplasticity and neuroreorganization. The critical ability to evaluate the complex interactions between cognitive, emotional, social, and situational influences will be required for psychologists to make predictions regarding client abilities related to life enhancement and neurobiological understanding.

Today, clinical neuropsychologists are expected to demonstrate proficiency in choosing their assessment tools and methodology when addressing more complex questions such as predicting a client's ability to function in a particular context given an increasingly diverse population. In addition, neuropsychologists must address whether particular techniques are valid for individuals from different cultural and linguistic backgrounds and in various contexts. Moreover, the field must consider the recent dual pandemic, referring to the simultaneous COVID-19 pandemic and social unrest due to racial inequity, when completing comprehensive evaluations and offering appropriate services. The future of applied human service psychology will depend on the ability to accurately assess neuropsychological impairment in addition to reliably identifying appropriate, effective, and innovative interventions that are scientifically valid. As neuropsychology is grounded in a rich history of empiricism that is constantly influenced by advancements in related fields, psychologists who understand the interactions between physical and psychological processes and individual social environments are uniquely positioned to integrate information across disciplines in an effort to understand each client's central nervous system functioning – subsequently, they must develop and monitor the effectiveness of individually tailored and functionally related treatment plans. With each bit of new knowledge the boundary between behavior and biology continues to merge and one day these two disciplines may evolve into an integrated human service practitioner.

We believe the composition of the authors of our book, who are some of the leading scientists the neurosciences (including psychology), is noteworthy. These authors call for the advancement of our practice, and we want to thank them for their innovative and timely contributions. The enduring contribution of neuroscience in

modern times will likely remain contingent upon each psychology practitioner's commitment to socially just, ethically based, empirically focused practice, continuing education, and scientific discovery. The challenge to health service psychologists will be in meeting the needs of an increasingly diverse population by providing quality evidence-based ecologically valid neuropsychological interventions currently not abundant or available in the field.

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Contents

Part I Introduction and Foundations of Clinical Practice

1	Understanding the Past, Present, and Future of Clinical Neuropsychology from a Health Service Provider Perspective	3
	Catherine Van Damme and Rik Carl D’Amato	
2	Understanding the Development of the Central Nervous System and Its Relationship to Clinical Practice	31
	Margaret Semrud-Clikeman	
3	Why Should We Care About Functional Neuroanatomy?	53
	Eleazar Cruz Eusebio and Anna Pignatiello	
4	Understanding Typical and Atypical Neurodevelopment in Children and Adults	71
	Cynthia A. Riccio, Linda Huilin Sun, and Alyssa Gonzalez	
5	Advances in Neuroimaging	107
	Chad A. Noggle and Andrew S. Davis	

Part II Using Research to Guide Neuropsychologically-Based Practice

6	Designing Single Subject Research-Based Interventions for Clinical Neuropsychology Practice	141
	Fan Wu	
7	Qualitative Research-Based Interventions for Clinical Neuropsychology Practice	161
	Mary (Rina) M. Chittooran and Gertina J. van Schalkwyk	
8	Designing Quantitative Evidence-Based Interventions for Clinical Neuropsychology Practice	187
	Andrew S. Davis, Cathrine M. Short, Amanda R. Slonaker, and Jacob Yuichung Chan	

Part III Linking Assessment to Intervention in Clinical, Counseling, and School Psychology

9 Using a Standardized Neuropsychological Model to Guide a Qualitative and Quantitative Assessment for Evidence-Based Interventions 213
 Elizabeth M. Power and Rik Carl D’Amato

10 Integrating Clinical Assessments to Develop Health Service Neuropsychological Interventions 257
 Elizabeth M. Power, Rik Carl D’Amato, Jonathan Titley, Richard McNulty, Whitney Gibson, Christy Roman, Caitlin Cox Treffert, Catherine M. Van Damme, Elise M. Chalus, Jaclyn Hoffmeister, and Sydney Mitchell

Part IV Interventions Driven by Behavioral Neuroscience

11 Neuropsychologically Driven Evidence-Based Interventions in Clinical Psychology 341
 Amanda Skierkiewicz and Tiffany Keller

12 Neuropsychologically Driven Evidence-Based Interventions in Counseling Psychology 367
 Kristin Perrone and Ashley Schoener

13 Neuropsychologically Driven Evidence-Based Interventions in School Psychology 387
 Scott L. Decker, Christopher Anzalone, Rachel M. Bridges, and Jessica C. Luedke

14 Proactive and Transformational Directions: What We Need to Learn About Our Biological Basis of Behavior for Clinical Practice 409
 Andrew S. Davis, Bethany M. Schwandt, Elizabeth M. Power, and Rik Carl D’Amato

Appendices 429

Index 505

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Part I
Introduction and Foundations of Clinical
Practice

Chapter 1

Understanding the Past, Present, and Future of Clinical Neuropsychology from a Health Service Provider Perspective



Catherine Van Damme and Rik Carl D'Amato

Learning Objectives

- To understand the basic concepts of clinical neuropsychology.
- To understand how clinical neuropsychology fits within a health service psychology framework.
- To understand the major health service provider specialties in psychology and when is post-doctoral training required.
- To understand information on training and licensing for clinical neuropsychologists.
- To understand the services that a clinical neuropsychologist provides.
- To understand the highest level of expertise needed in clinical neuropsychology.

