NEUROTHERAPY AND NEUROFEEDBACK

Brain-Based Treatment for Psychological and Behavioral Problems

Theodore J. Chapin and Lori A. Russell-Chapin

Foreword by Allen E. Ivey

ROUTLEDGE

Neurotherapy and Neurofeedback

The fields of neurobiology and neuropsychology are growing rapidly, and neuroscientists now understand that the human brain has the capability to adapt and develop new living neurons by engaging new tasks and challenges throughout our lives, essentially allowing the brain to rewire itself. In *Neurotherapy and Neurofeedback*, accomplished clinicians and scholars Ted Chapin and Lori Russell-Chapin illustrate the importance of these advances and introduce counselors to the growing body of research demonstrating that the brain can be taught to self-regulate and become more efficient through neurofeedback (NF), a type of biofeedback for the brain. Students and clinicians will come away from this book with a strong sense of how brain dysregulation occurs and what kinds of interventions clinicians can use when counseling and medication prove insufficient for treating behavioral and psychological symptoms.

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Lori A. Russell-Chapin, PhD, is a professor and associate dean of the College of Education and Health Sciences at Bradley University in Peoria, Illinois. She is also the co-director of the Center for Collaborative Brain Research at Bradley University, where she facilitates collaborative research in the areas of cognitive research, brain imaging, and neural feedback. In 2013, she was the recipient of the national Linda Seligman Counselor Educator of the Year Award, and she currently maintains a private counseling practice and is the co-author of six books, including *Clinical Supervision: Theory and Practice*.

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This book is dedicated to everyone who finds the human brain fascinating. Neurofeedback has made such a difference in many people's lives. Thank you to our children, Elissa and Jaimeson, who trusted us enough to allow neurofeedback into their lives.

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FOREWORD

After reading, I am shamelessly impressed by the scholarly and creative work of Drs. Lori Russell-Chapin and Ted Chapin. This book offers both the basics of neurofeedback and, equally important, a superb summary of current discoveries on the brain and neuroscience research. While oriented to those interested in neurofeedback, it is also an ideal introduction to brain basics for anyone who wishes to bring science into counseling and psychotherapy.

Neurofeedback's history goes back to 1924, when the German psychiatrist Hans Berger attached electrodes to the scalp and detected small currents in the brain. His research became the foundation for what is occurring today. In the 1960s, Joe Kamiya brought neurofeedback into more popular attention through his pioneering study of alpha brainwaves. It has taken some time, but now more sophisticated equipment at a reasonable price for what it provides has made neurofeedback and neurotherapy available to professionals and to the lay public.

The Chapins' book is also pioneering, even seminal, in several ways. First, it defines and summarizes the nature of neurofeedback clearly and succinctly. Next, it is the first book that brings together neuroscience as the foundation of neurotherapy. The definition of neuroscience is wisely broad, as neuroscience is the most integrative of all science disciplines. In this book, you will discover a raft of implications for neuroscience and neurofeedback. Among these are how diet and exercise impact the brain and the importance of Bowlby's attachment theory as a central aspect of neuroscience, as well as many brain basics.

I could go on at great length reviewing and discussing each chapter. For those who want to learn essentials of neurofeedback, you may want to start by reading Chapters 5 and 6. Here you will learn about the several types of

neurotherapy interventions, the relation of operant and classical conditioning to neurotherapy, and the latest computerized software including electroencephalograph (EEG) instrumentation.

Assessment and treatment follow in Chapters 8 and 9. It is impressive to read the clear summary of how neurofeedback can be used for training with therapeutic challenges such as ADHD, depression, anxiety, and chronic pain. There is evidence for its effectiveness with post-traumatic stress disorder (PTSD).

Neurofeedback *normalizes* dysregulated brains. However, neurotherapy must be conducted by an ethical and well-trained professional. Sadly, there are many "certification" programs that run through the many complexities of neurofeedback much too quickly. Quality technical equipment that is fully up to date is required. Ethical practice demands that neurotherapists be licensed in their helping profession, seek the BCIA certification, and receive supervision from a certified neurotherapist. The Chapins emphasize these points quite well.

