The Efficacy of Neurofeedback in the Treatment of Individuals with Anxiety-Spectrum Disorders: A Meta-Analysis

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THE EFFICACY OF NEUROFEEDBACK IN THE TREATMENT OF INDIVIDUALS WITH ANXIETY-SPECTRUM DISORDERS: A META-ANALYSIS

A Dissertation presented in partial fulfillment of the requirements for the degree of Doctorate of Philosophy in the Department of Leadership and Counselor Education The University of Mississippi

by

G. MICHAEL RUSSO

MAY 2021
ABSTRACT

A number of authors have published articles that assert the efficacy of neurofeedback (NFB) in the treatment of people with anxious symptomatology. Despite this, many insurance companies identify NFB as experimental, which prohibits individuals from utilizing benefits to obtain this therapeutic treatment. In order to examine these discrepancies, the present meta-analyses were conducted and guided by research questions designed to examine the overall effectiveness of NFB, the impact of participant characteristics, and identify if there is a significant difference in anxiety-spectrum outcomes. Twenty-six trials were divided based on design (14 single group [SG]; 12 between group [BG]) and analyzed in separate meta-analyses. Overall, results indicate that anxiety-spectrum self-report assessments reduced by nearly one (SG $SDM = -0.94$; BG $g = -0.87$) standard deviation unit with relatively small degrees of bias. Limitations and future directions are reported.
DEDICATION

This dissertation is dedicated to my grandfather, Michael Mario Russo; grandmother, Jeanette Louise Russo; father, Mark J. Russo; and my loving wife, Jessica N. Russo. These individuals instilled the values of: passion, perseverance, pride, and patience in me throughout my personal and professional endeavors. Additionally, as the first member of the Russo family to obtain a doctoral degree, this dissertation is dedicated to our familial posterity. It is my hope that you will rise above adversarial constructs and that you will fearlessly pursue excellence, as you see fit for yourself; trusting in the knowledge that true family members will be there to support you throughout the peaks and valleys of your endeavors.
LIST OF ABBREVIATIONS AND SYMBOLS

BFB  Biofeedback
NFB  Neurofeedback
EEG  Electroencephalogram
QEEG Quantitative Electroencephalogram
GAD  Generalized Anxiety Disorder
PTSD Posttraumatic Stress Disorder
OCD  Obsessive Compulsive Disorder
I would like to express my upmost gratitude for my academic mentors who have inspired, challenged, and supported me throughout my professional development as a counselor educator with a specialization in clinical mental health counseling and integrative neurotherapy. Specifically, I would like to thank my undergraduate mentor, Dr. Mary McNaughton-Cassill; graduate mentors, Drs. Gerald A. Juhnke and Thelma Duffey; as well as my doctoral mentor, Dr. Richard S. Balkin. Each of these individuals have uniquely supported and inspired the counselor and counselor educator that I have become. I am forever thankful for the support and encouragement to pursue leadership positions and utilize them as a platform to advocate with, and on behalf of, those whom I serve.

Furthermore, I would like to thank my neurofeedback mentor and friend, Dr. D. Allen Novian. Many of my successes would not have been possible without the support of the neuroscience communities within the counseling profession specifically: Drs. Eric T. Beeson, Thomas A. Field, Raissa Miller, Carlos P. Zalaquett, Laura K. Jones, Yoon Suh Moh, Michelle R. Ghoston, Chad Luke, Eraina Schauss, and the many others that have inspired and supported my growth as a neuroscience-informed counselor.

I would also like to thank the members of my dissertation committee, Drs. Balkin, Lenz, Lusk, and Stapp, for their support and encouragement as I undertook this dissertation and the corresponding defense.
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CHAPTER I

INTRODUCTION
The Efficacy of Neurofeedback in the Treatment of Individuals with Anxiety-Spectrum Disorders: A Meta-Analysis

The integration of mental health and neuroscience have had a long history dating back to the Hippocratic ideals that underpin medical ethics (Kleisiaris, et al., 2014); the founding of the Association of Medical Superintendents of American Institutions for the Insane in 1844, which evolved into the American Psychiatric Association (APA, 2019); and later Jean-Martin Charcot’s studies of hysteria in the 1860’s, which fueled the fascination of Sigmund Freud (Bogousslavsky, 2014). Despite this rich history, there was a divide in the 20th century between mental health and neuroscience; neurologists began to focus on diagnoses such as brain injury, stroke, and seizure disorders; psychiatrists began to focus on mood disorders (Baker et al., 2002). Amidst this divide among the medical profession, counselors began to recognize and advocate for the inclusion of technologies that increase an individuals’ awareness of biological processes (e.g. brain waves, heart rate, muscle tension) to assist in the reduction of clinical symptomatology while empowering autonomy (Danskin & Walters, 1973; Sarnoff, 1982). However, these conversations went relatively stagnant until President George H. W. Bush designated the 1990’s as the Decade of the Brain (Library of Congress, 2000). This period of time saw unparalleled advancements within brain-based sciences and advancements in technology that supports the study of the brain.

Currently, the American Counseling Association (ACA), Council for the Accreditation of Counseling and Related Educational Programs (CACREP), and American Mental Health Counselors Association (AMHCA) all address neuroscience through their standards, interest networks, and/or designated space within their official publications. ACA recognized and offered
dedicated space for topics related to the integration of neuroscience within the practice of counseling in their publication, *Counseling Today* (Russell-Chapin & Field, 2020) as well as supported the Neurocounseling Interest Network (ACA, 2015). CACREP (2015) mandated that accredited programs provide foundational knowledge to all graduates in the areas of “biological, neurological, and physiological factors that affect human development, functioning, and behavior” (p.10). AMHCA also provided backing of neuroscience-informed counselors through the dedication of space within the *Journal of Mental Health Counseling* (Weigold, 2020), as well as professional standards known as the *Biological Basis of Behavior* (AMHCA, 2020). ACES provided support to their membership with an interest in the integration of neuroscience into counselor education and supervision through their Neuroscience Interest Network (ACES, 2019). Outside of clinical neuropsychology, counseling is the only other mental health profession that has created and implemented training standards to address the integration of neuroscience into clinical practice (Russo et al., 2021).

However, outside of the mental health professions, there are numerous organizations that explore the application of biofeedback (BFB) and/or neurofeedback (NFB). Some of these organizations include the Association of Applied Psychophysiology and Biofeedback (AAPB), Biofeedback Federation of Europe (BFE), and the International Society for Neuroregulation & Research (ISNR). Additionally, the Biofeedback Certification International Alliance (BCIA, 2020a) recognizes and certifies individuals that have successfully completed a set of specified standards. BCIA currently offers four certifications including: Board Certification in Biofeedback (BCB), Heart Rate Variability Biofeedback (HRVB), Board Certification in Neurofeedback (BCN), and Pelvic Muscle Dysfunction Biofeedback (PMDB). Additionally, BCIA (2020b) established a progressive certification program in 1996 that recognizes the
following distinctions: Associate Fellow, which indicates that the clinician has maintained certification for a range of 5-8 years, has obtained a minimum of 4 years of clinical experience, and has completed basic certification requirements plus 48 hours of continuing education; Fellow, which indicates that the clinician has maintained certification for a range of 9-16 years, obtained a minimum of 12 years of clinical experience, and has completed basic certification requirements plus 144 hours of continuing education; Senior Fellow, which indicates that the clinician has maintained certification for a minimum of 17 years and has obtained a minimum of 192 hours of continuing education within their specified scope.

With the increased recognition and professional backing, counselor educators such as Zeglin (2020) have even considered the infusion of neuroscience into the counseling profession as the sixth force of counseling. However, there are recognized challenges to this dualistic model, as well as calls to acknowledge the benefits that brain-based sciences can bring to the understanding and treatment of mental health (Beeson & Field, 2017; Ilardi & Feldman, 2001; Ivey et al., 2018; Johnson, 2001; Jones, 2015; National Institute of Mental Health, 2020; Ross et al., 2015; Russell-Chapin, 2016; Russo et al., 2021). Examples of challenges include topics such as the implementation of standards of training (e.g. Russo et al., 2021) and agreed-upon terminology. With respect to terminology, Montes (2013) and Russell-Chapin (2016) described the use of neuroscience in counseling as neurocounseling. Some critics of this term suggest that the term would be lost within the larger scope of helping professions. To address this, others like Luke and Field (2017) suggested that the term “translational neuroscience” is the process where counselors take neuroscience literature and apply it into their counseling practice (p.195). However, even this term has its deficits in that the implementation of neuroscientific principles that are not translated in their entirety lead to lofty generalizations or, at worst, pseudoscience.
An example of these lofty generalizations comes from the largely held notions of one being “left-brained” or “right-brained,” which is largely inaccurate because principles of neuroscience indicate that the brain is highly interconnected and does not solely rely on any one hemisphere (Jones, 2017, p. 6). As such, at this point in time, there seems to be some sense of agreement with the use of the term *neuroscience-informed counseling* (Chatters et al., 2017; Luke, 2019; Russo et al., 2021; Schauss et al., 2019; Weigold, 2020). Although, use of the term *neuroscience-informed counseling* is not without criticism. Advocates within the counseling profession suggest that this term is too narrowly focused as it does not directly address therapeutic interventions such as BFB or NFB. Appropriate integration of NFB and BFB often require additional specialized training, which is rarely provided in traditional counseling coursework (Russo & Stevens, 2016). Despite this, some states, such as Texas, have included BFB within the scope of counseling practice (Texas Administrative Code, 2003/2019). Other states, such as Mississippi, whose *Rules and Regulations* (1972/2008) are informed by the *ACA Code of Ethics* (2014), defines competency based on formal educational experiences, trainings, and/or professional certifications. With this recognition, Field et al. (2019) posited the term integrative neurotherapy to act as a more encompassing phrase that includes the integration of neuroscience-informed counseling, BFB and NFB, as well as adjunctive therapies to counseling practice with the aim of empowering client growth.

NFB has been utilized synonymously with the term electroencephalogram (EEG) biofeedback (BCIA, 2016; Meyers & Young, 2012; Longo & Russo, 2017). Russo and Novian (2014) advocated that NFB is similar to other counseling interventions in that NFB teaches the client how to control their brain, thus empowering the client to self-regulate and, as such, decrease symptomology. Given the brain-based application of NFB, NFB is able to address a
wide-range of client goals, which include both clinical and non-clinical applications. Examples of non-clinical applications of NFB include the enhancement of athletic performance (Graczyk et al., 2014), musical performance (Egner and Gruzelier, 2003), and dance performance (Raymond et al., 2005). In terms of clinical approaches, NFB has been suggested to be efficacious in the treatment of individuals with post-traumatic stress disorder (PTSD) (Peniston & Kulkosky, 1991; van der Kolk et al., 2016; Kluetsch et al., 2013). Additionally, Peniston et al. (1993) suggested that NFB is efficacious in the treatment of Vietnam theater veterans with comorbid PTSD and alcohol abuse. Kerson et al., (2009) found evidence that NFB was successful in the treatment of individuals with generalized anxiety disorder. NFB has also been shown to be an effective tool in the treatment of a sample of individuals with various anxiety-spectrum disorders (Dries et al., 2015; Hardt & Kamiya, 1978). Furthermore, NFB may also be efficacious in the treatment of individuals with mixed anxiety and depressive symptomatology (Hammond, 2005; White et al., 2017).

Statement of the Problem

According to the Harvard Medical School (2007), approximately 31.2% of the total population in the United States will experience some form of anxiety disorder throughout the course of their life. Within this scope of anxiety disorders, the Harvard Medical School looked at the pervenances for panic disorder (4.7%), agoraphobia without panic (1.3%), specific phobia (12.5%), social phobia (12.1%), generalized anxiety disorder (5.7%), post-traumatic stress disorder (6.8%), obsessive-compulsive disorder (2.3%), and adult/child separation anxiety disorder (9.2%). Furthermore, the Harvard Medical School suggested that 57.4% of the total US population will experience some form of a mental health diagnosis throughout the course of their lifetime. Shirneshan et al. (2013) reported that adults in the United States with anxiety disorders
utilize approximately 33.71 billion U.S. dollars in direct medical expenditures. Hartman et al. (2015) reported that the total U.S. Healthcare Budget was 2.9 trillion dollars in 2013. Given these metrics, 1% of the total U.S. healthcare budget in 2013 was utilized in covering direct costs associated with the treatment of anxiety-spectrum disorders. Based on the fiscal impact of the treatment of anxiety-spectrum disorders, the development of high-quality research is needed to explore the efficacy of therapeutic interventions to reduce such symptoms. Research, especially in the form of meta-analytic analyses or meta-analyses, have been identified as being highly beneficial to policy makers given their ability to inform readers of the present state of the literature while reducing bias (Davis et al., 2014).

**Purpose and Significance of the Study**

Arns et al. (2009) completed a meta-analysis to explore the efficacy of NFB in the treatment of ADHD and represented a total of 1,194 individuals. Arns et al. found high effect sizes for the ability of NFB to treat individuals with inattentive and impulsive subtypes of ADHD, as well as moderate effect sizes for the ability of NFB to treat individuals with hyperactive subtype of ADHD. An additional meta-analytic review was completed with the goal of exploring the efficacy of NFB in the treatment of depression and anxiety disorders under the framework of frontal alpha asymmetry (Thibodeau et al., 2006). This analysis reflected data obtained from a total of 2,761 participants and showcased an overall “moderately large effect” indicating that individuals with either anxiety and depression experience frontal alpha asymmetry (Thibodeau et al., 2006, p. 728). However, Thibodeau et al. (2006) only utilized 2 databases: MEDLINE and PSYCHINFO. Based on this limited search, Thibodeau et al. did not review articles in peer-reviewed journals such as the *Journal of Neurotherapy*, which is indexed under Scopus. This oversight prevented Thibodeau et al. from identifying articles such as the
article completed by Norris et al. (2000), which explored the efficacy of NFB in the treatment of stress utilizing the Self-Assessment Stress Inventory (SASI). Despite this oversight, Thibodeau et al. (2000) suggested that NFB has a moderately strong effect on the reduction of symptoms associated with depression or anxiety. Unfortunately, this same oversight (limited database utilization) was completed by Tolin et al. (2020) in the meta-analysis of the efficacy of NFB in the treatment of anxiety-spectrum symptomatology. Akin to Thibodeau et al. (2000), Tolin et al. (2020) found that NFB produced a large effect size when paired with wait-list controlled studies with respect to the reduction of symptoms of anxiety. However, this study completed by Tolin et al. was also limited to the selection of MEDLINE and PSYCHINFO databases, which prohibited the inclusion of articles published in the Journal of Neurotherapy/NeuroRegualtion. This lack of inclusivity prohibits practitioners, as well as policy makers, from thoroughly exploring populations, protocols, and accurately assessing the overall efficacy of NFB in the treatment of anxiety-spectrum disorders. This becomes most evident when exploring in variations among insurance reimbursement policies. Currently, very few insurance companies offer reimbursement/coverage for individuals that seek to obtain NFB services. As such, this creates an issue for social justice. This occurs because individuals that have the fiscal resources to pay for NFB services out of pocket can do so. However, those that do not have the fiscal resources to pay are forced to obtain support in other ways of simply forgo treatment in its entirety. This dissertation aims to inform such policies by discussing the clinical efficacy of neurofeedback. Conversely, this dissertation could reinforce insurance policy practices and inform clinicians/individuals about the lack of clinical efficacy for specific populations.

Given this dearth, it is paramount that a comprehensive meta-analysis be conducted in order to better inform counselors who are trained to provide NFB to clients with anxiety-
spectrum disorders. Additionally, a comprehensive meta-analysis could be helpful to counselors who advocate on behalf of their clients that wish to utilize their insurance benefits to receive NFB services. Oftentimes, those who seek reimbursement are informed that NFB is considered to be experimental. As such, research that explores the efficacy of such an approach could be beneficial and serve as a tool to inform policy. Currently, many clients who undergo NFB services have the fiscal resources to do so. One possible use of this proposed dissertation would be to better inform policies held by many insurance companies as to the extent to which NFB is efficacious in the treatment of individuals with anxiety-spectrum disorders; thus, addressing the inequities between those seeking NFB treatment that have the fiscal resources to pay for it and those that do not. In this light, this proposed dissertation aims to serve a function of social justice.