Understanding the History of Clinical Neuropsychology

The science of psychology is linked to current medical advances which have culminated in improved living. Clinical neuropsychology is the study of the relationship between the human brain and behavior (MacNeil et al., 2008; Meier, 1974; Smith & Moulin, 2012). Our brain is the basic and complex foundation for which all human interactions originate including simple to complex behaviors and thoughts. Today,

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researchers understand the brain because of historical knowledge from dozens of real-life cases. The study of psychology became a cornerstone for advancing areas of science, understanding, improving life, and helping humankind lead to societal change (Schultz & Schultz, 2015). The focus of this chapter is on understanding the importance of our biological basis of behavior and how it interacts to shape individuals, society, and the world. This chapter will integrate where clinical neuropsychology has been, where clinical neuropsychology is now, and where clinical neuropsychology will be going in the future. A special focus will be on relating clinical, counseling, and school psychology to the practice of clinical neuropsychology. The chapter will conclude with a focus on how one may become a clinical neuropsychologist and what current standards of training would need to be followed.

Most practicing psychologists know the famous case of Phineas Gage, the man who survived the metal rod and was arguably one of the first neuroscience cases (Larner & Leach, 2002). Phineas was a railroad worker, and an explosion thrusting a metal rod through his skull destroyed most of his frontal lobe. Detailed accounts showed that after the rod pierced his skull, he was talking and aware of his surroundings in only a few minutes. Early on, practitioners believed that any significant damage to the brain would cause complete dysfunction in the individual such as resulting in irreparable brain damage and total dysfunction (D'Amato & Hartlage, 2008). What happened in the nineteenth century helped to clarify that there are distinct structures with unique functions in the human brain. Moreover, this case demonstrated that the brain has a significant impact on each individual's personality; in the example of Mr. Gage's, he experienced a serious personality shift from a competent adult to an erratic and often angry man. This case example was one of many such studies that have demonstrated the impact of localized brain injuries on human behavior (Dean & Reynolds, 1997; Pankseep & Biven, 2012). Today we understand the brain more than ever and can apply treatment to a localized injury area. Neuropsychological practices can be implemented in the assessment and diagnosis of patients, as well as to determine the most effective treatment for patients. The American Psychological Association (APA), the largest group of psychologists in the world, oversees professional development, training, and credentialing with model licensure acts and professional associations found in every state encompassing the diverse field of psychology. The APA is organized according to more than 50 divisions that relate to specialty areas with Division 40 labeled as the Society for Clinical Neuropsychology which is most related to this text. Other professional associations such as the National Academy of Neuropsychology, the International Neuropsychological Society, and the American Board of Professional Psychology also are leading organizations which help to define, articulate, and advocate for understanding and training related to our biological basis of behavior, affective, social, and cognitive functioning. Through a neuropsychological perspective, researchers and clinicians alike can use what neuropsychology has to offer by developing treatments based on patient cognitive strengths and weaknesses to implement treatments that best match the cognitive capabilities of those patients (Power & D'Amato, 2018).

Altogether, neuropsychology was a major transition for the field of psychology from the work of Reitan who indicated at the beginning of his career his focus on neuropsychology which was seen as aberrant to the times (Reitan & Wolfson, 1985). Most departments and universities abandoned their historical focus on psychoanalysis and now focused on behavior. Over Reitan's life, he saw a complete change as journals who initially rejected his articles were then seeking his research which focused on neuropsychology and brain-behavior relations. The zeitgeist of the times had changed from psychoanalysis to behaviorism and now to clinical neuropsychology and behavioral neuroscience.

The Past: Foundations of Clinical Neuropsychology

Origins of Neuropsychology

Neuropsychology is the combination of several mental and physical sciences combined to create a field focused on brain and behavior relationships. While all science has advanced, so has neuropsychology which absorbed new information and applied it within a clinical framework. Specifically, as researchers continue to understand the brain through localized injury, they are able to better understand the behavioral outcomes related to each specific deficit, and study brain damage. Witsken, D'Amato, and Hartlage (2008), p. 5 defined clinical neuropsychology as "the scientific application of psychological and psychometric measurement procedures to assess and understand behaviors related to the central nervous system."