Now, let me return to the superb discussion of the brain and neuroscience you will find in Chapters 3 and 4. These two chapters alone are worth the price of the book. Although I write and present on neuroscience around the world, I have never seen such a useful and clear description of the basics in such a small space. I like these two chapters so much that I intend to reread them several times. They are ideal introductions for both beginners and advanced professionals. Included are the basics for further study and further growth.

The National Institute of Mental Health is currently funding projects and research that will lead us to a fully developed brain-based counseling and therapy system within 10 years. This project will include specifics for recommended treatments as well as assessment and diagnosis, thus possibly changing the *Diagnostic and Statistical Manuals* of the American Psychiatric Association.

The Chapins provide the reader with a real sense of neurofeedback and neurotherapy in action. The concluding chapters "ice the cake" with a summary of key research and what we can anticipate from this field in the next several years.

Neurotherapy and Neurofeedback: Brain-Based Treatment for Psychological and Behavioral Problems will make a difference in both your understanding and practice, whether you work in medicine, psychology, counseling, social work, or any field where human communication and development is central.

Kudos to the authors. Read on!

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1

INTRODUCTION TO NEUROTHERAPY AND NEUROFEEDBACK

The human brain is estimated to have about a hundred billion nerve cells, two million miles of axons, and a million billion synapses, making it the most complex structure, natural or artificial, on earth.

—Tim Green, Stephen Heinemann, Jim Gusella

When the authors of this book combine their past counseling work experiences, we have an amazing and varied clinical counseling history. Ted has been a licensed clinical psychologist for several decades and has been in private practice for the past 25 years. Lori has been counseling as a licensed clinical professional counselor and teaching graduate counseling courses for the past 25 years. During this time period, discussions inevitably evolve to outcome-based questions such as, "Does counseling actually work? If so, how do helping professionals know that it works?"

These questions stimulate wonderful personal and classroom debates about counseling's efficacy. The conversations usually go something like this: There have always been counselors and a variety of other helping professionals throughout the history of mankind. From the village shaman to the wise sage to local pastors to licensed clinical professionals, people have been seeking out experts to help sort out the problems of daily living. In the beginning, the answer to "Does counseling work?" seemed a bit obvious.

Yes, counseling does work because "clients" come back and say they are feeling better in some way. When probing a bit more deeply, the answer is narrowed down further by specifically stating that the problem was gone or the presented behavioral symptoms have been reduced. Through research on counseling effectiveness, the largest predictor of counseling success is therapeutic alliance, over gender of therapist to theoretical orientation (Smith & Glass, 1977; Landman & Dawes, 1982; Lambert & Cattani, 1996).

Sometimes when cognitive therapy does not seem to be helpful, we then turn to medicine and psychopharmacology to assist us in reducing symptoms. Results of meta-analyses indicate that often the combination of counseling and medication is the best solution for many of our depressed adolescent

clients (Bhatia & Bhatia, 2007). In the past, counseling and medication have been the two mainstay approaches for the treatment of behavioral and psychological symptoms.

Just as discussions revolve around counseling efficacy concerns, every year discussions arise about the brain. For years, we have been saying that in the future the advances in neuropsychology, neurobiology, and neurorehabilitation will change the way we all conduct counseling. That future has arrived with the advances in neuroscience and fMRI research. We were correct; this new information has changed our thinking about counseling. It must change how we conduct our counseling strategies and interventions. These advances in neuroscience allow clinicians to understand more fully the above beliefs about why clients change and how symptom reduction occurs.

Fortunately we have a third option for treatment of behavioral and psychological symptoms, neurotherapy and neurofeedback.