Research Questions

The following research questions will be addressed in this study:

Research Question 1: What are the study and sample characteristics within studies evaluating the impact and effectiveness of NFB for decreasing anxiety-spectrum symptomatology?

Research Question 2: What is the degree of treatment gain in pre-experimental studies of NFB for decreasing anxiety-spectrum symptomatology?

Research Question 3: What is the degree of comparative effectiveness between NFB and other interventions for decreasing anxiety-spectrum symptomatology?

Research Question 4: What are the moderating effects of sample and study characteristics on the impact and comparative effectiveness of NFB for decreasing anxiety-spectrum symptomatology?
Research Design

To address these questions, the author will complete a comprehensive meta-analysis, which will include academic repositories omitted by Tolin et al. (2020). Meta-analyses are beneficial in addressing incongruent findings, as well as demonstrating the efficacy of a particular intervention by way of an overall effect size (Erford et al., 2010). Borenstein et al. (2009) identified that meta-analyses are helpful in the sense that they highlight methodological and population gaps in the literature, which establishes a foundation which yields greater stability to the field/modality. Meta-analyses have been identified as helpful also helpful in terms of limiting potential experimenter/researcher bias in that, by providing a comprehensive overview of the literature (Lipsey & Wilson, 2001). However, Lipsey and Wilson (2001) warned that meta-analyses can be problematic in terms of their sensitivity to issues, such as cultural inclusivity, theoretical underpinnings of generalized topics, and inter-study characteristics such as design, methodology, and study results.

Assumptions and Limitations of the Study

A limitation of this study is the assumption that researchers who study NFB have adequate training to do so. Given the large degree of interdisciplinary work that occurs involving psychophysiological regulation techniques, such as BFB and/or NFB, training is paramount to promote appropriate interpretation of the results/findings of any given study. Failure to comprehend the modality can result in inappropriately reported results. Unfortunately, only 4 regionally-accredited academic/university NFB certification didactic programs have been recognized by BCIA (2020c) in the United States. As such, the likelihood that researchers have an appropriate level of training/certification is one of the leading limitations of this meta-analysis. To attempt to correct for this, the author will track information with respect to
researcher training and/or experience with special notation given to BCIA certification level (Assoc. Fellow, Fellow, etc.), when applicable.

A second crucial limitation of the study is that articles will be limited to English language only. This becomes a significant limitation given the international scope of research that informs integrative neurotherapy practices, such as NFB. Many advancements in the intervention of NFB come from European countries such as Russia (e.g.; Russian Academy of Sciences) and Germany (e.g.: University of Tübingen). One notable example is Kirschenbaum and Gistl (1974), whose article was written in the German language and appears to explore the efficacy of alpha-based NFB in the treatment of anxiety. Unfortunately, articles like this would need to be omitted given the inability to accurately evaluate the entirety of the article for inclusion. Additionally, these articles will be omitted due to differences across national standards for research. Specifically, Institutional Review Boards (IRB) in the United States of America are likely to have different standards for research than those IRBs or IRB-equivalent regulatory bodies in other nations.

A third limitation to this analysis is the omission of qualitatively analyzed studies. Qualitative analyses have the strength of providing rich information about a particular phenomenon. However, this approach is open to potential bias and, as such, would not be able to be analyzed in this present study. Despite these limitations, this proposed dissertation warrants full consideration given the fact that it addresses significant oversights that can be helpful when evaluating the literary basis of the efficacy of NFB in the treatment of anxiety-spectrum disorders. As previously noted, these articles are helpful when informing policy, clinical practices, and future directions for research.

Definitions of Key Terms
**Effect size**: “…the difference between the means… divided by the control group standard deviation” (Glass, 1977, pp. 362-363).

**Grand Average Effect**: The combination of effect sizes from multiple studies, which share a specified set of characteristics, indicates the overall efficacy of a particular modality or intervention of interest. (Erford et al., 2010).

**Integrative Neurotherapy**: The term used by members of the counseling profession that encapsulates the therapeutic modalities of neuroscience-informed counseling, neurofeedback and biofeedback, as well as adjunctive therapies (Field, et al. 2019).

**Anxiety-Spectrum Disorders**: The grouping term that consists of panic disorder, agoraphobia without panic, specific phobia, social phobia, generalized anxiety disorder, post-traumatic stress disorder, obsessive-compulsive disorder, and adult/child separation anxiety disorder (Harvard Medical School, 2007).

**Biofeedback**:

Biofeedback is a process that enables an individual to learn how to change physiological activity for the purposes of improving health and performance. Precise instruments measure physiological activity such as brainwaves, heart function, breathing, muscle activity, and skin temperature. These instruments rapidly and accurately “feed back” information to the user. The presentation of this information—often in conjunction with changes in thinking, emotions, and behavior—supports desired physiological changes. Over time, these changes can endure without continued use of an instrument (Schwartz, 2010, p. 90).

**Neurofeedback**:
Like other forms of biofeedback, Neurofeedback training (NFT) uses monitoring devices to provide moment-to-moment information to an individual on the state of their physiological functioning. The characteristic that distinguishes NFT from other biofeedback is a focus on the central nervous system and the brain. NFT has its foundations in basic and applied neuroscience as well as data-based clinical practice. It takes into account behavioral, cognitive, and subjective aspects as well as brain activity. NFT is preceded by an objective assessment of brain activity and psychological status. During training, sensors are placed on the scalp and then connected to sensitive electronics and computer software that detect, amplify, and record specific brain activity. Resulting information is fed back to the trainee virtually instantaneously with the conceptual understanding that changes in the feedback signal indicate whether or not the trainee’s brain activity is within the designated range. Based on this feedback, various principles of learning, and practitioner guidance, changes in brain patterns occur and are associated with positive changes in physical, emotional, and cognitive states. Often the trainee is not consciously aware of the mechanisms by which such changes are accomplished although people routinely acquire a “felt sense” of these positive changes and often are able to access these states outside the feedback session…At a neuronal level, NFT teaches the brain to modulate excitatory and inhibitory patterns of specific neuronal assemblies and pathways based upon the details of the sensor placement and the feedback algorithms used thereby increasing flexibility and self-regulation of relaxation and activation patterns. (International Society for Neuroregulation & Research [ISNR], 2020a).
**Brainwaves:** The visual representation of the electrical activity between millions of neurons in the brain (Russo & Stevens, 2016).

**Delta:** A pattern of brainwave activity that is slow, in terms of frequency, but powerful in terms of amplitude, and is generated by the brain stem and cerebellum (Longo & Russo, 2017).

**Theta:** A pattern of brainwave activity that is slightly faster than delta, in terms of frequency, but is less powerful than delta, in terms of magnitude, and generated by the hippocampal loop (Longo & Russo, 2017).

**Alpha:** A pattern of brainwave activity that is slightly faster than theta, in terms of frequency, but is less powerful than theta, in terms of magnitude, and generated by the resonance between the thalamus and the cortex (Longo & Russo, 2017).

**Beta:** A pattern of brainwave activity that is slightly faster than alpha, in terms of frequency, but is less powerful than alpha, in terms of magnitude, and is generated by the resonance within the cortex (Longo & Russo, 2017).

**Amplitude Training:** A form of neurofeedback that focuses on the rewarding and/or inhibiting of a particular brainwave at a specified site (Demos, 2019).

**Coherence Training:** A form of neurofeedback that addresses the extent to which two regions in the brain are communicating with each other by measuring the similarities between brainwave frequencies across time (Demos, 2019).

**Z-Score Training:** the training of an individual’s brain activity against a similarly matched database, as determined by factors such as: age, handedness, and sex; often times this form of training includes multiple types of training (e.g. amplitude, coherence, etc.) (Coben et al., 2019; Demos, 2019).
Low Resolution Electromagnetic Tomography (LORETA): A type of quantitatively analyzed neurofeedback training which allows users to conceptualize the brain based on 7 mm x 7mm x 7mm cubic “voxels” to localize and train electroencephalogram (EEG) at the subcortical level (Thatcher et al., 2012, p. 1065).
CHAPTER II

BACKGROUND
Description of Construct in Counselor Education and Supervision

BFB has been a recognized therapeutic modality for the reduction of stress within the counseling profession for over 45 years (Danskin & Walters, 1973). NFB, a form of BFB that focuses on EEG activity, gained its seminal footing in counseling literature nearly 40 years ago (Sarnoff, 1982). Since the 1980’s, there have been numerous advancements to brain-based intervention and assessment. In fact, integration of neuroscience in counselor training is mandated for graduates of all CACREP-accredited programs (CACREP, 2009; 2015). Furthermore, Luke et al. (2020) posited that counselors who do not utilize neuroscience-informed counseling are missing a crucial understanding of the clients that they serve, and as such, are being unethical in their therapeutic practice. However, this does not mean that counselors should operate outside their scope of practice or their levels of competency; conversely, Luke et al. encouraged counselors, counselor educators, and counselors-in-training to seek training, education, and professional support (e.g., consultation/supervision) around the appropriate and ethical integration of neuroscience into their practice domains. In order to assess the extent that counselors received training in AMHCA’s (2020) Biological Bases of Behavior (BBB), Russo et al., (2021) created and distributed a survey to counselors-in-training, doctoral students, masters’ level counselors, and doctoral-level counselors. Of the respondents, a majority identified themselves as masters’ level counselors, over 50% identified that they have received training in 38 of the 46 BBB standards (Russo et al., 2021). Russo et al. (2021) found that the majority of participants felt as though they did not have adequate training in more technical standards of the BBB, such as: “The functioning in the central and peripheral nervous systems
(e.g., quantitative electroencephalography, MRI, galvanic skin response)” (p. 30). At the present time, there are not certification processes in place that allow counselors who are interested in neuroscience-informed counseling to advance their training. Field et al. (2020) reported that the AMHCA Neuroscience Task Force began work to create a three-tier training curriculum. Field et al. (2020) reported that the proposed training curriculum will allow counselors to obtain a certification in neuroscience-informed counseling. Counselors that aim to further specialize in BFB or NFB are encouraged to do so through BCIA; however, Field et al. report that counselors who complete the first three tiers of the training curriculum will be eligible to pursue BCIA recognized didactic training as part of the 4th training tier.

Through the creation of such certifications, counselors are better able to showcase competency. In fact, The ACA Code of Ethics (2014) indicated that certification is a recognized route that establishes counselor creditability while further informing their counseling practice. Examples of such recognition come from section “C.4.b Credentials,” which stated that “counselors claim only licenses or certifications that are current and in good standing (ACA, 2014, p. 9). Furthermore, section C.2.a of the ACA Code of Ethics (2014) required that counselors practice within areas that they are competent, as evidenced by “education, training, supervised experience, state and national professional credentials, and appropriate professional experience” (p. 8). Balkin and Kleist (2017) built upon these ethical mandates and advocated that in order to maintain competency within practice, counselors should frequently steep themselves within the ever-changing body of literature that make up the foundation of the counseling profession. Lenz (2017) advocated that counselors should utilize evidence-based practices, which provides additional insight into the unique sociopolitical context of their clients, while implementing interventions that honor the whole person. Furthermore, Lenz (2017) suggested
that high-quality meta-analyses are of particular use to counselors because they utilize all available research on a topic to identify the efficacy of a particular intervention while answering the questions: “what works, for whom, how, and under what circumstances” (p.161).

Additionally, Lipsey and Wilson (2001) advocated that meta-analyses allow individuals to ground themselves in a particular body of research while reducing the presence of researcher bias, which is often present in qualitative summaries of the literature.

**Foundation of EEG in Counseling**

CACREP mandated that accredited counselor training programs teach students about the “biological, neurological, and physiological factors that affect human development, functioning, and behavior” (CACREP, 2015, p. 10). To address this mandate, some programs, such as: The University of Texas at San Antonio (Villa, 2014); The Pennsylvania State University (Swayne, 2016), and The University of Memphis (Walters, 2019) have opted to create neurofeedback labs and/or coursework within their counselor training programs. One factor that many of these programs share is a recognition of the impact that brainwaves have on mental health. Myers and Young (2012) asserted, “The NFB approach fits naturally with counseling philosophy because of its noninvasive design for increasing functionality through empowering clients to strengthen core performance in a manner sustainable over time” (p.21). As Figure 1 depicts, brainwaves are the visual representation of the electrical activity between millions of neurons in the brain that are detected through the use of an EEG (Russo & Stevens, 2016).
Figure 1

Sample Brainwave Graph with Amplitude and Frequency Depiction

Note. The figure provides a visual representation of the sampling method and creation of brain waves over a period of time. Time refers to the specified sampling rate of the EEG amplifier and is somewhat variable. This figure has been adapted from “Counseling Students Gaining Early Exposure to Neurofeedback,” by G. M. Russo and S. Stevens, 2016, Counseling Today, 58(8), p. 15. Copyright 2016 by the American Counseling Association. Reprinted with permission (see Appendix A).
Brainwaves are differentiated based on the frequency of oscillations per second and are measured in terms of hertz (frequency) and microvolts (amplitude) (Demos, 2019). This method of measuring electrical activity in the brain has had a long history that has been informed by multiple disciplines. Berger (1929) was the first person to report non-invasive recordings of human EEG activity. Additionally, Berger identified two forms of brainwave activity, which he identified as “first order” waveforms that ranged from 10-11 per second and “second order” waveforms that ranged from 20-30 per second (pp. 567-568). Adrian and Matthews (1934) coined the term “Berger rhythm” as an homage to its methodological founder (p. 356). However, this was later re-defined as alpha and beta waves based on the frequency of their oscillations (Foxe & Snyder, 2011). Building upon Berger’s work, Walter (1936) identified “δ waves”, or delta waves, as waveforms that are lower in frequency than Berger’s alpha (p. 308).

There are alpha components, at frequencies of from 8 to 13 per second, beta components, at frequencies of from 17 to 30 per second, and possibly gamma components, of still higher frequencies (from 35 to 48 per second), which are usually obscured by the more prominent alpha and beta potentials (Jasper & Andrews, 1938, pp. 114-115).

There are seven main waveforms that are utilized in amplitude-based NFB training that include: delta, theta, alpha, beta, high beta, gamma, and sensorimotor rhythm (SMR) (Field & Ghoston, 2020; Kober et al., 2015; Sherlin, 2009). Kober et al. (2015) identified that SMR is unique in that it reflects localized activity that is recorded over the sensorimotor cortex and has a frequency range of 12-15 hertz. The remaining waveforms (i.e. delta through gamma) are differentiated based on the frequency and amplitude of their oscillations (Field & Ghoston, 2020; Kober et al., 2015; Sherlin, 2009). However, there is debate in the field as to the ranges that appropriately encapsulate each term. Field and Ghoston (2020) asserted that the hertz (Hz) range
for “Delta is 0-4 Hz; Theta is 4-8; Alpha is 8-12 Hz; Beta is 12-25 Hz; High Beta is 25-35 Hz; Gamma is 35-60Hz” (p.211). However, Sherlin (2009) asserted that “Delta is 0.5-3.5 Hz; Theta is 4-7.5; Alpha is 8-12 Hz; Beta is 13-35 Hz” (p.87). Given the discrepancies between frequency ranges, nominal identification of the brainwaves (e.g. delta, theta, etc.) is often followed by the specified frequency range (1-4 Hz, 4.1-7, etc.). Comprehension of the value of filtered EEG activity can best be understood from a functional perspective. To address this, Russo created “The Brain State Spectrum” to explore related cognitive states associated with the specified EEG waveform (Russo & Stevens, 2014, pp. 15-16).
Figure 2

*The Brain State Spectrum*

*Note.* The figure depicts the relationship between EEG activity and cognitive states. From “The Hope Behind the Squiggles: Neurofeedback and Neurocounseling,” by G. M. Russo, 2015, October 21, University of Texas at San Antonio, Department of Counseling Invited guest lecture to COU 5203: Introduction to Clinical Mental Health Counseling, San Antonio, Texas, USA. Copyright 2015 by G. Michael Russo.
Russo and Stevens (2016) asserted that, in general, brain waves that are slower, in terms of frequency, are more powerful in terms of amplitude. Sherlin (2009) posited that each waveform generator lies in regions of the brain that span from the thalamus (i.e. delta) to frontal cortex (i.e. high beta). These waveforms seem to developmentally progress from the hindbrain to the frontal lobes. Oftentimes, NFB is driven by a comparison between the individuals’ clinical goals and aberrant brain-based activity, as identified by quantitative electroencephalogram (QEEG) (Arns et al., 2012; Longo & Russo, 2017; Cantor, 2009). For example, Dreis et al. (2015) created individualized client protocols that were driven by QEEG recordings to identify the specific regions in the brain that were associated with their clinical symptoms of anxiety.