History of Rehabilitation

Rehabilitation focuses on developing a lost skill or teaching a new skill. One of the first rehabilitation programs was focused on developing and/or restoring reading skills (Boake, 2003). Later rehabilitation focused on treating brain injury, specifically New York University developed one of the first traumatic brain injury programs (Rothlisberg et al., 2003). This program revolutionized the way we currently treat brain injury, focusing on preparing the individual for the future through teaching skills and supporting family engagement. The program developed a six-stage growth model for individuals who had brain injuries (see Table 1.1).

The World Wars

As the wars took place over the twentieth century, there was an increased demand for psychologists based on evaluation and treatment needs (Kennedy & Moore, 2010; Schultz & Schultz, 2015). Both World War I and World War II created a large number of veterans who required psychological support after the stress and damage

Table 1.1 Clinical/cognitive stages of growth

Stage 1	Improve alertness, attention, and concentration
Stage 2	Develop self-awareness of the brain injury and adjust to the change
Stage 3	Master cognitive tasks
Stage 4	Control compensatory strategies
Stage 5	Accept the limits due to brain injury
Stage 6	Establish an identity

Note: Six stages are taken from Rothlisberg et al. (2003)

inflicted by combat. In addition, many of the most prominent psychologists fled to the United States during World War II which brought with a great body of research and interest to the scientific community (Schultz & Schultz, 2015). Prior to the World Wars, there were two types of clinical psychologists: the first were those who conducted psychotherapy and mental health counseling, and the latter focused on psychometrics and took a more analytical approach focused on assessment (D'Amato et al. & Dean, 2011). After the wars, many clinicians trained in both models to allow assessment to *drive* intervention rather than having two distinct entities.

Early Neuropsychologists

Early neuropsychology developed as both a clinical and research specialty which was focused on understanding areas of damage to the brain. For example, Marshall Hall learned that damaging and decapitated animals lead to specific behavioral outcomes (Schultz & Schultz, 2015). Pierre Flourens destroyed parts of the brain in pigeons hoping to understand the human brain. Marc Dax in 1836 wrote a paper on damage to the left hemisphere and the impact on an individual's behavior (Benton, 2000; Schultz & Schultz, 2015). Later, Paul Broca, the well-known surgeon, found supporting evidence that language is impacted when damage to the left hemisphere of the brain occurs (Broca, 1960/1865). Researchers then took on the challenge to start mapping out the human brain, which in part is correct because specific areas have been found to correlate with behaviors (Benton, 2000; Parks, Levine & Long, 1998). However, this was a misled endeavour due to the wrong singular application approach, today we understand that each area has a number of purposes and functions (Dean & Noggle, 2013a; 2013b; MacNeil et al, 2008; Smith & Moulin, 2012).

The Present: Current Practice of Clinical Neuropsychologist

Modern medicine and technological advances have revolutionized the role of the clinical neuropsychologist. In the past, the neuropsychologist used assessments to identify brain damage in patients. Then as technology advanced with scanning, we were able to see where the brain damage was through brain imaging (Papanicolaou,

2017). Now, we understand the brain-behavior relationship and that assessments can be used to inform treatment interventions. Neuropsychology has been argued as a way of thinking rather than simply a battery of tests (Davis & D'Amato, 2005; D'Amato, 1990; Power & D'Amato, 2018). It is true that neuropsychologists use a range of diverse tests to assess individuals; however, a patient who achieves a specific score can be viewed differently by health service provider psychologists. One train of thought could indicate a behavioral impairment, while the other may indicate cerebral dysfunction requiring specific rehabilitation. Thus, the same data may be interpreted differently from practitioners with distinct theoretical training (D'Amato & Rothlisberg, 1992/1997). Throughout the rigorous training regimen to becoming a neuropsychologist—this distinct perception and understanding of human behavior and cognitive capabilities was established. Clinical neuropsychologists are skilled in the assessment, interpretation, and treatment of comprehensive psychological disorders. Essential skills include neuropsychological assessment techniques, intervention techniques, research design and analysis, professional issues and ethics, culturally competent approaches, and understanding of implications of conditions for behavior and adjustment (Davis & D'Amato, 2014; Lezak et al., 2012; Zaroff & D'Amato, 2015). Competence in clinical neuropsychology requires the ability to integrate findings with medical knowledge, psychosocial and behavioral data, as well as the expertise from the neurosciences, to interpret findings in light of an appreciation of ecological and ethical issues (APA, 2017; D'Amato et al., 2005). Progress monitoring data can also be collected via neuropsychological assessment with a focus on cognitive or social-emotional processing. For example, a child with attention deficit/hyperactivity disorder (ADHD) can benefit from regular progress monitoring when a teacher completes a daily sheet based on both positive and negative work completion. In this example, progress monitoring consists of an analysis of the child's data and developing a report to provide feedback to the child and the family. A related concept is the topic of self-monitoring which is often used with individuals who have experienced a traumatic brain injury, such as setting a timer before turning on the stove to help manage a potentially dangerous living situation or using biofeedback to help regulate physiological symptoms related to anxiety.