Therefore, the main purpose of this book is to provide a thorough understanding of many of the aspects surrounding the world of neurotherapy and neurofeedback. In Chapter 1, *Introduction to Neurotherapy and Neurofeedback*, we will discuss in general terms the definition of neurotherapy (NT) and neurofeedback (NFB), the goals of neurotherapy and neurofeedback, and the basic principles. In-depth analysis of those topics will be covered in separate chapters. Chapter 2, *The History of Neurotherapy*, offers the reader an historical perspective of neurotherapy and neurofeedback. Then we showcase several of the pioneers in this field who have dramatically influenced the progress of neurofeedback. In Chapter 3, *Sources of Brain Dysregulation*, a thorough explanation of many of the reasons our brains become dysregulated are presented, from genetic predisposition to chronic illnesses. Chapter 4, *The Neurophysiology of Self-Regulation*, provides essential information to better understand the biological underpinnings of neurotherapy and neurofeedback, explaining the functions of the autonomic nervous system and the polyvagal system. The remaining six chapters offer specific information about NT and NFB. For example, in Chapter 5, *Strategies for Self-Regulation*, distinct categories of NT are presented from biofeedback to neurofeedback. Chapter 6, *Basic Concepts and Principles in Neurofeedback*, describes the needed instruments, computers, electroencephalographs, and the learning principles of operant and classical conditional that allow NFB to work. Chapter 7, *Assessment, Treatment Planning, and Outcome Evaluation*, outlines the step-by-step procedures and processes necessary to conduct NFB. This chapter describes the expectations and types of assessments needed to gather information on each NFB client. Following a logical order, Chapter 8, *Neurofeedback Training, Protocols, and Case Studies*, delineates actual NFB protocols designed for specific symptoms from ADHD to Peak Performance. We offer several NFB case studies to illustrate the needed protocols and presenting symptoms. Chapter 9, *Neurofeedback Efficacy Research*, offers essential and useful information about efficacy ratings

and NFB research. Chapter 10, *The Future of Neurotherapy and Other Professional Issues*, is our final chapter advocating for further NFB research, available resources, and ethical codes. We briefly visit the world of epigenetics and its impact on NFB.

NEUROTHERAPY AND NEUROFEEDBACK DEFINED

Neurotherapy is a form of neuromodulation. Neuromodulation simply means the alteration of some aspect of neuronal functioning. This could happen because of a variety of experiences, whether that occurs through physical exercise, learning a novel task, or neurofeedback. In future chapters, we will go more in depth about differing types of neurotherapy, but for now we will focus on neurofeedback (NFB), a type of neurotherapy involving a brain-computer interface (BCI) that maps certain aspects of a client's neurophysiology (e.g., brain wave amplitudes for various frequency bands) to some form of feedback, usually audio or video, that allows the brain to monitor and manipulate the underlying EEG activity. NFB, sometimes called EEG operant conditioning, is a type of self-regulation training (Swingle, 2010). Sometimes neurofeedback is labeled biofeedback for the brain, noninvasive brain surgery, or a neurological tune-up. When applied correctly, NFB has been found to lead to clinical improvements in several mental health disorders (Yucha & Montgomery, 2008). According to Yucha and Montgomery's thorough reviews, the authors rated the combined efficacy of biofeedback and neurofeedback a Level 4—"Efficacious" for anxiety reduction, attention disorders, chronic pain, epilepsy, and headaches. NFB "reinforces an optimal baseline of central nervous system self-regulation" (Legarda, McMahon, Othmer & Othmer, 2011, p. 1050). In addition, this self-regulation often decreases the need for multiple medications.

THE GOALS OF NFB

Many neurotherapists believe that because of living life and allowing life to happen, our brains become dysregulated. Chapter 3 will emphasize many of the occurrences that may cause dysregulation. For this discussion, though, here are a few examples for dysregulation: high fevers, accidentally falling on your head, personal trauma, or misuse of alcohol and drugs. These situations may cause three very different categories of brain states: overarousal, underarousal and/or unstable arousal. Overaroused persons may have symptoms ranging on a continuum from highly anxious to chronic pain. Underaroused persons may have symptoms from depression to ADHD, and the unstable aroused persons may be prone to anything from migraines to bipolar concerns.

The goal of NFB for any of these arousal states would be to reregulate and normalize brain functioning. Neurofeedback has the capacity to restore brain efficiency and begin to optimize personal and behavioral performance once again. This is accomplished with the principles of operant and classical conditioning. A neurotherapist will select a reinforcement brainwave target for a particular symptom such as ADHD. Perhaps there is not enough low beta in a child with ADHD, so the reinforcement target might be around 12–15 Hertz. Because the brain loves to be challenged, it will search for that targeted brainwave. When it hits that specified brainwave, it will be reinforced with a reward such as a full puzzle unfolding or a game moving forward. This is the action behind the principles of operant conditioning and learning in general.