Nuwer (1997) identified QEEG as the mathematical analysis of brain-based activity. Thompson and Thompson (2009) also asserted that QEEG assessments occur when you apply mathematical analyses to data derived from as few as 1 sensor all the way up dense array sensor placements that consist of over 200 sensors. Brain maps are among the most commonly recognized form of QEEG (Cantor, 2009; Longo & Russo, 2017). Brain maps are created by comparing data that are derived from 19 strategically placed sensors to a database of individuals that share neurophysiological similarities, such as: age, handedness, and sex (Cantor, 2009; Longo & Russo, 2017). This assessment has allowed clinicians to conceptualize client goals in terms of areas of overactivation, under-activation, or inter-neuronal communication difficulties (i.e. too much communication or too little) (Cantor, 2009; Longo & Russo, 2017). This approach to clinical goals (i.e. over/under-activation, and/or interhemispheric difficulties) can be a powerful tool to decrease stigma surrounding mental health diagnoses. This development allowed trained counselors the opportunity to reframe client goals from the reduction of symptoms, such as anxiety, to excessive high beta (Dreis et al., 2015), or frontal-lobe alpha...
asymmetry as opposed to depression (Baehr et al., 2001). Thus, brain-based mental health assessment and treatment have resulted in the reduction and/or elimination of stigma-prone mental health jargon (Danskin & Walters, 1973; Myers & Young, 2012; Schauss et al., 2019).

However, mental health and performance enhancement are not the only use of brain-based analyses. QEEG can also be used to measure changes in physiological responses to environmental stressors, such as those experienced by an individual who is pushing the limits of an American muscle car (Mekjian, 2013). Additionally, Banerjee et al. (in review) used QEEG to raise awareness of racial biases held by counselors-in-training through exploring differences in students’ brain-based reactions to pictures of people with varied skin tones. This approach to raising awareness of ones’ own biases is not based on self-report or qualitative analysis; instead this brain-based approach is based on measurable physiological changes in the brain that reflect unconscious preferences (Bonnstetter & Collura, 2020). The use of QEEG described by Mekjian (2013) and Banerjee et al. (in review) provide examples of the multifaceted utility of brain-based conceptualizations.

Current Status

Given the multi-disciplinary nature of NFB, a complete search of the literature was conducted using the Cochrane Library, Google Scholar, Scopus, Science Direct, and all available databases within EBSCO (87 databases), The National Center for Biotechnology Information (39 databases), and ProQuest (20 databases). The goal of this search was to identify previously conducted meta-analyses or meta-analytic studies that explored the efficacy of NFB in the treatment of individuals with anxiety-spectrum disorders. To address this, the following search terms were utilized: (“neurofeedback” or “eeg biofeedback”) AND (“meta-analysis” or “meta-analytic”) AND (“Anxiety” OR “Fear” OR “Stress” “anxiety disorder” OR “over arousal” OR
“trauma” OR “PTSD” OR “posttraumatic stress disorder” OR “obsessive compulsive disorder” OR “OCD” OR “phobia” OR “phobic” OR “GAD” OR “generalized anxiety disorder”). Given the intention to identify previously conducted meta-analyses, the search terms: *meta-analysis* or *meta-analytic* were required to appear within either title, abstract, or keywords of the article/manuscript/dissertation/thesis.

This search yielded a total of 24 academic documents within the Cochrane Library, 152 academic documents in Google Scholar, 89 academic documents in Scopus, 26 academic documents in Science Direct, 67 academic documents in EBSCO, 37 academic documents in NCBI, and 30 academic documents in ProQuest. Academic documents acquired from the ProQuest database included previously completed dissertations and theses.

Through this search a number of articles were analyzed to explore the extent to which they addressed the intended scope of this dissertation. Tolin et al. (2020) completed a qualitative and quantitative systematic review to explore BFB and NFB in the treatment of individuals with anxiety disorders (GAD, panic disorder, social anxiety, obsessive-compulsive disorder, PTSD, or agoraphobia). However, Tolin et al. overlooked a large body of the literature due to the fact that their search strategy only utilized articles indexed in PsychInfo and Medline. This limitation prevented the analysis of articles that were published by *NeuroRegulation*, the official journal of The International Society of Neuroregulation and Research (ISNR, 2020a), which is indexed by Scopus.

Additionally, Fifer (2018) had completed their dissertation using an all-encompassing protocol to explore the efficacy of NFB in the treatment of mental health and physical health disorders. However, much like Tolin et al (2020), Fifer (2018) neglected to evaluate articles published in *NeuroRegulation* due to the omission of searching for articles through Scopus. As
such, this meta-analysis did not thoroughly assess the full extent of available literature. Similarly, Begemann et al. (2018) neglected to include articles indexed in Scopus, which likely contributed to a limited selection of articles that addressed the efficacy of NFB in the treatment of individuals with GAD.

Conversely, Ferrira et al. (2019) included articles indexed by Scopus within their search criteria and addressed the overall efficacy of NFB in the treatment of individuals with obsessive compulsive and related disorders. Ferrira et al. identified that NFB had a medium to large effect on the reduction of obsessive-compulsive related symptoms; however, it was noted that the articles that were addressed in this study had an overall low methodological quality, which could contribute to publication bias. Additionally, Grist et al. (2019) explored the overall efficacy of technologically-based interventions in the treatment of children and adolescents with symptoms of depression and anxiety. However, given Grits et al.’s scope of technologically-based interventions, relatively few articles were included that addressed NFB. Steingrimsson et al. (2020) explored the efficacy of NFB in the treatment of adults (over 18 years of age) with PTSD using only randomized controlled trials (RCT) that employed sham NFB. However, Steingrimsson et al. (2020) only identified 4 studies, which prohibited conclusive findings. Such sham-based NFB protocols are likely to be inconclusive, at best, since sham-controlled NFB is considered to be based on a limited understanding of principles of learning, which are paramount to appropriate administration of NFB interventions (Pigott et al., 2018).

Collectively, a total of 425 articles/manuscripts/academic works were reviewed in an attempt to identify previously completed meta-analyses that explored the efficacy of NFB in the treatment of individuals with anxiety-spectrum disorders. Throughout this comprehensive search of the literature, none of the reviewed articles directly addressed this dearth.
Unification of Constructs Within Proposed Dissertation

Given the strong backing throughout professional counseling organizations (e.g. ACA, ACES, and AMHCA), educational/training standards (e.g. CACREP and BBB), advanced certification (e.g. BCB, BCN, and proposed AMHCA certification), and uniquely identified space within counseling publications (e.g. Counseling Today and JMHC), there is little doubt that neuroscience has already created a firm footprint within the counseling profession and, in many ways, impacts the lives of the clients that counselors already serve. Clinical mental health counselors that were trained under the 2016 CACREP Standards have been equipped 1) in the administration of assessments (CACREP, 2015, standard 5.c.2.d.); 2) in the art of incorporating research into counseling practice (CACREP standards 2.F.8); 3) in recognizing normal stages of development throughout the lifespan (CACREP standards 2.F.3); and 4) in comprehending the impacts of neuroscience on human behavior (CACREP, 2015, Section 2.F.3.e; Section 5.c.1.d; Section 5.c.2.g). Furthermore, AMHCA’s BBB (2020) outlined 46 specific standards that address counselor knowledge and skills for the integration of neuroscience into counseling practice.

Despite the strong impact that neuroscience-informed counseling has had on counselor training and post-graduate professional development opportunities (e.g. Russo et al., 2021), there are significant foundational gaps within the literary basis. Most notable is the deficit of comprehensive meta-analyses that explore the efficacy of NFB in mental health diagnoses, such as anxiety-spectrum disorders.

Additional Perspectives of Neurofeedback

Although much of the information provided as part of this dissertation provides an optimistic perspective with regard to the clinical utility of NFB in the treatment of anxiety-spectrum disorders, this body of research is not without critics. Thibault et al. (2015, 2016) and
Thibault and Raz (2017) asserted that neurofeedback operates as a placebo, whereas participants expect that the therapeutic intervention (i.e., NFB) will assist them in the reduction of their symptoms, as such after their investments (e.g., time, transportation, cost, etc.) they begin to erroneously ascertain clinical benefits. Furthermore, Thibault et al. (2018) reported that there are no differences between sham-controlled NFB and active NFB studies. Pigott et al. (2018) retorted assertions made by Thibault et al. (2018) and conducted a study that analyzes NFB sham-controlled conditions. Pigott et al. identified 8 sham-controlled studies of NFB and analyzed them in order to explore the efficacy of such methods. Pigott et al. found that the sham-controlled literature overlooked fundamental principles of operant conditioning and principles of learning, which renders such sham-controlled modalities as ineffective treatments conditions.

Furthermore, Thibault and Raz (2017) asserted that board members, authors, and journal editors of many of the professional organizations that support clinical practice/research relating to NFB have notable financial biases that impact their works. To support such claims, Thibault and Raz identified that at one point in time 8 of the 9 Board Members of ISNR were NFB practitioners and the 9th was a major vendor/creator of NFB equipment. Thibault and Raz touted that fiscal biases held by practitioners and industry leaders undoubtedly present biases throughout the body of NFB literature. In order to assess these assertions, the present meta-analysis will explore the extent of biases and the overall efficacy of NFB in the treatment of individuals with anxiety-spectrum symptomologies.
CHAPTER III

METHODOLOGY
Methodology

In order to systematically address the gap in the literature, a meta-analysis will be conducted with the aim of assessing the extent of the efficacy that neurofeedback has on anxiety spectrum disorders. The present chapter will provide details about the procedures and processes utilized to analyze pertinent data that is found within articles that meet the appropriate inclusionary criteria. Additionally, methods will be discussed that assess and mitigate risk to internal validity within the present meta-analysis. Although formulae are provided throughout this chapter, the data will be computed by Comprehensive Meta-Analysis, Version 3.3 (CMA v3.3).

Information Sources

Documents will be considered for inclusion based upon the following search strategy: (“neurofeedback” OR “brainwave biofeedback” OR “Z score training” OR “amplitude training” OR “coherence training” OR “phase synchrony training” OR “LORETA” OR “sLORETA”) AND (“anxiety” OR “fear” OR “stress” OR “anxiety disorder” OR “over arousal” OR “trauma” OR “PTSD” OR “posttraumatic stress disorder” OR “obsessive compulsive disorder” OR “OCD” OR “phobia” OR “phobic” OR “GAD” OR “generalized anxiety disorder”). The following databases and repositories will be used to identify articles that meet inclusion criteria: PsycINFO, PubMed, Cochrane Library, Campbell Collaboration, Scopus, Science Direct, EBSCO, National Center for Biotechnological Information, ProQuest, ProQuest Dissertations and Theses, and Google Scholar. Additionally, journal-specific searches will be conducted for the following journals: Neuroregulation, Applied Physiology and Biofeedback, Journal of Mental
Health Counseling, Journal of Counseling and Development, and Counseling Outcome Research and Evaluation. These journals were selected based on the high degree of overlap in their scope and the search strategy of the present meta-analysis.

In addition, articles from previously-conducted meta-analyses will be mined and analyzed for appropriateness of the scope of the present meta-analysis. This mining process will be conducted with the aim of identifying additional articles that were omitted by the previously-identified search strategy.

**Inclusion and Exclusion Criteria**

Articles will be included that utilize NFB, as an independent variable, in the treatment of anxiety-spectrum disorders, as the dependent variable. Eligible study designs include quasi-experimental, experimental, and single-group research designs. Articles that are included must include pre/post assessments of anxiety that have undergone peer-review. These peer-reviewed measures must also have been shown through the literature to be reliable, valid, and have been appropriately normalized. Furthermore, the articles that are selected for inclusion in this meta-analysis must have been published in peer-reviewed journals. Dissertations and/or theses will also be considered for inclusion based on similar peer and/or expert reviews of the textual work.

In the case of multiple reports, preference will be given to articles that were published first, meaning that primary study reports will be favored over secondary analyses. Articles that include participants with multiple diagnoses will not be excluded as long as they meet criteria for at least one of the predetermined diagnoses that falls into the category of anxiety-spectrum disorders. In the case of multiple diagnoses, only data that relates to anxiety-spectrum disorders
will be included within the present meta-analysis. Additionally, articles will not be excluded based on the geographic region nor will they be excluded based on participant age or sex. Although the brain undergoes developmental changes throughout the lifespan and there are differences between male and female brains, similar NFB training protocols have been shown to be efficacious in the treatment of anxiety-spectrum disorders for male and female children ranging in age from 6 to 15 years of age (e.g., Huang-Storms et al., 2010), as well as male and female participants that range in age from 11 to 61 years (e.g., Dreis et al., 2015). However, articles that are published in languages other than the English language will be excluded since the author will be unable to determine the appropriateness of measures and the overall quality of the article. Additionally, neurofeedback approaches that utilize invasive techniques will be excluded since such techniques may fall outside of the counseling scope of practice.

Articles will be included that have been published between the timeframe of 1973-2019. The commencement year of the inclusion criteria was selected based upon The ISNR Comprehensive Bibliography of Neurofeedback Research (2020b), which indicates that the oldest article to address the topics of anxiety and NFB was published in 1973. Every effort will be made to convert the reported data into usable data (e.g., computation of means based on reported confidence intervals and standard deviation value). Articles will be excluded in the event that data are missing and is unable to be identified through appropriate computational methods.

**Study Selection**
An initial analysis of the title, abstract, and keywords will be conducted to determine if the article identified by the previously-determined search strategy meets initial eligibility criteria. In the event that the article had been determined to meet eligibility requirements, an analysis of the methods and results sections of the article will occur. This second stage analysis will determine the extent that the appropriate information is included such as, mean, standard deviation, sample size, which is needed to compute effect sizes. If all information is reported or can be obtained from the article, the said article will be selected for inclusion and analyzed appropriately.

Given that the current study is being completed in partial fulfillment of the requirements set forth by The University of Mississippi (UM) Graduate School and The UM Department of Leadership and Counselor Education, the primary responsibility of the determination of the textual works resides with the doctoral candidate. However, the doctoral candidate may consult with members of their committee and/or their committee as a whole in order to determine the appropriateness of the selection of studies.

Data Collection

Articles that are selected for analysis will have data extracted that relates to: APA reference, classification of diagnosis evaluated (e.g., GAD, OCD, PTSD), name of assessment used as study dependent variable, number of participants included in each of the conditions utilized by the study (e.g. placebo, wait-list, active treatment, alternative treatment), mean and standard deviation per treatment condition and time that assessment was completed (i.e., pre-treatment, post-treatment, follow-up), categorization of any alternative treatments used (e.g.
neuroscience-informed cognitive-behavior, person-centered therapy, deep breathing), participant demographic data (i.e., mean age, ethnicity, and sex), training time per condition in terms of minutes, number of sessions provided to participants, and number of treatment providers.