The Health Service Provider and Clinical Practice

To be an effective psychologist, the clinician must be trained in the comprehensive basics of professional practice. In students' first years of training, they are given opportunities to develop both practical skills and theoretical underpinnings. Clinicians must attain competency in a variety of psychological domains including the biological and cognitive aspects and the affective basis of behavior. The purpose of this text is to teach the biological aspects of behavior but also to achieve an understanding of the neuroscientific systems of psychology and the cognitive aspects of behavior. Health service psychology covers the initial, middle, and end of both the developing human lifespan as well as advancing public health and university

training programs. For example, learning about neurodevelopment will help a patient understand why they present in a certain fashion with a type of problem. For advanced practicum, it will help diagnose and recommend future and appropriate services, knowing the outcome of the client given the unique neurodiversity of the individual. In addition, professional and personal development is achieved through the training stages of practicum, advanced practicum, and internship training.

“Health Service Psychology: is defined as the integration of psychological science and practice in order to facilitate human development and functioning. Health service psychology includes the generation and provision of knowledge and practices that encompass a wide range of professional activities relevant to health promotion, prevention, consultation, assessment, and treatment for psychological and other health-related disorders. Programs that are accredited to provide training in health service psychology prepare individuals to work in diverse settings with diverse populations. Individuals who engage in health service psychology have been appropriately trained to be eligible for licensure as doctoral-level psychologists.” (American Psychological Association, 2017, p. 2)

Understanding Medicine as It Relates to Psychology

The human body is a complex system that requires training specialties to treat and support a healthy person. Figure 1.1 demonstrates the variety of focus areas a practicing doctor can specialize in according to the American Medical Association (2014).

As health service psychologists, we are trained to support the overall health of human beings. To do this, the psychologist must not only be able to understand psychological symptoms but also help to connect patients with related services. For instance, an individual might suffer from depression and clearly demonstrate symptoms, but their hearing might be declining which presents as a reduction in the amount of social interactions. Having a trained psychologist recommending yearly doctor visits to get general testing can help to reduce and remove missed areas that support healthy human development. Alternatively, an individual might suffer from a lifelong disorder such as congenital anomalies which present as anxiety related to the outcomes. Together psychologists, physicians, and patients can increase positive outcomes through consultation and collaboration. Table 1.2 demonstrates the areas of specialty across the world according to the *International Classification of Diseases, Tenth Edition* (ICD-10).

The application of neuropsychological research for professionals has broadened and reached out to an array of fields (e.g., forensic neuropsychology, school psychology) and is not only used by researchers but also hospitals, prisons, and other vocational settings. Clinical neuropsychology is now very much valued as involving the assessment of cognitive pathology and playing a major role in the rehabilitation