There may be excess brainwaves causing symptoms as well. This same child with ADHD may have excess in theta and high beta. The neurotherapist might need to set two inhibits to help condition the brain to lower theta and high beta. These inhibits could have sounds attached to them, such as birds chirping, to remind the client there is too much theta. To remind them there may be too much high beta, a foghorn-like sound could be associated with high beta. When the client hears these sounds, it is a reminder, consciously and unconsciously, to lower those brainwaves. The brain wants those noises to go away and wants its goal to occur. Often, a client might work too hard or try too hard to make these sounds go away or make the puzzle unfold. The neurotherapist then has to teach the client to allow this natural process to occur. This may mean teaching the client some basic relaxation techniques or heart rate variability techniques. Eventually the brain wins out, and reinforcement and inhibit goals are achieved. Again these are basically the same principles of classical and operant conditioning and the principles of learning that change any behavior. These conditions all work together to assist the dysregulated brain to function in a more normal, regulated, and efficient manner.

NEUROPLASTICITY AND NEUROGENESIS

Through the advances of neuroscience, we better understand the brain, its functions, and its capabilities. In the last decade, brain research has debunked some old ideas, validated other existing beliefs, and offered new and encouraging interventions for helping people grow and learn. For years, educators and helping professionals believed that the brain matured around 12 years of age. Now with the help of functional magnetic resonance imaging (f MRI), researchers know that the adolescent brain is fully developed in the middle twenties (Giedd, 2004). However, neuroscientists now understand that the brain has the capability to adapt and develop new living neurons up until the very end of our lives, according to Dr. Norman Doidge, a psychiatrist at

Columbia University Center for Psychoanalytic Training and Research in New York. This process is called neuroplasticity. "Neuroplasticity can result not only in one region of the brain colonizing another—with remarkable effects on mental and physical functions—but also in the wholesale remodeling of neural networks" (Doidge, 2007, p. 16). A brain can rewire itself, as authors Schwartz and Begley demonstrate in their 2003 book called *The Mind and the Brain: Neuroplasticity and the Power of Mental Force*.

The brain is no longer considered a stagnant organ, but rather three to four pounds of plastic, fluid, and malleable tissue. Human beings can change their brains and develop new pathways through repetition and learning new skills. Challenging and taxing the brain with new tasks such as learning a foreign language can forge different pathways in the brain. The capacity to restructuring our brain allows our brain span to match our life span. The old adage, "you can't teach an old dog new tricks," no longer holds true.

One of the early neurorehabilitation pioneers, Dr. Paul Bach-y-Rita, recounts a poignant, personal story about his beginnings in the world of neuroplasticity (Bach-y-Rita, 1980). His father, Pedro Bach-y-Rita, a 65-year-old widower, had a disabling stoke. Pedro was paralyzed and unable to speak. Dr. Bach-y-Rita's brother, George, a medical student at that time, took his father in and was determined to help him recover. George first taught Pedro to crawl through painstaking and frustrating incremental movements. Then they begin to work on daily survival tasks such as washing dishes. They turned normal daily activities into life exercises. After months of struggles, Pedro slowly got better and better. Three years later, Pedro was able to return to his love of writing, poetry, and teaching. Pedro even remarried and became active in traveling and hiking. This story in itself has a wonderful and unique ending, but the best part of the story is yet to come. When Pedro was 72, he died of a heart attack while climbing in the high mountains of Colombia. Paul, curious about his father's astonishing recovery, requested an autopsy. He wanted to see slides of his father's brain. Paul's emotions ran from shock to amazement. Paul could actually see the part of his father's brain that had the lesion from the stroke. Ninety-seven percent of the nerves that went from his cerebral cortex to his spine were destroyed. The remainder of the slides, however, showed Pedro's brain had reorganized itself and built new nerve growth that restored his higher life functions. Pedro's brain slides dramatically demonstrated the devastation from the stroke and the creation of new growth. His determination, struggle, and hard work were clearly worthwhile. This dramatic story and countless other research results can also be read in Dr. Doidge's remarkable 2007 book, *The Brain That Changes Itself*.

Our brains are changeable and malleable organs for the positive and negative, and we know we can reorganize and maintain our brains for the better. Negative neuroplasticity can occur through trauma, repeated negative events, poor environmental conditions, and even constant negative thinking. Positive neuroplasticity can develop by challenging the brain with a new task

such as learning a musical instrument, physical exercise, and even counseling.