Additionally, the author will track article-specific data including: total sample size, number of girls/women, number of boys/men, average participant age, the location that the study was completed (U.S. or outside of the U.S.), participant ethnicity, average number of NFB sessions completed, if the protocol was individualized (QEEG-driven), or if the study used a protocol, name of the sites trained, frequencies trained, NFB treatment time in terms of minutes, alternative treatment time in terms of minutes, if a waitlist was used how long participants remained on the list in terms of days, treatment setting, number of NFB providers, extent of provider training in NFB, extent of provider training in alternative treatment, and details of article deficits. These data will assist in providing additional insights into the results of the present meta-analysis.

**Method for Assessing Risk to Internal Validity**

I will identify and record data derived from included studies. In order to assess the accuracy of data obtained, an independent analyst will randomly review 20% of the included articles to ensure reporting accuracy. Prior to randomization, the articles will be alphabetized by primary author last name. Once alphabetized, each article will receive a corresponding number, whereby the first article will be identified as 1, second article 2, and so on. Once ordered, the doctoral candidate will set the minimum number on the Google (n.d.) random number generator to 1 and the maximum number to the total number of articles included and generate numbers that
correspond to 20% of the articles. In the event that an article is selected more than once, the doctoral candidate will negate that number generation and generate another number so that a unique 20% of articles are uniquely identified. Once identified, the doctoral candidate will compare their data with data recorded by the independent analyst. If there are any disagreements in the data, the article will be re-reviewed independently. This process will continue until there is an agreement rate of 95% or higher to promote accuracy in data and reduce risks to internal validity.

Summary Measures

Calculating Effect Size Using Hedges’ g

Effect sizes will be calculated using CMA v3.3 to compute Hedges’ g effect sizes and sampling error of the studies for all articles that meet inclusionary criteria. Hedges’ g is a modification that has been applied to Cohen’s d that reduced the impact that sample size had on calculating treatment efficacy (Borenstein et al., 2009; Erford et al., 2010; Hedges, 1981; Lipsey & Wilson, 2001; Watson et al., 2016). According to Borenstein et al. (2009), the formula used for the calculation of Hedges’ g is as followed: \( g_i = d_{\text{mod}} \times d \). This calculation is made for each article that is included in the meta-analysis and in doing so, we will have a series of effect size calculations (i.e., \( g_1, g_2, \ldots, g_i \)). As noted, to calculate Hedges’ g, one must first calculate Cohen’s d, which is accomplished by using the formula: \( d = \frac{X_1 - X_2}{S_{\text{pooled}}} \) (Borenstein et al., 2009). Within Cohen’s d is the term \( S_{\text{pooled}} \), which is obtained through use of the formula: \( S_{\text{pooled}} = \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}} \) (Borenstein et al., 2009). The \( S_{\text{pooled}} \) formula utilizes the terms \( n \), which
reflects the sample size of the groups, as well as the terms $S$, which reflects the standard deviation of each of the included studies. In addition to the aforementioned formulae for the calculation of $g_l$, Borenstein et al. (2009) noted that calculation of the term $d_{mod}$ is accomplished through the formula: $d_{mod} = 1 - \frac{3}{4df - 1}$. The term $df$ is used to calculate $d_{mod}$ and is the same term in the denominator for the equation for $S_{pooled}, n_1 + n_2 - 2$ (Borenstein et al., 2009). Upon calculating Hedges’ $g$, Lipsey and Wilson (2001) recommended using cutoff scores in the interpretation of treatment efficacy, whereby scores that fell within the range of 0.30-0.49 indicated a low degree of practical significance, 0.50-0.66 indicated a moderate degree of practical significance, and 0.67-1 indicated a large degree of practical significance.

**Variance and Standard Error**

In order to calculate the variance of Hedges’ $g$, Borenstein et al. (2009) provided the formula: $V_{g_l} = d_{mod}^2 \times V_d$. In this equation, the term $V_d$, which represents the variance of Cohen’s $d$, is calculated using the formula: “$V_d = \frac{n_1 + n_2}{n_1n_2} + \frac{d^2}{2(n_1 + n_2)}$” (Borenstein et al., 2009, p. 26). The term $V_{g_l}$, or the variance of Hedges’ $g$, is then used to calculate the standard error of $g$ through the formula: “$SE_{g_l} = \sqrt{V_{g_l}}$.” (Borenstein et al., 2009, p. 27). The term $SE_{g_l}$ will then be used to calculate a 95% confidence interval (CI). Watson et al. (2016) use the formula “$CI = g_l \pm z \times SE_{ES}$”; whereas $SE_{ES}$ is equivalent to $SE_{g_l}$ and $z$ at a 95% CI reflects reflect the value of 1.96 (Watson et al., 2016, p. 116). Confidence intervals for each specified study assist in accounting for chance, error associated with statistical analyses, rounding, and other factors that address are associated with threats to internal validity, essentially reflecting that the actual degree
of efficacy falls somewhere within the individual study confidence interval limits (Erford et al., 2010).

**Grand Effect Size Estimate and Grand Confidence Intervals**

Grand effect size, also commonly referred to as the mean effect size, is computed based on values obtained from the corresponding effect size (Hedges’ g), variance, and standard error of each study that is included in the meta-analysis. In order to calculate the grand effect size ($G_{ES}$), Erford et al. (2010) reported that it is important to weight each measure based on the inverse of its variance. As noted previously, variance is represented by the term $V_d$ and each corresponding effect size is represented by $g_i$. To calculate the mean effect size, Erford and colleagues (2010) used the formula $G_{ES} = \frac{\sum(V_d g_i)}{\sum V_d}$. Akin to previous interpretation, effect sizes that fell between 0.3-0.49 indicated a low degree of practical significance, 0.5-0.66 indicated a moderate degree of practical significance, and 0.67-1 indicated a large degree of practical significance (Lipsey & Wilson, 2001).

Upon calculating the mean effect size, Erford et al. used the formula $SE_{G_{ES}} = \sqrt{\frac{1}{\sum V_d}}$ to calculate the standard error of the grand effect size ($SE_{G_{ES}}$). With $SE_{G_{ES}}$ calculated, Erford et al. applied this value to the following formulas to calculate the lower ($G_{ESL}$) and upper ($G_{ESU}$) limits of the confidence intervals at the 95% level: $G_{ESL} = G_{ES} - 1.96(SE_{G_{ES}})$ and $G_{ESU} = G_{ES} + 1.96(SE_{G_{ES}})$. Similarly, to confidence interval interpretation for individualized studies, the grand confidence interval accounts for the likelihood of identifying the true efficacy despite factors that threaten internal validity.
Method of Synthesis

In addition to the aforementioned procedures associated with effect size and confidence interval calculations, effect sizes will be weighted using Hedges’ g in order to reflect the impact that study sample size has on effect size calculations. Effect sizes reflecting larger samples will be weighted more heavily due to the aspect that they contain less sampling variance (Erford et al., 2010). Critical values reflecting the 95% confidence intervals will be calculated for individual studies as well as aggregated studies (grand effect).

Analysis of Homogeneity

Cochran’s Q allows meta-analysts to test the hypothesis that studies included in the meta-analysis do not share a common effect size. Cochran’s Q value will be acquired using CMA v3.3. However, this calculation can also be acquired using the formula: $Q = \sum_{i=1}^{k} W_i (g_i - G_{ES})^2$. In this formula, the term $W_i$ refers to the weight of each study and is calculated by the formula $W_i = \frac{1}{v_{g_i}}$. Additionally, the term $k$ is introduced in the formula, which reflects the total number of studies included in the meta-analysis. Based on the calculation of $Q$, meta-analysts can begin to explore the assumption that the selected articles share a similar effect size as well as test to see if the variation is due to sampling error within the studies (Borenstein et al., 2009). In order to test these assumptions, meta-analysts use the following formula that identifies excess variation ($EV$): $EV = Q - (k - 1)$. $EV$ informs meta-analysts about the true effects between studies. With this information, meta-analysts can then compute the variance of the true effects ($T^2$) and the standard deviation of the true effects ($T$). Borenstein et al. (2009) recommend the
formula: $T^2 = \frac{Q-df}{c}$. Within this formula, the term $C$ is used as a scaling factor based on the properties of $Q$, which is a weighted sum of squares (Borenstein et al., 2007). $C$ is identified using the formula: $C = \sum W_i - \frac{\sum W_i^2}{\sum W_i}$. With the variance of the true effect calculated ($T^2$), we can acquire the standard deviation of the true effect ($T$) by taking the square root of the value, $T^2$. In formulaic terms, $T = \sqrt{T^2}$.

**T² vs I²: Differences in Deviation of the True Effect Size.** $I^2$ is a descriptive statistic used to identify the amount of within-study variance, which varies from study to study (Borenstein et al., 2009). Borenstein et al. (2009) identifies that $\tau^2$ refers to the actual variance and $T^2$ refers to the estimate of the parameter of $\tau^2$. Additionally, $I^2$ differs from $T^2$ in that $T^2$ quantifies deviation on the same scale as the effect size index (Borenstein et al., 2009). In other words, $T^2$ has a tendency overestimate the shared variance between studies. As such, $I^2$ is used to calculate a degree of inconsistency across studies and allows meta-analysts to answer the question: “What proportion of the observed variance reflects real differences in effect size?” (Borenstein et al., 2009, p. 117). $I^2$ is found by the formula: $I^2 = \left(\frac{Q-df}{Q}\right) \times 100\%$. This ratio also has the benefit of not being directly affected by number of studies in the meta-analysis (Borenstein et al., 2009).

**Moderator Analysis**

**Meta-Regression Analysis.** Borenstein (2019) reported that meta-regression explores the differences between model covariates and their corresponding outcomes at a study level. These values are expressed in terms of degrees of heterogeneity. Each measure grouping (anxiety,
PTSD, etc.) and set of corresponding covariates will be analyzed in their own unique meta-regression. The meta-regressions will all be interpreted using an alpha level of 0.05 and their results will utilize an $R^2$ analogue. The $R^2$ analogue will be used to explain proportions of heterogeneity as opposed to explaining change within the model. Interpretation of the $R^2$ analogue output values mirror traditional $R^2$ output. That is, the value reflects the degree of the variance in true effects explained by the covariate (Borenstein, 2019). As such, an $R^2$ value of .82 would indicate that 82% of the variance in the true effect is accounted for by the covariate of session time.

Data reflecting the corresponding meta-regressions will be presented in terms of a graph, which represents the regression line of the standard difference in means based on the degree of change for each of the anxiety-spectrum diagnoses explored in the present study.

**Mixed-Effect Subgroup Analysis.** A mixed-effects subgroup analysis model will be utilized, which consists of an exploration of the differences in studies within the subgroups by way of a random-effect model as well as a common-effects model. The initial random-effect model will allow for the exploration of each subgroup (GAD, OCD, PTSD, etc.) by subgroup weight. Borenstein et al. (2009) suggested the following formula in order for subgroup comparison: $Q_a = WY^2 - \left[ \frac{(WY)^2}{W} \right]$. Within the formula, the term $W$ reflects the sum of the individual study weights, $WY$ refers to the massed sums of the individual study weights multiplied by the individual study effect size, and $WY^2$ refers to the product of $W$ and the sum of
the squared variance. This calculation is repeated based on the number of subgroups (i.e. GAD, OCD, PTSD, etc.).

Upon completing the analyses for the random-effect model, the author will complete the analysis for the common-effects model. This model uses the same $Q$ calculation formula that was described in the random-effect model; however, instead of looking at the individual studies, the formula treats the subgroups as the studies. So, instead of exploring study #1 within the GAD subgroup, the formula compares GAD to PTSD, OCD, Specific phobias, and the remaining anxiety classifications.

Upon calculating the analyses required for a mixed-effect model, an *ANOVA analogue* will be conducted to explore the differences between data obtained by the random-effect model and data obtained by common-effect data. The term *ANOVA analogue* is used in place of an ANOVA being as though I will be testing the model by way of the Q-distribution with an alpha level of 0.05. This is a contrast to the traditional F-distribution that is used in an ANOVA. The ANOVA analogue will compare studies within each subgroup to the subgroups themselves. Data obtained will be presented via an ANOVA analogue table in order to assess differences in data obtained from the mixed-effect subgroup analyses (Borenstein et al., 2009). If statistical significance is found through the ANOVA analogue, a post hoc analysis will be computed in order to identify individual predictors of significance in the model. The analysis of variance analogue will yield internally consistent data that is missing from the mixed-effect subgroup analysis (Borenstein et al., 2009).

**Publication Bias and Selective Reporting**
**Funnel Plot Analysis**

We can then graph the standard error on the y-axis and Hedges’ $g$ values on the x-axis to create a funnel plot to identify the extent of the impact of publication bias (Borenstein et al., 2009). Graphing standard error on the “y-axis has the advantage of spreading out the points on the bottom half of the scale” and allows for greater ease in the interpretation of asymmetry (Borenstein et al., 2009, p. 283). In the event that publication bias is detected in the graph, the author will seek to examine the extent of the bias.

**File drawer effect**

Oftentimes, this bias is the result of what is known as the file drawer effect. Erford et al. (2010) described the file drawer effect as the result of the reality that many researchers may often choose to avoid publishing insignificant results. This tendency creates a body of literature that may represent an oversaturated and unrealistic pool consisting of biased publications. To compensate for publication bias, this research will utilize a fail-safe $N$. The fail-safe $N$ will be calculated using the following two formulas:

\[
\frac{ES}{Ny} = \frac{.01}{k} \quad \text{and} \quad N_f = Ny - k
\]

In these equations, Erford et al. (2010) reported that “$N_f$ is the fail-safe $N$, $k$ is the number of studies in the meta-analysis sample, $ES$ is the mean effect size for the meta-analysis under study, and $Ny$ is the number of studies required to reduce the effect size to .01.” (p. 37). The calculation of the fail-safe $N$ identifies the number of unpublished articles consisting of insignificant that will be required to move the effect size calculation from efficacious to non-
efficacious. A larger number of studies required to move the effect size from efficacious to non-efficient would indicate that publication bias is not contributing to the results. As such, the calculation of a fail-safe $N$ will allow for the determination of the degree to publication bias present in the selected studies.

**Trim and Fill**

Upon recognizing the extent of the impact that publication bias has on the results, the author will attempt to remove it by utilizing Duval and Tweedie (2000a & 2000b) *Trim and Fill* process. Calculation of the trim and fill procedure will be completed using CMA v3.3. The rationale for this process is to remove publication bias in order to determine the efficacy of NFB. Borenstein et al. (2009) identified that the *Trim and Fill* algorithm “…uses an iterative procedure to remove the most extreme small studies from the positive side of the funnel plot, re-computing the effect size at each iteration until the funnel plot is symmetric about the (new) effect size” (p.286). Theoretically, this algorithm creates an unbiased approximation of effect size (Borenstein et al., 2009).
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THE EFFICACY OF NEUROFEEDBACK IN THE TREATMENT OF INDIVIDUALS WITH
SYMPTOMS OF ANXIETY: A META-ANALYSIS

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I have no conflicts of interest to disclose.

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Abstract

Despite the documented efficacy of neurofeedback (NFB) in the treatment of people with anxious symptomatology, many insurance companies identify NFB as experimental, which prohibits individuals from utilizing benefits to obtain this therapeutic treatment. In order to examine these discrepancies, the present meta-analyses were conducted to examine the overall effectiveness of NFB, examine the impact of participant characteristics, and identify the extent of the differences in anxiety-spectrum outcomes. Twenty-six trials were divided based on design (12 single group [SG]; 14 between group [BG]) and analyzed in separate meta-analyses. Overall, results indicated that anxiety-spectrum self-report assessments reduced by nearly one (SG $SDM = -.91$; BG $g = .82$) standard deviation unit with relatively small degrees of bias. Limitations and future directions are reported.