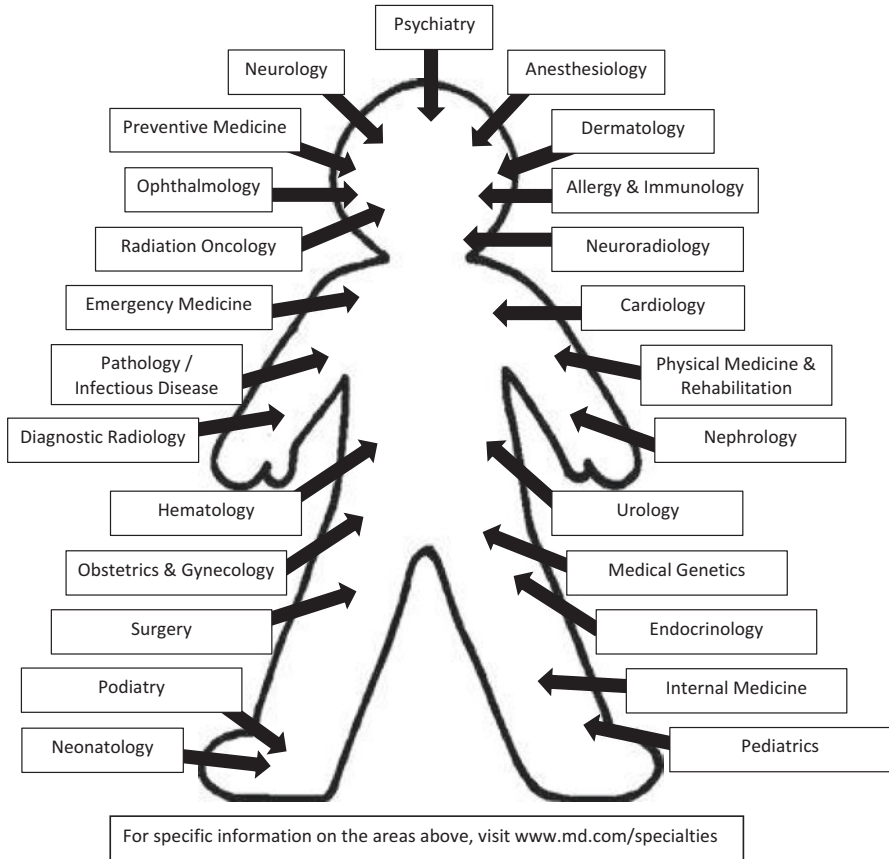


Fig. 1.1 Graphic Display of Medical Podiatry Nephrology Specialty Areas Podiatry

of patients (Goldstein & McNeil, 2012). Neuropsychologists conduct comprehensive evaluations to determine appropriate supports for patients who may have difficulty learning or functioning in daily life (Power & D’Amato, 2018). For example, the ability to live alone, drive a car, or take care of others is often critical to living independently. It is important to delineate the difference between brain scanning techniques which reveal the presence of abnormalities and how such neurological abnormalities impact life functioning. Indeed, brain damage alone does not reveal clear behavioral outcomes until considered within the context of rehabilitation and a full comprehensive neuropsychological evaluation. Medical technology alone is not sufficient for understanding behavioral outcomes – clinical neuropsychology should offer recommendations for understanding behavioral results related to everyday living. In general, brain impairment can take the form of degenerative diseases, traumatic injury, infections, and environmental toxins. All of these challenges create the need for comprehensively trained psychologists to work as health service providers.

Table 1.2 International Classification of Diseases, Tenth Edition (ICD-10) – areas of focus

1: Infectious and Parasitic Diseases
2: Neoplasms
3: Endocrine, Nutritional and Metabolic Diseases, and Immunity Disorders
4: Diseases of the Blood and Blood-Forming Organs
5: Mental, Behavioral, and Neurodevelopmental Disorders
6: Diseases of the Nervous System
7: Diseases of the Eye and Adnexa
8: Diseases of the Ear and Mastoid Process
9: Diseases of the Circulatory System
10: Diseases of the Respiratory System
11: Diseases of the Digestive System
12: Diseases of the Skin and Subcutaneous Tissue
13: Complications of Pregnancy
14: Diseases of the Genitourinary System
15: Diseases of the Musculoskeletal System and Connective Tissue
16: Congenital Anomalies
17: Certain Conditions Originating in the Perinatal Period
18: Symptoms, Signs, Ill-Defined Conditions
19: Injury, Poisoning, External Causes
20: Factors Influencing Health
21: External Causes of Morbidity

Note: The classifications above are from the American Medical Association (2014)

Practice of Clinical Neuropsychology

One of the largest growth areas in the field of psychology has been the practice of clinical neuropsychology (Davis & D'Amato, 2005; Davis, 2011). In fact, researchers have analyzed job openings and found that a large number of positions required neuropsychological skills (D'Amato et al., 1987). As time goes on, the number of open positions only increase due to technology and transportation (Witsken et al., 2008). Advances in transportation and communications have revolutionized the amount of time it takes to provide emergency medical services to individuals in need. The 911 emergency system has allowed bystanders with cell phones to dispatch emergency services such as ambulances and helicopters in seconds. These technological advances reach more individuals than ever before and have drastically improved emergency medicine allowing experts to save individuals who even 10-years ago would have been lost. Concomitantly, advances in medical technology such as scanning techniques allow medical practitioners to diagnose and intervene with life-saving medicine (Dean & Noggle, 2013a; 2013b; Kennedy & Moore, 2010; Lee 2010). Figure 1.2 demonstrates the variety of populations health service psychologists can work with, along with the services provided and the setting in which they are located.