The research and stories described above are only the beginning of this exciting new frontier into our changing brains and neurorehabilitation. Neurofeedback is just one more way we can help our brains. Swingle stated, "The mind is capable of astounding regeneration, growth and change" (2010, p. 31). Having the capacity to build new neuronal pathways, or neurogenesis, has far-reaching implications for all of us.

JAIMESON'S STORY

This story will seem all too familiar. Meet Jaimeson, a small, 7-year-old boy, who is bright and energetic. He is well liked in his class, very verbal but easily distracted. He is busy and constantly on the go. His teachers send home notes about his conduct, behaviors, and falling behind in homework. Jaimeson's parents are well educated and concerned about his learning in general. Many academic tests are administered, and all are in the normal ranges. His IQ is 130. Finally, his parents take him to a psychiatrist for additional testing. A Single Photon Emission Computer Tomography (SPECT) is done, along with several computerized continuous performance tests. After much discussion, the diagnosis was possible ADHD.

Jaimeson's parents decided not to place him on medication and began the long and arduous task of structuring his environment with behavioral modification plans. The psychiatrist supported their decision but warned that when their son hit puberty and his testosterone was in full motion, that his symptoms might progressively worsen. Providing structure and finding physical activities that Jaimeson enjoyed such as drumming, music, and Tae Kwon Do seemed to work, especially in coordination with the school system. His academic performance was average, but Jaimeson began not enjoying school.

During the eighth grade, Jaimeson became discouraged and struggled academically. His parents finally relented and placed him on a stimulant medication. After the first day of medication, his mom picked him up from school. He declared, "This is what it feels like to be focused!" His grades began to improve slowly, but contraindications from the stimulant were discouraging. Jaimeson lost weight, had difficulty sleeping, and had an even more difficult time getting up in the morning. Of course, this created emotional distress among other family members in the house.

Entering high school was even more difficult for Jaimeson. He lacked confidence in his learning skills, and that generalized to diminished social skills. An individualized education plan (IEP/504) was developed, allowing for special testing and homework tactics. Jaimeson detested having an IEP and being labeled as a "special needs student." Along the way, he had many

tutors and camps to assist him in learning better skills. It seemed as if nothing truly made a substantial difference.

During Jaimeson's junior year in high school, his parents bribed him into doing 40 sessions of SMR neurofeedback (NFB)! They offered to purchase a new drum that he dearly wanted, after completing his 40 NFB sessions. The lure of a new drum enticed him, but he was scared that somebody would be "messing" with his brain. One day he mentioned that he basically liked his personality and didn't want to be changed through neurofeedback. This concern was discussed with his neurotherapist, and he wisely stated, "Your personality will not be changed. NFB only makes you a better you, a more efficient Jaimeson!" This alleviated some of Jaimeson's fears, so he reluctantly began his sessions. He was taught several beginning biofeedback interventions, Heart Math and skin temperature control. Then his NFB sessions began.

Around session number 20, his mom noticed that Jaimeson seemed to get out of bed more easily, and his general demeanor seemed more relaxed. By session 30, Jaimeson's entire life seemed to go more smoothly. He had the courage to begin a 20-hour-per-week job, maintained Bs and a few As in classes, and had a steady girlfriend. His mother commented that his life was like the Claritin commercial on television. In that commercial anyone with allergies lives a very foggy and cloudy lifestyle, but when Claritin is introduced into the system, that veil of fogginess is lifted away. That described Jaimeson's new life. He began to live life with clarity and ease.

The story does not end here. During his senior year of high school, Jaimeson earned the distinction of Dean's Honor Roll for the first time and graduated from high school. He began weaning off his stimulant medication, becoming medication-free during the summer. He surprised his parents by requesting to take a study skills class before entering college. He completed that series and began his freshman year in college at a small, private university. He is majoring in finance and the prelaw curricula. He successfully completed his first semester of college with all As and Bs and also competed in mock trials with other universities. The reader needs to know, however, that Jaimeson would not contribute his success to NFB. He believes it certainly helped, but it was he who made the difference.

As a practicing neurotherapist, I agree with Jaimeson's statement. It was that young man who made the difference, but it was NFB that gave him the needed neurological foundation and stability to put that ever-maturing brain into action. This is only one success story that will be discussed throughout this book, but it gives the reader an example of the power and hopefulness that NFB offers.