*Keywords:* meta-analysis, anxiety, counseling, neurofeedback, EEG biofeedback
The Efficacy of Neurofeedback in the Treatment of Individuals with Symptoms of Anxiety: A Meta-Analysis

According to the most recently available metrics available by the Harvard Medical School (2007), approximately 31.2% of the total population in the United States will experience some form of anxiety disorder throughout the course of their life. Within this scope of anxiety disorders, the Harvard Medical School reported the prevalence for panic disorder (4.7%), agoraphobia without panic (1.3%), specific phobia (12.5%), social phobia (12.1%), generalized anxiety disorder (5.7%), post-traumatic stress disorder (6.8%), obsessive-compulsive disorder (2.3%), and adult/child separation anxiety disorder (9.2%). Furthermore, the Harvard Medical School suggested that 57.4% of the total US population will experience some form of a mental health diagnosis throughout the course of their lifetime. Shirneshan et al. (2013) reported that adults in the United States with anxiety disorders utilize approximately 33.71 billion U.S. dollars in direct medical expenditures. Hartman et al. (2015) reported that the total U.S. Healthcare Budget was 2.9 trillion dollars in 2013. Given these metrics, 1% of the total U.S. healthcare budget in 2013 was utilized in covering direct costs associated with the treatment of anxiety-spectrum disorders. Based on the fiscal impact of the treatment of anxiety-spectrum disorders, the development of high-quality research is needed to explore the efficacy of therapeutic interventions to reduce such symptoms. Neurofeedback (NFB) appears to be efficacious in the reduction of symptoms of anxiety, as reported in extent research (e.g., Bennett et al., 2020; Johnson et al., 2013), literature reviews (e.g., Hammond, 2005), and systematic reviews (e.g., Moore, 2000; Tolin et al., 2020).

Neurofeedback found its seminal footing in published works completed by Joe Kamaya (1969) during his tenure at The University of Chicago. Shortly after, an article came out in the
Personnel and Guidance Journal by Danskin and Walters (1973) that advocated for the use of biofeedback, including brainwave biofeedback, to assist individuals to reduce a wide range of symptoms, including anxiety. More recently, there have been advances within the counseling profession that integrate neurofeedback, biofeedback, neuroscience-informed counseling, and adjunctive therapies, such as meditation, under the encompassing umbrella term, integrative neurotherapy (Field et al., 2019).

Organizational Support in Counseling for Neuroscience

Organizational support for the integration of neuroscience within counseling practices began with the Council for Accreditation of Counseling and Related Educational Programs (CACREP) when they released programmatic standards that required all programs that they accredit to teach counselors-in-training about the neurobiological underpinnings of human behavior (CACREP, 2009). With the addition of the explicit mandates (i.e., CACREP, 2009, 2015) to address the neurobiological underpinnings of human behavior came a new resolve to learn about and integrate neuroscientific principles into counseling practice. This resolve is noted by the creation of multiple interest networks, task forces, and dedicated space within counseling literature and organizations. Most notable is the dedication of space for topics related to the integration of neuroscience within the practice of counseling in their publication, Counseling Today (Russell-Chapin & Field, 2020) as well as support for the Neurocounseling Interest Network (American Counseling Association [ACA], 2015). The American Mental Health Counselors Association (AMHCA) also provided backing of neuroscience-informed counselors through the dedication of space within the Journal of Mental Health Counseling (Weigold, 2020). Outside of clinical neuropsychology, counseling is the only other mental health profession
that has created and implemented training standards to address the integration of neuroscience into clinical practice (Russo et al., 2021).

**Neurofeedback as Experimental**

Despite this large level of institutional support, intentional efforts to promote neurobiological training for counselors, and dedicated space within official publications, there are some researchers that asserted that neurofeedback is experimental at best (Thibault & Raz, 2017; Thibault et al., 2015, 2016). Thibault and Raz (2017) asserted that board members, authors, and journal editors of many of the professional organizations that support clinical practice/research relating to NFB have notable financial biases that impact their works. Thibault and Raz touted that fiscal biases held by practitioners and industry leaders undoubtedly present biases throughout the body of NFB literature.

**Insurance Company Policies Opposing Neurofeedback**

Nihilistic ideologies regarding the efficacy of neurofeedback are presently endorsed by many insurance companies. In fact, many insurance companies have policies that indicate that they will deny reimbursement requests for neurofeedback and/or biofeedback services that are provided. TRICARE (2020) stated that it “doesn’t cover neurofeedback” (p.1). Humana (2021) is another company that stated that their members “may not be eligible… for EEG biofeedback for any indications including, but may not be limited to… Anxiety disorders…” (p.3). Additionally, Aetna (2020) stated that “biofeedback [is] experimental and investigational because there is insufficient evidence in the medical literature documenting the effectiveness of this approach for… anxiety disorders…” (p.2). UnitedHealthcare® (2021) is another company that will not provide coverage for the CPT codes 90875 or 90876, which involve the combination of psychotherapy with biofeedback.
Purpose of the Study and Research Questions

Due to the varied assertions presented in previous research surrounding the efficacy of neurofeedback in the treatment of individuals with anxious symptomatology, a synthesis of available research is warranted. The purpose of the present study was to identify and evaluate the efficacy of neurofeedback in the reduction of symptoms of anxiety-spectrum symptomatology in an unbiased manner. Our activities were guided by four research questions: (a) What are the study and sample characteristics within studies evaluating the impact and effectiveness of NFB for decreasing anxiety-spectrum symptomatology?; (b) What is the degree of treatment gain in pre-experimental studies of NFB for decreasing anxiety-spectrum symptomatology?; (c) What is the degree of comparative effectiveness between NFB and other interventions for decreasing anxiety-spectrum symptomatology?; (d) What are the moderating effects of sample and study characteristics on the impact and comparative effectiveness of NFB for decreasing anxiety-spectrum symptomatology?

Method

I implemented a systematic search strategy to identify, collate, and synthesize the findings of quasi-experimental, experimental, and single-group research designs that evaluate NFB effectiveness. Articles that reported data in a single group design were run in one meta-analysis, whereas articles that reported data in a between group design were reported in a second meta-analysis. The following methodology were applied to both arms of analysis.

Inclusion and Exclusion Criteria

Articles were selected for inclusion if they utilized NFB, as an independent variable, in the treatment of anxiety-spectrum disorders, as the dependent variable. Eligible study designs included quasi-experimental, experimental, and single-group research designs. Articles that were
included reported pre/post assessments of anxiety and were peer-reviewed. Dependent variables selected must have been shown through peer-reviewed literature to be reliable, valid, and have been appropriately normalized. Dissertations and/or theses were considered for inclusion based on similar peer and/or expert reviews of the textual work.

In the case of multiple reports, preference was given to articles that were published first, meaning that primary study reports will be favored over secondary analyses. Articles that include participants with multiple diagnoses were not excluded as long as they meet criteria for at least one of the predetermined diagnoses that falls into the category of anxiety-spectrum disorders. In the case of multiple diagnoses, only data that relates to anxiety-spectrum disorders were included within the present meta-analysis. Additionally, articles were not excluded based on participant demographics or geographic region. Although the brain undergoes developmental changes throughout the lifespan and there are differences between male and female brains, similar NFB training protocols were shown to be efficacious in the treatment of anxiety-spectrum disorders for male and female children ranging in age from 6 to 15 years of age (e.g., Huang-Storms et al., 2010), as well as male and female participants that range in age from 11 to 61 years (e.g., Dreis et al., 2015). However, articles that were published in languages other than the English language were excluded since the author was unable to determine the appropriateness of measures and the overall quality of the article. Additionally, neurofeedback approaches that utilized invasive techniques were excluded since such techniques may fall outside of the counseling scope of practice.

Articles were included that have been published between the timeframe of 1973-2020. The commencement year of the inclusion criteria was selected based upon *The ISNR Comprehensive Bibliography of Neurofeedback Research* (2020), which indicated that the oldest
article to address the topics of anxiety and NFB was published in 1973. Every effort was made to convert the reported data into usable data (e.g., computation of means based on reported confidence intervals and standard deviation value). Articles were excluded in the event that data were missing and unable to be identified through appropriate computational methods.

**Information Sources**

Documents were be considered for inclusion based upon the following search strategy: (“neurofeedback” OR “brainwave biofeedback” OR “Z score training” OR “amplitude training” OR “coherence training” OR “phase synchrony training” OR “LORETA” OR “sLORETA”) AND (“anxiety” OR “fear” OR “stress” OR “anxiety disorder” OR “over arousal” OR “trauma” OR “PTSD” OR “posttraumatic stress disorder” OR “obsessive compulsive disorder” OR “OCD” OR “phobia” OR “phobic” OR “GAD” OR “generalized anxiety disorder”). Given the multidisciplinary nature of neurofeedback treatment and hardware/software development, the following databases and repositories were used to identify articles that meet inclusion criteria: Campbell Collaboration, Cochrane Library, EBSCO, ProQuest, and ProQuest Dissertations and Theses Global, PubMed, Science Direct, and Scopus. When conducting the aforementioned search through EBSCO, the following databases were selected: Academic Search Premier, Biological Abstracts®, Computers & Applied Sciences Complete, ERIC, MEDLINE, APA PsychArticles®, Psychology and Behavioral Sciences Collection, and APA PsychInfo®. Additionally, journal-specific searches were conducted for the following journals: The Journal of Neurotherapy, Neuroregulation, Applied Physiology and Biofeedback, Journal of Mental Health Counseling, Journal of Counseling and Development, and Counseling Outcome Research and Evaluation. These journals were selected based on the high degree of overlap in their scope and the search strategy of the present meta-analysis.
In addition, articles included in the *ISNR Comprehensive Bibliography* (2020) and those that were reported in previously-conducted meta-analyses with a similar scope were mined and analyzed for appropriateness of the scope of the present meta-analysis. The previously-completed meta-analyses that were found included works completed by the following: Ferreira et al. (2019), Moore (2000), Reiter et al. (2016), Schoenberg and David (2014), and Steingrimsson et al. (2020). This mining process was conducted with the aim of identifying additional articles that were omitted by the previously-identified search strategy. Forward citation was not used based on the number of databases, repositories, journal-specific searches, and references mined. This limitation is further addressed in the discussion section.

Finally, a total of five principle authors were contacted via the email addresses that were provided on their publications in order to attempt to include data that were missing from their publications. Additional attempts to search and contact authors were made via google search given the possibility that the researchers could have moved to other institutions, organizations, and/or private practices since publishing their article. However, at the time of the analyses, none of the authors had responded.

**Study Selection**

An initial analysis of the title, abstract, and keywords was conducted to determine if the article identified by the previously-determined search strategy met initial eligibility criteria. In the event that the article had been determined to meet eligibility requirements, an analysis of the methods and results sections of the article occurred. This second stage analysis determined the extent that the appropriate information was included, such as mean, standard deviation, and sample size, which were needed to compute effect size calculations. If all information was
reported or could be obtained from the article, the said article was selected for inclusion and analyzed appropriately.

The author is a current doctoral candidate (DC) and completed this manuscript in concert with his Dissertation Committee in partial fulfillment of the requirements to obtain his doctoral degree in Counselor Education and Supervision. The DC has obtained Board Certification in Neurofeedback from the Biofeedback Certification International Alliance (BCIA). Additionally, the DC has completed a doctoral level meta-analysis course and is currently enrolled in a second. Finally, the DC has obtained a Master’s of Science in Clinical Mental Health Counseling (CMHC) as well as completed a majority of the requirements to obtain a Doctorate of Philosophy (Ph.D.) in Counselor Education and Supervision, both of which are from CACREP-accredited programs.

Additionally, an external evaluator was used in the present study to promote consistency in data reporting, which assisted in moderating risks to internal validity. In terms of experience, the independent analyst had completed a graduate-level BICA recognized didactic neurofeedback course, completed graduate-level coursework in statistics and research methodology, obtained a Master’s of Science in CMHC from a CACREP-accredited program, received training on the code book that was used in this study, as well as received training on the inclusionary/exclusionary criteria used in the present study.

Data Collection

Articles that were selected for analysis had data extracted consisting of the following: APA reference, classification of symptoms evaluated (i.e. anxiety, OCD, or PTSD), name of assessment used as study dependent variable, number of participants included in each of the conditions utilized by the study (e.g. placebo, wait-list, active treatment, alternative treatment),
mean and standard deviation per treatment condition and time that assessment was completed (i.e., pre-treatment, post-treatment, follow-up), categorization of any alternative treatments used (e.g. Neuroscience-informed Cognitive Behavioral Therapy, Person-Centered Therapy, deep breathing), participant demographic data (i.e., mean age, ethnicity, and sex), training time per condition in terms of minutes, number of sessions provided to participants.

Additionally, the author tracked article-specific data including the following: total sample size, number of girls/women, number of boys/men, average participant age, the location that the study was completed (U.S. or outside of the U. S.), participant identified race and ethnicity, average number of NFB sessions completed, if the protocol was individualized (quantitative electroencephalography; qEEG-driven), or if the study used a protocol, NFB treatment time in terms of minutes, treatment setting, number of NFB providers, extent of provider training in NFB. These data were used to assist in providing additional insights into the results of the present meta-analyses.

**Method for Assessing Risk to Internal Validity**

In order to assess the accuracy of data obtained, an independent analyst randomly reviewed 20% of the included articles to ensure reporting accuracy. Prior to randomization, the articles were alphabetized by primary author last name. Once alphabetized, each article received a corresponding number, whereby the first article was identified as 1, second article 2, and so on. Once ordered, the DC set the minimum number on the Google (n.d.) *random number generator* to 1 and the maximum number to the total number of articles included and generated numbers that corresponded to 20% of the articles. In the event that an article was selected more than once, the DC negated that number generation and re-generated another number so that a unique 20% of articles were identified. Once identified, the DC compared their data with data recorded by the
independent analyst. If there were any disagreements in the data, the article was re-reviewed independently. This process was repeated until there is an agreement rate of 95% or higher to promote accuracy in data and reduce risks to internal validity.

Summary Measures

Calculating Effect Size Using Standardized Mean Differences

Effect sizes were evaluated using standardized mean differences (SMD) for studies that utilized a single group (SG) pre-post design. Akin to the calculation of Hedge’s g, SMD was calculated using CMA v3.3. This effect size calculation differs from Hedge’s g in a number of ways. Of these ways, one of the most notable is that SMD does not weight studies based on sample size and, as such results in an effect size measure that is susceptible to bias associated with sample size inflation. Calculation of SMD can be completed by using the formula provided by Borenstein et al. (2009): $SMD = \frac{\bar{Y}_1 - \bar{Y}_2}{S_{within}}$. Accordingly, the terms $\bar{Y}_1$ and $\bar{Y}_2$ reflect difference scores that are computed by determining changes that occur between pre and post score values across each study that was included. Within this metric, Borenstein et al. (2009) identify that the term, $S_{within}$ is calculated using the following formula: $S_{within} = \frac{s_{difference}}{\sqrt{2(1-r)}}$. The $S_{within}$ formula utilizes the terms $r$, which reflects the paired pretest-posttest correlation pairs.

Essentially, SMD is calculated by dividing each studies’ mean difference by the corresponding study’s standard deviation to create the SMD that allows for cross study comparison (Borenstein et al., 2009). Interpretation of SMD effect size values uses the same quartile-based cutoff scores recommended by Lipsey and Wilson (2001); whereby scores that fell within the range of 0.30-0.49 indicated a low degree of practical significance, 0.50-0.66 indicated a moderate degree of practical significance, and 0.67-1 indicated a large degree of practical significance.