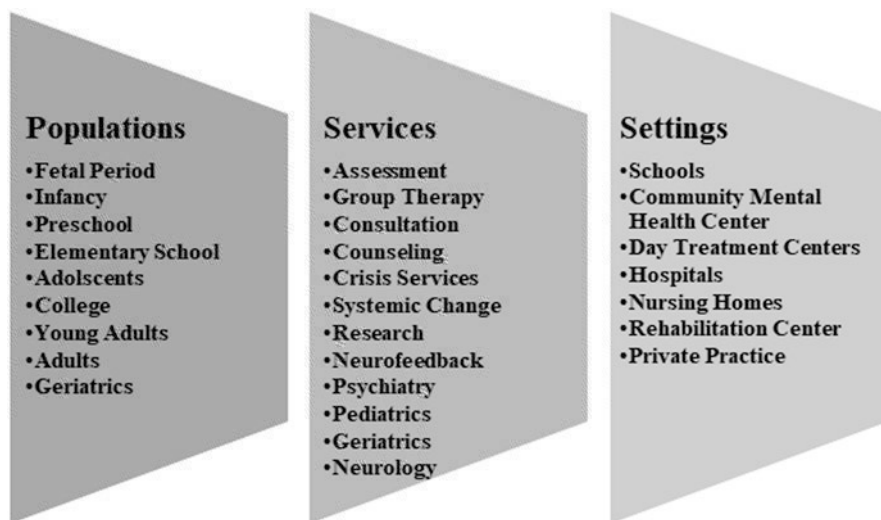


Fig. 1.2 Major areas of specialization by population, services, and settings

Since survival from a major accident or illness has dramatically increased, enduring aftercare treatment has also seen substantial growth with few psychological providers available. Moreover, advances in neonatal care and evidence-based practices greatly increased the survival rates of babies saved each year (Darmstadt et al., 2005, The Apgar score, 2006). Medical advances have created numerous populations (e.g., infant, toddler, children, adults, geriatrics) where providers are limited and these areas (i.e., geriatric neuropsychologists) will need workforce growth in the future. Prevention and intervention have created a need for services such as neurofeedback. Clinical hypnosis has provided opportunities to increase life satisfaction or, even more, to generally maintain physical health through regular exercise and healthy eating habits to increase overall life satisfaction. Today there is a focus on the importance of positive psychology groups and care groups focusing on grief, dieting, and smoking cessation. Most hospitals now provide preventative care to help support and enrich an individual's overall life. What society has now realized is that they need both psychological wellness and physical health to live a long life (Thornicroft & Tansella, 2004; Webb, 2011). This opens doors to the practice of psychology at every life stage to provide an abundance of services. The practice of psychology in medical settings is a growing and lucrative area of psychology starting with a comprehensive clinical interview including a medical, family, and environmental history. Appendix A provides a sample neuropsychological questionnaire developed by D'Amato et al. (2021). The questionnaire focuses on the presenting problem or reason for referral, living conditions, home environment, pregnancy, birth, development, medical history, socialization, current functioning, pathology, personality organization, and behavior. Table 1.3 demonstrates the areas a health

Table 1.3 What areas should be assessed from a neuropsychological assessment?

1. Perceptual/sensory	7. Academic achievement
(a) Visual	(a) Preacademic skills
(b) Auditory	(b) Academic skills
(c) Tactile/kinesthetic	(i) Reading decoding
2. Motor functions	(ii) Reading fluency
(a) Strength	(iii) Reading comprehension
(b) Speed	(iv) Arithmetic facts/calculation
(c) Coordination	(v) Social studies
(d) Lateral preference	(vi) Language arts
3. Intelligence/cognitive abilities	(vii) Science
(a) Verbal functions	(viii) Written language
(i) Language skills	8. Personality/behavior/family
(ii) Concepts/reasoning	(a) Adaptive behavior
(iii) Numerical abilities	(i) Daily living
(iv) Integrative functions	(ii) Development
4. Executive functioning/attention	(iii) Play/leisure
(a) Sustained attention	(b) Environmental/social
(b) Inhibition	(i) Parental/family
(c) Shifting set	(ii) School environment
(d) Problem-solving	(iii) Peers
5. Memory	(iv) Community
(a) Short-term memory	(c) Student coping/tolerance
(b) Long-term memory	(d) Family interpersonal style
(c) Working memory	9. Educational classroom environment
6. Communication/language skills	(a) Learning environment fit
(a) Phonological processing	(b) Peer reactions
(b) Listening comprehension	(c) Community reactions
(c) Expressive vocabulary	(d) Teacher/staff reactions
(d) Receptive vocabulary	(e) Classroom descriptions
(e) Speech/articulation	
(f) Pragmatics	

Note: Adapted from Power and D'Amato (2018)

service psychologist may have to investigate when working with an individual patient.

Above are the general areas a clinician should know to ask during an evaluation. This highlights the vast range of possible interventions that should accompany any outcome results related to the individual's deficits. A clinical neuropsychologist goes one step further in this process to work to understand the underlying biological functioning that might be impacting assessment results, which makes it even more important that intervention is tied to the assessment results to provide strong services for some of the highest needs population.