There is one additional component to this particular story that is important. Jaimeson is the son of the book authors! He gave us permission to share his story, and all three of us are thrilled with the results of NFB. We truly believe that NFB was the essential turning point for Jaimeson's successful life journey.

AN INITIAL NFB SCREENING FOR THE READERS

This final section of Chapter 1 is a short screening assessment titled "Neurological Dysregulation Risk Assessment" (Chapin, 2013). Read through the tool thoroughly and check off any of the categories that might apply to your life. Score the screening, and then read the bottom to see if NFB might be appropriate for you. Each one of these dysregulation categories will be explained further in Chapter 3.

NEUROLOGICAL DYSREGULATION RISK ASSESSMENT

Name (or Child's Name):_____ **Age:**_____ **Date:**_____

Current Problem, Symptom, or Complaint: _____

Please read each potential source of neurological dysregulation and indicate whether or not it may be a risk factor for you or your child.

	Yes	No
Genetic Influences: Grandparents, parents or siblings with mental health or learning disorders (including attention deficit hyperactivity disorder), post-traumatic stress disorder, depression, generalized anxiety disorder, substance abuse, personality or other severe psychological disorders (bipolar or schizophrenia).	_____	_____
Prenatal Exposure: Maternal distress, psychotropic medication use, alcohol or substance abuse, nicotine use, or possible exposure to environmental toxins including genetically modified foods, pesticides, petrochemicals, xenestrogens in plastics, heavy metals (lead/mercury), and fluoride, bromine, and chlorine in water.	_____	_____
Birth Complications: Forceps or vacuum delivery, oxygen loss, head injury, premature birth, difficult or prolonged labor, obstructed umbilical cord, or fetal distress.	_____	_____
Disease and High Fever: Sustained fever above 104 degrees due to bacterial infection, influenza, strep, meningitis, encephalitis, Reye's Syndrome, PANDAS, or other infections or disease processes.	_____	_____
Current Diagnosis: Of mental health, physical health, alcohol abuse, substance abuse, or learning disorder.	_____	_____

	Yes	No
Poor Diet and Inadequate Exercise: Diet high in processed food, preservatives, simple carbohydrates (sugar and flour), genetically modified foods, foods treated with herbicides, pesticides, and hormones, low daily water intake, high caffeine intake, and lack of adequate physical exercise (20 minutes, 7 times a week).	_____	_____
Emotionally Suppressive Psychosocial Environment: Being raised or currently living in poverty, domestic violence, physical, emotional, or sexual abuse, alcoholic or mentally unstable family environment, emotional trauma, neglect, institutionalization, and inadequate maternal emotional availability or attachment.	_____	_____
Mild to Severe Brain Injury: Experienced one or more blows to the head from a sports injury, fall, or auto accident (with or without loss of consciousness), or episodes of open head injury, coma, or stroke.	_____	_____
Prolonged Life Distress: Most commonly due to worry about money, work, economy, family responsibilities, relationships, personal safety, and/or health causing sustained periods of anxiety, irritability, anger, fatigue, lack of interest, low motivation or energy, nervousness, and/or physical aches and pains.	_____	_____
Stress Related Disease: Includes heart disease, kidney disease, hypertension, obesity, diabetes, stroke, hormonal, and/or immunological disorders.	_____	_____
Prolonged Medication Use, Substance Use or Other Addictions: Including legal or illegal drug use, substance abuse, or addiction (alcohol, drugs, nicotine, caffeine, medication, gambling, sex, spending, etc.) and overuse of screen technologies (cell phones, video games, television, computers, Internet, etc.).	_____	_____
Seizure Disorders: Caused by birth complications, stroke, head trauma, infection, high fever, oxygen deprivation, and/or genetic disorders and includes epilepsy, pseudo-seizures, or epileptiform seizures.	_____	_____
Chronic Pain: Related to accidents, injury, or a disease processes Including back pain, headache and migraine pain, neck pain, facial pain, and fibromyalgia.	_____	_____

	Yes	No
Surgical Anesthesia, Chemotherapy, and/or Aging: Can cause mild cognitive impairment, insomnia, and depression and be related to emotional trauma, loss and grief, chronic illness, physical decline, reduced mobility, physical, social, and emotional isolation and decreased financial security.	_____	_____
Scoring and Interpretation: Total Number of "Yes" Responses	_____	_____

In general, the greater the number of "yes" responses, the greater the risk of significant neurological dysregulation. However, even one severe "yes" response could cause significant neurological dysregulation and result in serious mental, physical, or cognitive impairment that may benefit from individually designed neurofeedback training.