Calculating Effect Size Using Hedge’s g
Between-group (BG) study effect sizes were calculated using Comprehensive Meta-
Analysis, Version 3.3 (CMA v3.3) to compute Hedges’ \( g \) effect sizes as well as sampling error of
studies that met inclusionary criteria. Hedges’ \( g \) is a modification that has been applied to
Cohen’s \( d \) that reduced the impact that sample size had on calculating treatment efficacy
(Borenstein et al., 2009; Erford et al., 2010; Hedges, 1981; Lipsey & Wilson, 2001; Watson et
al., 2016). This modification process creates effect size measures that are not susceptible to
biases brought on by artificial inflation of study sample size. According to Borenstein et al.
(2009), the formula used for the calculation of Hedges’ \( g \) is as followed: \( g_i = d_{mod} \times d \). This
calculation is made for each included article that utilized between-group designs in the meta-
analysis and in doing so, resulted in a series of effect size calculations (i.e., \( g_1, g_2, \ldots g_i \)). As
noted, to calculate Hedges’ \( g \), one must first calculate Cohen’s \( d \), which is accomplished by
using the formula: \( d = \frac{X_1 - X_2}{S_{pooled}} \) (Borenstein et al., 2009).

Within Cohen’s \( d \) is the term \( S_{pooled} \), which is obtained through use of the
formula: \( S_{pooled} = \sqrt{\frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1 + n_2 - 2}} \) (Borenstein et al., 2009). The \( S_{pooled} \) formula utilizes the
terms \( n \), which reflects the sample size of the groups, as well as the terms \( S \), which reflects the
standard deviation of each of the included studies. In addition to the aforementioned formulae for
the calculation of \( g_i \), Borenstein et al. (2009) noted that calculation of the term \( d_{mod} \) is
accomplished through the formula: \( d_{mod} = 1 - \frac{3}{4df - 1} \). The term \( df \) is used to calculate \( d_{mod} \) and
is the same term in the denominator for the equation for \( S_{pooled} \), \( n_1 + n_2 - 2 \) (Borenstein et al.,
2009). Upon calculating Hedges’ \( g \), Lipsey and Wilson (2001) recommended using quartile-
based cutoff scores in the interpretation of treatment efficacy, whereby scores that fell within the
range of 0.30-0.49 indicated a low degree of practical significance, 0.50-0.66 indicated a
moderate degree of practical significance, and 0.67-1 indicated a large degree of practical significance.

**Methods of Synthesis**

CMA v3.3 was used to compute the effect size measures for both arms of meta-analyses, which evaluated the efficacy of NFB in the reduction of anxiety-spectrum symptomatology for SG or BG study designs. Both meta-analyses were evaluated using the random effects model from primary and post hoc analyses to combine individual study effects into an overall mean effect size metric. Null hypotheses were evaluated using the 95% confidence intervals and were created to address issues associated with outcome imprecision. Standard deviation units reflected the magnitude of the effects, whereby larger magnitudes represented larger efficacy. Additionally, prediction intervals were calculated and displayed using a 95% lower limit and upper limit intervals for both study designs in order to determine the future anticipatory range of likely scores given that said future studies utilize similar methodology and consist of similarly described participant samples.

Cochran’s $Q$ and inconsistency index ($I^2$) were used to estimate that the degree of variation among unique effect sizes was not due to chance. These metrics allowed for the assessment of homogeneity within the sample of studies. Post hoc moderator analyses were conducted for instances when $Q$ statistically significant ($p < .05$) and $I^2$ values exceeded 50 (Borenstein et al., 2009; Lipsey & Wilson, 2001). Categorical moderator variables (i.e. clinical outcome) were assessed using subgroup analyses and continuous moderator variables (e.g. number of sessions, participant age) were assessed by meta-regression with random effects modeling. The $R^2$ analogue, which is obtained through meta-regression, was used to reflects the degree of the variance in true effects explained by the covariate.
Studies that used a SG design were evaluated using SMD, as a biased and unweighted measure of study variance. This metric was selected due to the fact that SMD reflects the differences between the groups of studies by identifying the degree of overlap between study distributions (Cohen 1987). Negative effect size measures indicated that NFB resulted in a reduction of clinical outcome measures associated with anxiety-spectrum symptomatology.

Studies that used BG designs were evaluated using Hedge’s g. Hedge’s g, as an unbiased measure of weighted invariance, was selected as the effect size measure based on its ability to account for variance in sample size and sampling error between studies (Borenstein et al., 2009; Erford et al., 2010; Rosenberg et al., 2013). Negative effect sizes indicated that NFB had a greater efficacy than control groups.

**Publication Bias and Selective Reporting**

**Funnel Plot Analysis**

A funnel plot was created to identify the extent of the impact of publication bias. I graphed the standard error on the y-axis and Hedges’ g values on the x-axis to create (Borenstein et al., 2009). Graphing standard error on the “y-axis has the advantage of spreading out the points on the bottom half of the scale” and allows for greater ease in the interpretation of asymmetry (Borenstein et al., 2009, p. 283). In the event that publication bias is detected in the graph, the author will seek to examine the extent of the bias.

**File drawer effect**

Oftentimes, this bias is the result of what is known as the file drawer effect. Erford et al. (2010) described the file drawer effect as the result of the reality that many researchers may often choose to avoid publishing insignificant results. This tendency creates a body of literature that may represent an oversaturated and unrealistic pool consisting of biased publications. To
compensate for publication bias, this research will utilize a fail-safe \( N \). The fail-safe \( N \) will be calculated using the following two formulas:

\[
\frac{ES}{N_y} = \frac{.01}{k} \quad \text{and} \quad N_f = N_y - k
\]

In these equations, Erford et al. (2010) reported that “\( N_f \) is the fail-safe \( N \), \( k \) is the number of studies in the meta-analysis sample, \( ES \) is the mean effect size for the meta-analysis under study, and \( N_y \) is the number of studies required to reduce the effect size to .01.” (p. 37). The calculation of the fail-safe \( N \) identifies the number of unpublished articles consisting of insignificant that will be required to move the effect size calculation from efficacious to non-efficacious. A larger number of studies required to move the effect size from efficacious to non-efficacious would indicate that publication bias is not contributing to the results. As such, the calculation of a fail-safe \( N \) will allow for the determination of the degree to publication bias present in the selected studies.

**Trim and Fill**

Upon recognizing the extent of the impact that publication bias has on the results, the author will attempt to remove it by utilizing Duval and Tweedie (2000a & 2000b) Trim and Fill process. Calculation of the trim and fill procedure will be completed using CMA v3.3. The rationale for this process is to remove publication bias in order to determine the efficacy of NFB. Borenstein et al. (2009) identified that the Trim and Fill algorithm “…uses an iterative procedure to remove the most extreme small studies from the positive side of the funnel plot, re-computing the effect size at each iteration until the funnel plot is symmetric about the (new) effect size” (p.286). Theoretically, this algorithm creates an unbiased approximation of effect size (Borenstein et al., 2009).

**Results**
Study Selection

A flowchart detailing the processes and procedures used in study selection for both arms of meta-analysis is provided in Figure 3. The 26 articles that met inclusionary criteria were categorized based on study design; whereas, 14 articles were identified as single group designs and 12 articles were between-groups designs. These were separated being as though it is not mathematically possible to include articles with varied study designs in the same meta-analysis in CMA v3.3.

Study Characteristics

Data pertaining to study and sample characteristics for the SG study designs are reported in Table 1; data pertaining to study and sample characteristics for the BG study designs are reported in Table 2. However, of the 26 studies included, only eight studies reported ethnic identity. Of the seven, six studies consisted of a majority of Caucasian/white (non-LatinX) participants. Based on the low frequency of reporting, data relating to participant race and ethnicity are not reported in Table 3. Limited reported of participant ethnicity is addressed in greater detail in the discussion section of the present.

Results of Individual Studies

Forest plots and statistical results corresponding to SG and BG meta-analyses are provided in Table 4 and 5, respectively.

Synthesis of Results

NFB Single Group Studies

The 20 effect sizes (see Table 4) included in the analysis addressing single group studies evaluating the efficacy of NFB for decreasing symptoms of anxiety, PTSD, or OCD (N = 259) yielded a mean effect size of -.94 (CI95 = -1.24, -0.64), τ² = .25, p < .01, suggesting that the null
hypothesis related to inferiority of NFB within this sample of studies can be rejected.

Interpretation of the mean effect size suggests that participants receiving NFB experienced desired treatment effects ranging from 124% to 64% of a standard deviation (SD) of change, indicative a point estimate ranging from moderate to large effects. This analysis resulted in a prediction interval ranging from -2.05 to 0.17, suggesting that the range of true effects in future studies with similar samples would yield observed effects ranging from a 205% of a SD unit reduction of anxiety symptoms to 17% increase in anxiety symptoms resulting from NFB treatment.

**Differential effects for NFB for PTSD versus anxiety versus OCD symptoms.** The analysis of differential effectiveness for NFB as a treatment approach for PTSD versus anxiety versus OCD revealed statistically significant differences, $Q (2, 20) = 8.70, p < .05$. Between clinical outcome subgroups, samples evaluating anxiety outcomes yielded larger mean effect sizes ($k = 14, SMD = -0.73 \ [CI95 = -0.96, -0.50], p < .01$) when compared to those applied to the treatment of OCD ($k = 4, SMD = -3.17 \ [CI95 = -5.17, -1.18], p < .01$). PTSD represented the lowest mean effect sizes ($k = 2, SMD = -2.25 \ [CI95 = -3.91, -0.58], p = .03$). Overall, moderator analysis by way of clinical outcome warranted a sizeable reduction in anxiety symptoms ($k = 20, SMD = -0.79 \ [CI95 = -1.02, -0.56], p < .001$).

**Heterogeneity among Observed Effect Sizes.** The effect size distribution within the sample of studies was heterogeneous $Q(15) = 55.29, p < .001, I^2 = 72.87$, indicating a large amount of heterogeneity wherein approximately 73% of the observed differences in effect sizes reflects non-systematic differences; thus, exploration of moderating variables was warranted.

**Study Characteristics that Predict Observed Variations in Treatment Effects.** The meta-regression analysis of study characteristics that predicted treatment variation was
statistically significant, $F(1, 16) = 9.61, p = < .01, R^2 = .49$, suggesting that number of sessions was a predictor of observed differences in study outcome estimations. None of the other hypothesized contributors of variance (mean age, percent of women versus men in sample, training time) were related to the non-systematic variations in observed effect sizes.

**Assessment of Internal Validity of Individual Studies**

Given that *SMD* does not account for the impact that small sample sizes introduce in the synthesis process, there is the potential for studies with small sample sizes to bias omnibus effect size measures. To address this impact that such studies have on the mean effect size, studies with extreme low sample sizes were removed in order to examine the impact that they have on the omnibus effect size measure. This calculation resulted in a decrease in study efficacy from -.94 (CI95 = -1.24, -0.64), $\tau^2 = .25, p < .01$ to -.89 (CI95 = -1.18, -0.60), $\tau^2 = .22, p < .01$, or an approximate 5% change in the *SMD* omnibus effect size measure.

**Potential for Publication Bias.** Inspection of the funnel plot indicated all 20 studies were located to the left (therapeutic) side of the mean effect. Inspection of study dispersion noted that 85% of observations were located within the funnel with a majority of the effect size measures located within the upper portion of the funnel plot. However, three studies that were located outside of the funnel and may have contributed to some publication bias (Scheinost et al., 2014, $N = 5$, *SMD* = -3.37; Cheon et al., 2016, $N = 20$, *SMD* = -2.31; Sürmeli & Ertem, 2011, $N = 36$, *SMD* = -2.15). The decision to retain the three studies within our sample was verified by trim and fill analyses that indicated no studies missing to the left; however, four theoretical study was missing from the right of the mean effect size. If this study was available, the mean effect size would be decreased by 6% of a SD from -0.94 to -0.88. This sample of studies resulted a $N_f =$
suggesting that we would need to locate 36 missing studies for every observed study for our observed effect to be nullified.

**Between Group Studies comparing NFB to Control Groups**

The 21 effect sizes (see Table 5) included in the analysis addressing single group studies evaluating the efficacy of NFB for decreasing symptoms of anxiety, PTSD, or OCD (N = 532) yielded a mean effect size of -.87 (CI95 = -1.20, -.53), τ^2 = .44, p < .01, suggesting that the null hypothesis related to inferiority of NFB within this sample of studies can be rejected. Interpretation of the mean effect size suggests that participants receiving NFB experienced desired treatment effects ranging from 120% to 53% of a standard deviation of change, indicative a point estimate ranging from moderate to large effects. This analysis resulted in a prediction interval ranging from -2.29 to .56, suggesting that the range of true effects in future studies with similar samples would yield observed effects ranging from a 229% of a SD unit reduction of anxiety symptoms to an 56% of a SD unit increase in anxiety symptoms resulting from NFB treatment.

**Differential effects for NFB for anxiety versus PTSD versus OCD symptoms.** The analysis of differential effectiveness for NFB as a treatment approach for PTSD versus anxiety versus OCD did not reveal statistically significant differences, Q (2, 21) = 2.15, p = .34. Between clinical outcome subgroups, samples evaluating anxiety outcomes yielded larger mean effect sizes (k = 11, g = -.98 [CI95 = -1.53, -.44], p < .001) when compared to those applied to the treatment of PTSD (k = 9, g = -.85 [CI95 = -1.30, -.40], p < .001). Overall, moderator analysis by way of clinical outcome warranted a sizeable reduction in anxiety symptoms (k = 21, g = -.82 [CI95 = -1.15, -.50], p < .001).
**Heterogeneity among Observed Effect Sizes.** The effect size distribution within the sample of studies was heterogeneous $Q (20) = 73.48, p < .01, I^2 = 72.78$, indicating a large amount of heterogeneity wherein approximately 70% of the observed differences in effect sizes reflects non-systematic differences; thus, exploration of moderating variables was warranted.

**Study Characteristics that Predict Observed Variations in Treatment Effects.** The meta-regression analysis of study characteristics that predicted treatment variation was statistically significant, $F(1, 13) = 15.07, p = .30, R^2 = .98$, suggesting that number of sessions was a predictor of observed differences in study outcome estimations. None of the other hypothesized contributors of variance (mean age, percent of women versus men in sample, training time) were related to the non-systematic variations in observed effect sizes.

**Assessment of Internal Validity of Individual Studies**

Given that Hedge’s $g$ accounts for the impact that small sample sizes introduce in the weighting process, there was limited risk to internal validity brought on by individual studies by sample size.

**Potential for Publication Bias**

Inspection of the funnel plot indicated 19 studies located to the left (therapeutic) and two effect sizes to the right (non-therapeutic) sides of the mean effect. Inspection of study dispersion noted that 90% of observations were located within the funnel with a majority of the effect size measures located high and tight within the top of funnel plot. The two studies that were located outside of the funnel may have contributed to some publication bias (Dadashi et al., 2015, $N= 28$, $g= -5.83$; Noohi et al., 2017, $N = 30$, $g= -2.65$). The decision to retain the two studies within our sample was verified by trim and fill analyses that indicated four studies missing to the left; and no studies missing to the right of the mean effect size. If these studies were available, the mean
effect size would be increased by 17% of a SD from -0.87 to -1.04. This sample of studies resulted a $N_f = 481$ suggesting that we would need to locate 22.9 missing studies for every observed study for our observed effect to be nullified.

**Adverse and Harmful Effects**

Of the studies included in either of the present meta-analyses, none reported harmful or adverse effects. However, adverse effects have been found in the larger body of neurofeedback literature. In one study by Lubar and Shouse (1976), participants taking part in an A-B-A neurofeedback study showed changes in ADD/ADHD symptomatology that corresponded with the sub-sequential stage of the study (i.e. decrease, increase, increase in symptoms). Additionally, Hammond (2008) reported that a range of adverse reactions are possible when participants take part in studies that are driven by protocols as opposed to qEEG. Hammond identified short-lived and mild aversive reactions such as headache, fatigue, irritability, and a decreased ability to concentrate. Additionally, Hammond found that more severe adverse reactions were possible such as: seizures, depression, and even symptoms of mania. In a separate study completed by Rogel et al. (2015), the most common adverse reaction reported was headache, followed by fatigue, and mood swings. Such findings point to the value associated with advanced clinical training in NFB and the need for high-quality continuing education to address adverse effects early on while protecting and promoting client/participant wellness.