Screening Measures Used in Medicine Within the medical setting, there are numerous opportunities for neuropsychologists to assess the physical status of patients. One of the first steps in understanding the abilities in a presenting patient should be an introduction and review of the patient's complaints. Many examinations begin with an analysis of understanding the client's orientation (e.g., knowing who they are, where they are, current time, and presenting reason). Widely used screening measures such as the Glasgow Coma Scale and the Rancho Los Amigos have been used to help psychologists understand severe concussions (Reswick & Rogers, 1976; Rowley & Fielding, 1991). The Glasgow Coma Scale offers insight into the functioning of eyes, motor, and verbal skills, while the Rancho Los Amigos has allowed a tiered rating system to help identify the current level of performance with a rating at ten different levels. For example, a Level I is someone who has no response and requires total support, while a middle-level Level V is seen as confused, having inappropriate behaviors given the individual's personality and requiring maximal assistance, ending with Level X which requires very minimal support. A neurological and psychiatric screener such as the Minnesota Multiphasic Personality Inventory, Second Edition (MMPI-2), would be a useful tool for a psychiatric hospital. Another area individuals may focus on is perinatal neurodevelopment is the universally used APGAR score is generated when children are born (American Academy of Pediatrics, 2006). Utilizing these scales allow professionals to communicate efficiently and demonstrate focused and well understood medical terminology.

Neuropsychology developed as a psychological concentration which has depended on the innovative theoretical models and the growth of a rigorous scientific base (Goldstein & McNeil, 2013). In the East, many would advocate that Luria conceived the neuropsychological case study approach to understanding individuals with unique profiles (Semrud-Clikeman et al., 2005). In the West, many would see Halstead as establishing a standardized neuropsychological approach to evaluating and understanding brain damage with individuals using his newly developed test (Davis et al., 2005). Initially, the role of clinical neuropsychology was to help practitioners understand the *what* meaning what was wrong with a patient and how to help. Since then, the specialty field of clinical neuropsychology has expanded the delineation of the brain-behavior relationship and the necessary concentrations for successful interventions for treatments of neuropsychological pathology to help address the *why*. Practitioners now focus more on understanding the uniqueness of patients and seek to understand the strengths as well as the deficits when interpreting data and in providing services and recommendations. Practitioners and researchers also use the advances in computer technology to improve assessment and treatment procedures. While working in the hospital, there was a football player who had a severe concussion. This young adult, with raging hormones, was attractive and fit. The nurses reported that he was in a coma (drug-induced to help his brain heal). When he awoke from his coma, he was cognitively cloudy, which is a common experience. Often the first few days after a brain injury are groggy, and he had no memory of the injury. The nurses reported to the neuropsychologists that he was

flirting with them, and mom reported this behavior was unusual. The neuropsychologist were professional and ignored his flirting; a few days later while still in the hospital, the football player really liked one nurse in particular. He requested water and the nurse left to get the water; then a few moments later, his mom came into his hospital room, so he, not knowing his mother was coming, decided to pull his gown up to his neck, and he pulled the sheet off and said “Oh hello, there” to his mother. Horrified by his actions, his mom was both embarrassed and confused by the behaviors. Once he realized it was his mother, he quickly covered himself. While this instance is not a common side effect, it highlights a common theme with brain injury; an individual may have reduced impulse control and may have poor memory then forgetting that the incident occurred. It also emphasizes that a brain injury can present in a range of behavioral outcomes both expected and unexpected.

Who Are Clinical Neuropsychologists?

As the medical field continues to advance, the need for clinical neuropsychologists becomes more urgent. Clinical neuropsychology is a specialty in professional psychology that applies the principles of assessment and intervention to patients based upon the scientific study of human behavior as it relates to normal and abnormal functioning of the central nervous system. As science progresses, so does the average life expectancy for humans, bringing with it more complex neurological disorders. An emphasis, experience, and exposure within the pre-doctoral and post-doctoral internship help to prove the structure for knowledge on brain-behavior relationships (APA, 2017). There are a number of specialties which cover populations and techniques similar to those in neuropsychology, and an individual might want to consider related specialties like rehabilitation psychology, school psychology, pediatric and adolescent psychology, forensic psychology, or clinical child psychology. Most of these areas require pre-doctoral training and/or post-doctoral training.

Roles and Duties

Neuropsychology plays an integral role in the research and practice of many professional fields. Neurologists and neurosurgeons request behavioral evaluations to aid in diagnosis and to document the course of brain disorders or the effects of treatment. Rehabilitation specialists request neuropsychological assessments to assist in rehabilitation planning and management of a neurological condition. School psychologists have also applied the neuropsychological perspective in testing and providing intervention services for students (Root et al., 2005). A clinical neuropsychologist may assess a defendant when there is a reason to suspect that brain dysfunction contributed to the misbehavior or when there is a question about

the mental capacity to stand trial (Lezak et al., 2012). Pediatric neuropsychologists provide clinical services to children and adolescents (and their families). More specifically the APA designates clinical neuropsychologists as a specialty. The APA describes the roles as the assessment and treatment of brain disorders. The most important aspects include understanding and applying a neuropsychological battery of assessments and interpretation of the findings related to brain-behavior relationships. A neuropsychologist is responsible for taking in large amounts of complex data and interpreting how the results and injury are impacting their daily functioning. In addition, a clinical neuropsychologist needs to be well established in understanding cutting-edge research, making adjustments related to cultural competency, and the interventions that support the individual with a deficit in functioning.