CONCLUSIONS

To help readers clarify what information will be emphasized throughout our book, this chapter outlines the main focus of each of the remaining nine chapters. A simple definition of neurotherapy and neurofeedback was offered using a neuromodulation model. Hopefully, this assists readers in understanding that all neurotherapy is a type of neuromodulation. Neurofeedback is a type of neurotherapy with biofeedback for the brain, as an excellent definition. The stories and the screening at the end of the chapter illustrate the possible benefits and hope that neurofeedback may bring. The remaining chapters discuss in detail the nature, function, and capabilities of neurotherapy and neurofeedback.

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2

THE HISTORY OF NEUROTHERAPY

With modern parts atop old ones, the brain is like an iPod built around an eight-track cassette player.

—Sharon Begley

Types of neurotherapy and neurofeedback have a surprisingly long history of self-regulating brain work that spans thousands of years with some unexpected origins. Throughout history, humankind has experimented with different methods to help with the complexities of living. The martial arts, yoga, meditation, and prayer have been practiced for millennia. Although no one understood exactly why these exercises helped, they made us feel better and stronger. Now we know these were examples of effective brain self-regulation (Swingle, 2010). In the past, we may have not known the whys or even the hows of what made life work, but slowly people began to discover more and more information about the body. For example, in ancient Egypt, a paper papyrus was discovered with hieroglyphs demonstrating that a hit to the left side of the head would diminish vision and, specifically, a blow to the left part of the head would influence the right side of the body (Robbins, 2008). We have been trying to understand the brain and its functions from the beginning of time. With all our new advances, Ivey, Ivey, Zalaquett, and Quirk (2009) stated that the "bridge between biological and psychological processes is erasing the old distinction between mind and body, between mind and brain" (p. 44).

This chapter will explore the history of neurotherapy and the science and research behind the evolving fields of neurotherapy and neurofeedback. In an effort to better understand the power and effects of brain self-regulating techniques from biofeedback to neurotherapy to neurofeedback (NFB), this history piece will begin with chronological biographical sketches of neurotherapy pioneers and their main contributions to neurotherapy and neurofeedback. Many early experimenters will be left out of this writing, but each one helped the other to discover the power of the brain. Today, the

neurotherapy and neurofeedback history is still growing, but we need to begin with the vision of one of the pioneers who discovered that the brain had electrical impulses.

NEUROTHERAPY PIONEERS

Richard Caton

Major Contributions: In 1875, Dr. Caton, a British physician, was exploring the different functions of the brain and found that the brain had electrical impulses or waves. He was working with animals and noticed that when a probe was placed in certain parts of the exposed cortices, an electrical impulse was observed. This discovery was a major beginning of the neuroscience and neurotherapy field.

Camillo Golgi

Major Contributions: Around the same time that Dr. Caton was working on electrical impulses, Dr. Golgi, an Italian anatomist, created an innovative brain stain, allowing nerve cells to be seen much more easily under a microscope. This occurred in the 1880s (Robbins, 2008).

Santiago Ramón y Cajal

Major Contributions: Using the new stain, Dr. Ramón y Cajal, a Spanish anatomist, discovered the brain cell, explaining and labeling the cell's function and structure with dendrites and axons. His work contributed to our current understanding of neuroplasticity and neurogenesis by demonstrating that cells change and grow when new learning occurs. The Nobel Prize was awarded in 1906 to Camillo Golgi and Santiago Ramón y Cajal (Robbins, 2008).

Hans Berger

Major Contributions: It took until 1924 for Hans Berger, a German psychiatrist, to discover the amplification of the brain's electrical activity from the surface of the scalp and actually record it on a type of graph paper using a reflecting galvanometer. This first was the beginning of the electroencephalogram (EEG) as we know it today, and it was Dr. Berger who coined the term EEG. Dr. Berger also was one of the first scientists to understand that a person's brain waves are different depending on the state of consciousness or attention (1929). He observed that if his subject was resting or sitting quietly with eyes closed, frequencies could be seen around 10 cycles per second (10 Hertz [Hz]). However, if the same person was concentrating on