**Discussion**

The purpose of this research was to identify the degree to which NFB was effective for decreasing symptoms of anxiety-spectrum disorders. Overall, the present meta-analyses suggest that NFB is beneficial in reducing symptoms of anxiety; however, there were relatively few articles that examined symptoms of OCD. Future results of similarly constructed single-group
NFB studies can expect to find that participants could experience a range clinical efficacy spanning from a slight increase in anxiety symptom severity to a large degree of alleviation from anxiety symptoms. Similarly, future results of similarly constructed between-group NFB studies can expect to find that participants could experience a range clinical efficacy spanning from a moderate increase in anxiety or trauma symptom severity to a large degree of alleviation from anxiety or trauma symptoms. These future predicted ranges of efficacy are not surprising given that no single counseling intervention is efficacious for everyone. There are numerous factors that could contribute to or detract from the efficacy of therapeutic interventions. Variations noted within the present study include participant age, nationality, ethnicity, number of NFB sessions, training times, and even clinician/researcher training. However, consistently in both meta-analyses, the moderating variable that explains the largest degree of inconsistency was number of sessions provided. This makes sense given the various modalities provided (e.g. qEEG-guided NFB, or protocol-driven NFB), as well as the fact that symptom severity varies based on the client.

Furthermore, there was a large degree of variation noted in control groups utilized in BG study designs. Some authors utilized active control groups, such as alternatively viable treatments, whereas other authors compared NFB to waitlist control conditions. The variation in comparison groups could have contributed to variation in the overall efficacy.

Of the 26 total articles included in both meta-analyses, only five articles reported clinician/researcher training. The depth of training reported ranged from graduate student counselors that completed one theory-driven course on neurofeedback (Dreis et al., 2015) to “experienced NF [neurofeedback] clinicians” (van der Kolk et al., 2016, p. 5). The observation relating to clinician training/experience is made to not only encourage researchers to report
training and years of experience, but is also made to notate the need to provide additional training in brain-based interventions. Currently, only four universities provide neurofeedback coursework that satisfies BCIA’s didactic requirements (BCIA, 2020). Of these recognized universities/academic programs, none of the BCIA-recognized coursework is facilitated by individuals that have training in counselor education. Russo et al. (2021) indicated that the majority of counselors that reported receiving training in NFB do so by way of continuing education. This modality presents problems when it comes to neuroscience-related continuing education. Miller (2016) points out that neuroscience-related continuing education is not created equally. There are ranges in terms of the quality of instruction as well as the accuracy of material (see Kim & Zalaquett, 2019).

**Limitations and Suggestions for Further Research**

A limitation of this study was the decision not to utilize forward citation searches. The searches could have resulted in the inclusion of the three studies that were potentially missing in the SG analyses and/or the four potentially missing studies in the BG trim and fill analyses. Despite this, there were robust findings related to *failsafe N*s for both meta-analyses (SG $N_f$ = 720; BG $N_f$ = 481). The values suggest that a large number of unpublished studies would need to be found to nullify the findings of the conducted meta-analyses.

An additional limitation was the decision to address the to exclude articles that utilized qEEG as the sole dependent variable. This metric was classified as an *unstandardized dependent variable* being as though there is a dearth in the literature that adequately addresses the ability for qEEG to appropriately address wide range of variation in human experiences. A multitude of lived experiences compounded by interaction effects between these experiences uniquely shape the physiology of the brain. Some experiences, such as: exercise (Panksepp, 2007), sleep
(Williamson & Feyer, 2000), languages spoken (Carrasco-Ortiz et al., 2017), nutrition and diet (Weiss & Hennet, 2017), subtle changes in mental state (Russo & Stevens, 2016), as well as issues of: poverty, abuse, neglect, traumatic experiences, racism, sexism, and many other social injustices (Zalaquett & Ivey, 2018) uniquely impact human EEG activity. Given the variation, it is unwarranted to solely rely on changes in EEG as a metric for client outcome.

Of the studies included between both meta-analyses, only two of the studies (Dreis et al., 2015; Rogel et al., 2020) included children. The lack of children represented in the included studies may be surprising given that previous meta-analyses exploring the efficacy of NFB in the reduction of symptoms of ADHD/ADD include a number of articles that represented the experiences of children (see Arns et al., 2009). However, even more surprising was the realization that of the 26 articles included, only seven reported data pertaining to participant ethnicity. Of the seven studies included, six of the studies reported that a majority of the participants that took part in their studies identified as white. Research completed by Dreis et al. (2015) and Jones and Hitsman (2018) were the only groups of authors that reported experiences obtained by participants that predominately identified as non-white. However, participants that took part in studies outside of the United States of America were often identified by their nationality as opposed to ethnicity. For example, participants that took part in the study completed by Askovic et al. (2020) were identified by the location of recruitment (i.e. Sydney, Australia). Observations related to variations in client demographic reporting practices could suggest that researchers in the U.S. might be some of the few to sub-categorize participants based on racial or ethnic factors. Ultimately, there would not be enough information presented in the present meta-analysis to draw conclusions regarding the efficacy of NFB for individuals that identify as racial or ethnic minorities. This creates opportunities for future research relating
to the efficacy of NFB for children and/or adolescents, as well as those participants that identify as racial or ethnic minorities. Virtually none of the included studies addressed the efficacy of NFB in populations that identified themselves as a member of any sexual/gender minority group, or having any level of intellectual and/or developmental disability. As such, future clinical efficacy could be potentially limited based on individual client/participant characteristics relating to: age (childhood, adolescents, or older adults), sex (people that identify as transgender), ethnicity, and/or degree of intellectual and/or developmental disability.

None of the articles included in either arm of meta-analysis (SG or BG) explored the efficacy of NFB in the reduction of symptoms associated with panic disorder, agoraphobia without panic, specific phobias, or adult/child separation anxiety. The only two authors that evaluated the efficacy of NFB in the reduction of PTSD using a SG design were Alhowaish (2020) and Askovic (2017). Hammond (2003), Scheinost et al (2014), and Surmeli & Ertem, 2011, were the only authors to explore the efficacy of NFB in the reduction of symptoms associated with OCD using a SG design that met inclusionary criteria. The only article that was included in the BG design meta-analysis that assessed symptoms of OCD was completed by Joseph et al. (2009).

Future researchers would be wise to consider the implementation of standardized measures of the desired symptomatology of interest in conjunction with brain-based metrics. However, when utilizing brain-based databases for comparative purposes, it is important to recognize the multicultural identity of the individual client/participant. Presently, many databases only account for the factors of age, sex, and handedness. This limited perspective may or may not be adequate when recognizing differences in experiences, such as race and ethnicity, language(s) spoken, diet/nutrition, and a multitude of other factors that impact EEG.
Concomitantly, databases should also be updated to better address the range of variation in individuals’ experiences, which affect neurophysiology.

Conclusion

There is a need for mental health training programs to provide quality mental health training to increase the availability of mental health service providers. Additionally, mental health training programs should consider the inclusion of coursework that trains individuals in brain-based interventions. Such coursework can assist counselors and mental health service providers to accurately evaluate brain-based interventions while integrating findings from neuroscience research to better address client goals. Currently, the counseling profession is one of the few mental health professions that has standards that address the integration of neuroscience into clinical practice (Russo et al., 2021).

NFB is similar to many counseling interventions in that it relies on principles of learning to promote a reduction of client symptomology (Russo & Novian, 2014). This reduction in symptomology occurs when clients learn to identify and regulate brainwave activity in a particular region in their brain. NFB is different than medical practices that rely on modulating brain activity through changes in neurotransmitters because NFB focuses on changes in the frequency at which nerve cells fire in a given region of the brain. NFB can also provide the benefit of reducing stigma associated with an individuals’ decision to seek mental health services due to the fact that NFB empowers people to create changes in their brainwave activity that corresponds with their mental health goals. Instead of working on stigma-laden goals, counselors and allied mental health practitioners can empower people to decrease or increase EEG activity in a particular region of their brain. This client-lead change occurs as they engage with feedback that is overlaid on the client’s favorite movie or a NFB game.
The present meta-analyses suggest that the efficacy of NFB in the reduction of symptoms of anxiety for Caucasian adults ranges from moderate to large. Accordingly, NFB should be a modality that is considered in the gamut of evidence-based clinical interventions that aids people in the reduction of symptoms of clinical anxiety. As such, policymakers at insurance companies (e.g. Aetna, Humana, TRICARE, UnitedHealthcare) are encouraged to revisit reimbursement policies relating to coverage for neurofeedback in the treatment of symptoms of anxiety.

According to the research findings presented in both arms of meta-analysis in the present study, claims regarding the experimental nature of NFB in the reduction of symptoms of anxiety are unfounded. As such, the continuation of policies that involve the denial of reimbursement requests made by trained mental health service providers on the premise that NFB is experimental is an issue of social injustice. Such policies create issues of social injustice because they serve to limit individuals’ access to evidence-based mental health services.
MANUSCRIPT REFERENCES
References

References marked with an asterisk indicate studies included in the meta-analysis.

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https://doi.org/10.1016/j.nicl.2020.102490


Russo, G. M., & Stevens, S. (2016). Counseling students gaining early exposure to

https://doi.org/10.17744/mehc.43.1.05


https://doi.org/10.1007/s10484-014-9246-9


https://doi.org/10.1192/j.eurpsy.2019.7


26 documents selected for inclusion in the analysis yielded a total of 41 effect sizes. The included effect sizes were based on:

- **Total Sample:** $N = 673; j = 26, k = 41$

- **Single-Group Design Outcomes:**
  - Total Sample: $N = 259; j = 14, k = 20$
    - Anxiety: $n = 211; j = 10, k = 14$
    - OCD: $n = 43; j = 3, k = 4$
    - PTSD: $n = 5; j = 2, k = 2$

- **Between-Group Design Outcomes:**
  - Total Sample: $N = 414; j = 12, k = 21$
    - Anxiety: $n = 216; j = 6, k = 11$
    - OCD: $n = 10; j = 1, k = 1$
    - PTSD: $n = 188; j = 7, k = 9$
<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Age (years)</th>
<th>Participant Characteristics</th>
<th>Outcome Assessment</th>
<th>Number of Sessions</th>
<th>Domicile</th>
<th>Sensor Placement</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Alhowaish, 2020)</td>
<td>3</td>
<td>$\bar{\chi} = 45$</td>
<td>Adults (3 women) receiving treatment in an outpatient setting for symptoms of PTSD</td>
<td>Davidson Trauma Scale</td>
<td>35</td>
<td>United States</td>
<td>Protocol</td>
<td></td>
</tr>
<tr>
<td>(Askovic et al., 2017)</td>
<td>2</td>
<td>$\bar{\chi} = 52$</td>
<td>Adults (2 men) receiving treatment in an outpatient setting for symptoms of anxiety and PTSD.</td>
<td>Hopkins Symptom Checklist-Anxiety Scale</td>
<td>31</td>
<td>Australia</td>
<td>Individualized</td>
<td>QEEG</td>
</tr>
<tr>
<td>(Cheon et al., 2016)</td>
<td>20</td>
<td>$\bar{\chi} = 43.3$</td>
<td>Adults (16 women, 4 men) receiving treatment in an outpatient setting for symptoms of anxiety.</td>
<td>HARS</td>
<td>10</td>
<td>Republic of Korea</td>
<td>Protocol</td>
<td></td>
</tr>
<tr>
<td>(Dreis et al., 2015)</td>
<td>14</td>
<td>$\bar{\chi} = 31.7$</td>
<td>Adults (4 women, 7 men, 1 girl, 2 boys) receiving treatment in an outpatient setting for symptoms of anxiety.</td>
<td>SCARED; SAS; ASEBA</td>
<td>12.93 (7–28)</td>
<td>United States</td>
<td>Individualized</td>
<td>QEEG</td>
</tr>
<tr>
<td>(Gregory et al., 2020)</td>
<td>52</td>
<td>$\bar{\chi} = 36.4$</td>
<td>Adults (21 women, 28 men, 3 not reported) receiving treatment in an outpatient setting for symptoms of anxiety.</td>
<td>SAS</td>
<td>13.4 (3–23)</td>
<td>United States</td>
<td>Individualized</td>
<td>QEEG</td>
</tr>
<tr>
<td>(Hammond, 2003)</td>
<td>2</td>
<td>$\bar{\chi} = 25$</td>
<td>Adults (1 woman, 1 man) receiving treatment in an outpatient setting for symptoms of OCD.</td>
<td>Y-BOCS</td>
<td>71.5 (50; 93)</td>
<td>United States</td>
<td>Individualized</td>
<td>QEEG</td>
</tr>
<tr>
<td>(Harris et al., 2019)</td>
<td>11</td>
<td>18–27</td>
<td>Adults (8 women, 3 men) receiving treatment in an outpatient setting for symptoms of anxiety.</td>
<td>Beck Anxiety Inventory</td>
<td>16</td>
<td>United States</td>
<td>Protocol</td>
<td></td>
</tr>
<tr>
<td>(Jones &amp; Hitsman, 2018)</td>
<td>40</td>
<td>$\bar{\chi} = 37.7$</td>
<td>Adults (19 women, 21 men) receiving treatment in an outpatient setting for symptoms of anxiety.</td>
<td>SAS</td>
<td>12.72 (7–19)</td>
<td>United States</td>
<td>Individualized</td>
<td>QEEG</td>
</tr>
<tr>
<td>(Lorenzetti et al., 2018)</td>
<td>8</td>
<td>23–28</td>
<td>Adults (8 women) receiving treatment in an outpatient setting for symptoms of anxiety.</td>
<td>State Trait Anxiety Inventory</td>
<td>3</td>
<td>Brazil &amp; Australia</td>
<td>Protocol</td>
<td></td>
</tr>
</tbody>
</table>

(Table Continues)
<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Age</th>
<th>Participant Characteristics</th>
<th>Outcome Measure</th>
<th>Number of Sessions</th>
<th>Domicile</th>
<th>Sensor Placement Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Marlats et al., 2020)</td>
<td>20</td>
<td>$\bar{x} = 76.1$</td>
<td>Older adults (17 women, 5 men) receiving treatment in an outpatient setting for symptoms of anxiety.</td>
<td>Goldberg Anxiety Scale</td>
<td>20</td>
<td>France</td>
<td>Protocol</td>
</tr>
<tr>
<td>(Mennella et al., 2017)</td>
<td>16</td>
<td>$\bar{x} = 23.1$</td>
<td>16 adult females receiving treatment for symptoms of anxiety. Participant sex and treatment setting were not reported.</td>
<td>Beck Anxiety Inventory</td>
<td>7</td>
<td>Italy</td>
<td>Protocol</td>
</tr>
<tr>
<td>(Sahraei et al., 2017)</td>
<td>30</td>
<td>Not Reported</td>
<td>3 female and 27 male participants received treatment in an unreported setting for symptoms of anxiety.</td>
<td>Depression Anxiety Stress Scale Y-BOCS</td>
<td>15</td>
<td>Iran</td>
<td>Protocol</td>
</tr>
<tr>
<td>(Scheinost et al., 2014)</td>
<td>5</td>
<td>$\bar{x} = 45.6$</td>
<td>Adults (2 women, 3 men) receiving treatment in an outpatient setting for symptoms of OCD.</td>
<td>Y-BOCS</td>
<td>2</td>
<td>United States</td>
<td>Protocol</td>
</tr>
<tr>
<td>(Sürmeli &amp; Ertem, 2011)</td>
<td>36</td>
<td>$\bar{x} = 30.1$</td>
<td>Adults (24 women, 12 men) receiving treatment in an outpatient setting for symptoms of OCD.</td>
<td>Y-BOCS</td>
<td>50.2 (9–84)</td>
<td>Turkey</td>
<td>Individualized QEEG</td>
</tr>
</tbody>
</table>

*Note. HARS = Hamilton Anxiety Rating Scale; SCARED = Screen for Child Anxiety-Related Disorders (SCARED); SAS = Zung Self-Rating Anxiety Scale; ASEBA = Achenbach System of Empirically Based Assessment; Y-BOCS = Yale-Brown Obsessive Compulsive Scale*
Table 2
Characteristics of Individual Studies Used in Between Group Meta-Analysis