Where Do Clinical Neuropsychologists Work?

Traditionally, the area of psychiatry is where many neuropsychologists have worked. The major questions psychiatrists have are the behaviors functional (environmental) or organic in origin (neurobiology). Exploring the disorders origin helps to direct pharmacological intervention and understanding of the behavioral outcome for a patient. Psychiatry is less about the uniqueness of the case but about how available you are as a practitioner to provide immediate support to clients with significant mental health needs. Psychologists can also work within neurology departments to help highlight appropriate interventions when neurological deficits are presented. D'Amato and Dean (1988) acknowledged the unique situation of a psychologist's understanding of both cognitive psychology and emotional development and connecting that understanding within a medical treatment plan. Neurologists can "pin-point" where the neurological issues are located, and clinical neuropsychologists can evaluate the behavioral outcomes and provide long-term services (D'Amato & Dean, 1988).

As noted earlier, as the medical field advances, so do survival rates for infants born with neurological deficits and genetic disorders (D'Amato & Dean, 1988). Science has advanced over the last few decades to increase the survival rate for babies born early and for enduring complications. Clinical neuropsychologists should be an integral part of the child's treatment team and can often consult with physicians on what the future outcomes are while recommending treatment options. One of the earliest indicators of biological-neurological deficits is diagnosed after birth. Neuropsychologists provide a secondary understanding of the current neurological data that inform outcomes and early interventions. Some pediatric neuropsychologists are trained in perinatal development and intervention. Clinical neuropsychologists may work alongside pediatricians in the hospital setting to support families and the child during their initial stages of understanding biological components to their deficits. As with the example of the young boy with a concussion, traumatic brain injury is another area where clinical neuropsychologists can facilitate long-term treatment planning and interventions. Specifically, when an

individual has a significant brain injury, they are likely to lose the ability to do the things that they had prior to the injury. Clinical neuropsychologists are able to help the individual retain or create new interpersonal connections, teach skill training, and complete psychotherapy if needed (Rothlisberg et al., 2003). In fact, the first program developed was in 1977 at New York University Head Trauma Rehabilitation Program focused on a holistic program which helped patients develop self-care routines, functional skills, and social skills (Rothlisberg et al., 2003). Today we understand even more about outcomes for traumatic brain injuries and can provide additional support throughout the recovery process.

Soon there will be a large call for geriatric services due to the shift in birthrates. The baby boomers are aging, retiring, and requiring additional supportive services. There will be a call for psychologists who can perform mental status exams and full neuropsychological evaluations to determine the level of need for an individual. This growth in our aging population coupled with the decline in current childbirth rates in the United States sets up a high demand for these services in the health psychology field. There is also significant work clinical neuropsychologists can do with the geriatric population. As individuals take place in the natural aging process, there are cognitive changes that the individual will likely experience, and neuropsychologists can complete baseline data as well as monitor the progression of some neurodegenerative disorders (Albert & Moss, 1988). As an individual ages, there is an increased chance of presenting as confused, developing dementia, and cerebrovascular disease all which impact the mental functioning of older individuals (Albert & Moss, 1988). Altogether clinical neuropsychologists can play an important role in helping to manage the stages of dementia and can provide families with psychoeducation about what to expect in terms of treatment. One case example was a 75- and a 78-year-old married couple of 60 years who had never spent a night apart. At the intake, the thought was that the woman might have had a heart attack and her husband was emotionally distraught over having to spend his first night apart from his wife. The doctors reported that she would have to spend the night and her husband stated that "I have never spent a night apart in the our 62 years of marriage" and the neuropsychologist happened to be available to speak with him. The neuropsychologists talked with the individual for a few minutes, and he decided to get a second bed set up so that the husband didn't have to experience any separation. Everyone complied with what the clinical neuropsychologist said and was an obvious solution. This example demonstrates the importance of using empathy and compassion during a neuropsychological consultation. Alternatively, in other settings, clinical neuropsychologists might have to prove or convince someone of their solution, while in the hospital or geriatric setting, patients and staff often respond quickly without questions.

There are also more individualistic approaches to using a specialty in clinical neuropsychologists, for example, working in private practice to provide a span of evaluations related to brain and behavior relationships. A private practice can provide both broad assessments for individuals and individual interventions geared toward the results of the evaluation. Also, there is a great need for research in the field which a clinical neuropsychologist can provide as they obtain detailed results