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Age (years)</th>
<th>Participant Characteristics</th>
<th>Outcome Assessment</th>
<th>Number of Sessions</th>
<th>Domicile</th>
<th>Sensor Placement Rationale</th>
<th>Type of Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Askovic et al., 2020)</td>
<td>26</td>
<td>(\bar{x} = 44.8)</td>
<td>Adults (9 women, 17 men) receiving treatment in an outpatient setting for symptoms of anxiety and PTSD.</td>
<td>HTS; HSCL-A</td>
<td>27</td>
<td>Australia</td>
<td>Protocol</td>
<td>Trauma Counseling</td>
</tr>
<tr>
<td>(Dadashi et al., 2015)</td>
<td>28</td>
<td>(\bar{x} = 30.5)</td>
<td>28 adults receiving treatment in an outpatient setting for symptoms of anxiety.</td>
<td>General Anxiety Disorder Scale-7</td>
<td>30</td>
<td>Iran</td>
<td>Protocol</td>
<td>Waitlist</td>
</tr>
<tr>
<td>(Gadea et al., 2020)</td>
<td>32</td>
<td>(\bar{x} = 21.8)</td>
<td>Adults (32 men) receiving treatment in an outpatient setting for symptoms of anxiety.</td>
<td>State Trait Anxiety Inventory Hamilton Rating Scale for Anxiety</td>
<td>1</td>
<td>Spain</td>
<td>Protocol</td>
<td>Sham</td>
</tr>
<tr>
<td>(Joseph et al., 2009)</td>
<td>10</td>
<td>18–50</td>
<td>Adults (4 women, 6 men) receiving treatment in an outpatient setting for symptoms of anxiety and OCD.</td>
<td>Hamilton Rating Scale for Anxiety</td>
<td>15</td>
<td>India</td>
<td>Protocol</td>
<td>Undescribed Control</td>
</tr>
<tr>
<td>(Misaki et al., 2018)</td>
<td>33</td>
<td>(\bar{x} = 32.3)</td>
<td>Adults (33 males) receiving treatment in an outpatient setting for symptoms of PTSD.</td>
<td>CAPS</td>
<td>3</td>
<td>United States</td>
<td>Protocol</td>
<td>No Treatment</td>
</tr>
<tr>
<td>(Nicholson et al., 2020)</td>
<td>36</td>
<td>(\bar{x} = 43.3)</td>
<td>Adults (26 women, 10 men) receiving treatment in an outpatient setting for symptoms of PTSD.</td>
<td>CAPS</td>
<td>19.75 (17–20)</td>
<td>Canada</td>
<td>Protocol</td>
<td>PTSD Control &amp; Veteran Control (w/o PTSD) Sham</td>
</tr>
<tr>
<td>(Noohi et al., 2017)</td>
<td>30</td>
<td>25–60</td>
<td>Adults (30 male) receiving treatment in an outpatient setting for symptoms of PTSD.</td>
<td>Impact of event scale-revised</td>
<td>25</td>
<td>Iran</td>
<td>Protocol</td>
<td>Pseudo-meditation &amp; Waitlist</td>
</tr>
<tr>
<td>(Rice et al., 1993)</td>
<td>45</td>
<td>(\bar{x} = 27.4)</td>
<td>Adults (23 women, 22 men) receiving treatment in an outpatient setting for symptoms of anxiety.</td>
<td>State Trait Anxiety Scale-State TSC-YC</td>
<td>8</td>
<td>United States</td>
<td>Protocol</td>
<td>Undescribed Control</td>
</tr>
<tr>
<td>(Rogel et al., 2020)</td>
<td>37</td>
<td>(\bar{x} = 9.6)</td>
<td>Children (13 girls, 24 boys) receiving treatment in an outpatient setting for symptoms of trauma.</td>
<td>State Trait Anxiety Scale-State TSC-YC</td>
<td>24</td>
<td>United States</td>
<td>Protocol</td>
<td>Pseudo-meditation &amp; Waitlist</td>
</tr>
</tbody>
</table>

(Table Continues)
<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Age</th>
<th>Participant Characteristics</th>
<th>Outcome Measure</th>
<th>Number of Sessions</th>
<th>Domicile</th>
<th>Sensor Placement Rationale</th>
<th>Type of Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>(van der Kolk et al., 2016)</td>
<td>52</td>
<td>( \bar{x} = 44.4 )</td>
<td>Adults (42 women, 7 men) receiving treatment in an outpatient setting for symptoms of PTSD.</td>
<td>CAPS</td>
<td>24</td>
<td>United States</td>
<td>Protocol</td>
<td>Waitlist</td>
</tr>
<tr>
<td>(Wang et al., 2019)</td>
<td>70</td>
<td>( \bar{x} = 41.9 )</td>
<td>Adults (47 women, 23 men) receiving treatment in an outpatient setting for symptoms of anxiety.</td>
<td>Beck Anxiety Inventory</td>
<td>10</td>
<td>Taiwan</td>
<td>Protocol</td>
<td>Treatment as Usual (TAU)</td>
</tr>
<tr>
<td>(Zotev et al., 2018)</td>
<td>15</td>
<td>31 (NFB) 34 (Control)</td>
<td>Adults (15 males) receiving treatment in an outpatient setting for symptoms of anxiety.</td>
<td>CAPS</td>
<td>3</td>
<td>United States</td>
<td>Protocol</td>
<td>Sham</td>
</tr>
</tbody>
</table>

*Note. CAPS = Clinician-Administered PTSD Scale; HTS = Harvard Trauma Scale; HSCL-A = Hopkins Symptom Checklist-Anxiety; TSC-YC = Trauma Symptom Checklist for Young Children*
Table 3

*Descriptive Statistics for Characteristics of Studies Included within Mean Effect Size Estimates and Moderator Analyses (j = 26; n = 673).*

<table>
<thead>
<tr>
<th>Characteristic Overall</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>Range</td>
</tr>
<tr>
<td><strong>Study Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Publication Year</td>
<td>2015.77</td>
<td>6.09</td>
<td>1993–2020</td>
</tr>
<tr>
<td>Average Sample Size</td>
<td>26.19</td>
<td>17.36</td>
<td>2–70</td>
</tr>
<tr>
<td>Number of NFB Sessions</td>
<td>18.83</td>
<td>15.95</td>
<td>1–71.5</td>
</tr>
<tr>
<td>Average NFB Time (mins)</td>
<td>674.50</td>
<td>733.08</td>
<td>20.5–3012</td>
</tr>
<tr>
<td><strong>Participant Sample Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>36.95</td>
<td>19.16</td>
<td>9.62–76.1</td>
</tr>
<tr>
<td>Percentage of Female Participants</td>
<td>42.36</td>
<td>32.01</td>
<td>0–100</td>
</tr>
<tr>
<td><strong>Number of studies</strong></td>
<td>n</td>
<td>Percent of Total Sample</td>
<td></td>
</tr>
<tr>
<td>Domicile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>12</td>
<td>309</td>
<td>45.91</td>
</tr>
<tr>
<td>International</td>
<td>14</td>
<td>364</td>
<td>54.09</td>
</tr>
<tr>
<td><strong>Treatment Protocol</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>qEEG-Driven</td>
<td>6</td>
<td>146</td>
<td>21.69</td>
</tr>
<tr>
<td>Protocol</td>
<td>20</td>
<td>527</td>
<td>78.31</td>
</tr>
<tr>
<td><strong>Symptomatology Addressed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>16</td>
<td>403</td>
<td>59.88</td>
</tr>
<tr>
<td>PTSD</td>
<td>7</td>
<td>218</td>
<td>32.39</td>
</tr>
<tr>
<td>OCD</td>
<td>3</td>
<td>52</td>
<td>7.73</td>
</tr>
</tbody>
</table>
### Table 4

*Effect Sizes, 95% Confidence Intervals, and p-Values for Studies Evaluating NFB for Decreasing Symptoms of Anxiety-Spectrum Disorders*

<table>
<thead>
<tr>
<th>Study name</th>
<th>Outcome</th>
<th>Statistics for each study</th>
<th>Std diff in means and 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Mennella et al., 2017)</td>
<td>Anxiety</td>
<td>-0.12 0.25 0.06 -0.61 0.37</td>
<td></td>
</tr>
<tr>
<td>(Lorenzetti et al., 2018)</td>
<td>Anxiety</td>
<td>-0.19 0.50 0.25 -1.18 0.80</td>
<td></td>
</tr>
<tr>
<td>(Lorenzetti et al., 2018)</td>
<td>Anxiety</td>
<td>-0.38 0.52 0.27 -1.39 0.64</td>
<td></td>
</tr>
<tr>
<td>(Marlats et al., 2020)</td>
<td>Anxiety</td>
<td>-0.53 0.24 0.06 -1.00 0.06</td>
<td></td>
</tr>
<tr>
<td>(Harris et al., 2019)</td>
<td>Anxiety</td>
<td>-0.54 0.32 0.10 -1.18 0.09</td>
<td></td>
</tr>
<tr>
<td>(Mennella et al., 2017)</td>
<td>Anxiety</td>
<td>-0.65 0.27 0.08 -1.19 0.11</td>
<td></td>
</tr>
<tr>
<td>(Sahraei et al., 2017)</td>
<td>Anxiety</td>
<td>-0.65 0.28 0.08 -1.20 0.09</td>
<td></td>
</tr>
<tr>
<td>(Cheon et al., 2016a)</td>
<td>Anxiety</td>
<td>-0.67 0.25 0.06 -1.16 0.19</td>
<td></td>
</tr>
<tr>
<td>(Gregory et al., 2020)</td>
<td>Anxiety</td>
<td>-0.68 0.15 0.02 -0.98 0.37</td>
<td></td>
</tr>
<tr>
<td>(Dreis et al., 2015a)</td>
<td>Anxiety</td>
<td>-0.86 0.31 0.10 -1.47 0.25</td>
<td></td>
</tr>
<tr>
<td>(Jones &amp; Hitsman, 2014)</td>
<td>Anxiety</td>
<td>-0.94 0.19 0.04 -1.31 0.56</td>
<td></td>
</tr>
<tr>
<td>(Dreis et al., 2015)</td>
<td>Anxiety</td>
<td>-1.13 0.34 0.12 -1.80 0.46</td>
<td></td>
</tr>
<tr>
<td>(Askovic et al., 2017a)</td>
<td>PTSD</td>
<td>-1.86 1.17 1.36 -4.15 0.43</td>
<td></td>
</tr>
<tr>
<td>(Sürmeli &amp; Ertem, 2014)</td>
<td>OCD</td>
<td>-2.15 0.30 0.09 -2.74 -1.55</td>
<td></td>
</tr>
<tr>
<td>(Cheon et al., 2016)</td>
<td>Anxiety</td>
<td>-2.31 0.43 0.18 -3.15 -1.47</td>
<td></td>
</tr>
<tr>
<td>(Alhowaish, 2020)</td>
<td>PTSD</td>
<td>-2.68 1.24 1.53 -5.10 -0.26</td>
<td></td>
</tr>
<tr>
<td>(Scheinost et al., 2014)</td>
<td>OCD</td>
<td>-3.37 1.16 1.33 -5.63 -1.10</td>
<td></td>
</tr>
<tr>
<td>(Hammond, 2003a)</td>
<td>OCD</td>
<td>-8.82 4.47 19.97 -17.58 -0.07</td>
<td></td>
</tr>
<tr>
<td>(Askovic et al., 2017)</td>
<td>Anxiety</td>
<td>-10.31 5.20 27.07 -20.51 -0.11</td>
<td></td>
</tr>
<tr>
<td>(Hammond, 2003)</td>
<td>OCD</td>
<td>-10.70 5.40 29.13 -21.28 -0.12</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.94 0.15 0.02 -1.24 -0.63</td>
<td></td>
</tr>
</tbody>
</table>

![Graph showing effect sizes and 95% confidence intervals for NFB studies](image-url)
Table 5

Between-Group: Effect Sizes, 95% Confidence Intervals, Standard error, and Variance for Studies

Evaluating NFB versus Control Groups for Decreasing Symptoms of Anxiety-Spectrum Disorders

<table>
<thead>
<tr>
<th>Study name</th>
<th>Outcome</th>
<th>Statistics for each study</th>
<th>Hedges's g and 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hedges's g</td>
<td>Standard error</td>
</tr>
<tr>
<td>(Joseph et al., 2009a)</td>
<td>OCD</td>
<td>0.00</td>
<td>0.57</td>
</tr>
<tr>
<td>(Rice et al., 1993)</td>
<td>Anxiety</td>
<td>-0.07</td>
<td>0.45</td>
</tr>
<tr>
<td>(Misaki et al., 2018b)</td>
<td>PTSD</td>
<td>-0.11</td>
<td>0.46</td>
</tr>
<tr>
<td>(Rice et al., 1993a)</td>
<td>Anxiety</td>
<td>-0.15</td>
<td>0.45</td>
</tr>
<tr>
<td>(Misaki et al., 2018)</td>
<td>PTSD</td>
<td>-0.21</td>
<td>0.46</td>
</tr>
<tr>
<td>(Rice et al., 1993b)</td>
<td>Anxiety</td>
<td>-0.27</td>
<td>0.45</td>
</tr>
<tr>
<td>(Zotev et al., 2018)</td>
<td>PTSD</td>
<td>-0.27</td>
<td>0.42</td>
</tr>
<tr>
<td>(Rice et al., 1993c)</td>
<td>Anxiety</td>
<td>-0.32</td>
<td>0.45</td>
</tr>
<tr>
<td>(Nicholson et al., 2020)</td>
<td>PTSD</td>
<td>-0.38</td>
<td>0.33</td>
</tr>
<tr>
<td>(Gadea et al., 2020)</td>
<td>Anxiety</td>
<td>-0.47</td>
<td>0.35</td>
</tr>
<tr>
<td>(Rogel et al., 2020)</td>
<td>PTSD</td>
<td>-0.68</td>
<td>0.35</td>
</tr>
<tr>
<td>(Wang et al., 2019)</td>
<td>Anxiety</td>
<td>-0.85</td>
<td>0.30</td>
</tr>
<tr>
<td>(van der Kolk et al., 2016a)</td>
<td>PTSD</td>
<td>-0.87</td>
<td>0.31</td>
</tr>
<tr>
<td>(Gadea et al., 2020a)</td>
<td>Anxiety</td>
<td>-0.90</td>
<td>0.36</td>
</tr>
<tr>
<td>(Askovic et al., 2020)</td>
<td>Anxiety</td>
<td>-0.90</td>
<td>0.40</td>
</tr>
<tr>
<td>(Wang et al., 2019a)</td>
<td>Anxiety</td>
<td>-1.18</td>
<td>0.31</td>
</tr>
<tr>
<td>(van der Kolk et al., 2016)</td>
<td>PTSD</td>
<td>-1.23</td>
<td>0.32</td>
</tr>
<tr>
<td>(Askovic et al., 2020a)</td>
<td>PTSD</td>
<td>-1.40</td>
<td>0.43</td>
</tr>
<tr>
<td>(Joseph et al., 2009)</td>
<td>Anxiety</td>
<td>-2.15</td>
<td>0.75</td>
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<td>(Noohi et al., 2017)</td>
<td>PTSD</td>
<td>-2.65</td>
<td>0.49</td>
</tr>
<tr>
<td>(Dadashi et al., 2015)</td>
<td>Anxiety</td>
<td>-5.83</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.87</td>
<td>0.17</td>
</tr>
</tbody>
</table>
CURRICULUM VITAE

G. Michael Russo, Ph.D., P-LPC (MS), NCC, BCN- Associate Fellow
The University of Mississippi
School of Education
Department of Leadership and Counselor Education
University, Mississippi
Telephone: *******/E-mail: grusso@go.olemiss.edu / Website: g michaelrusso.com

EDUCATION

Doctor of Philosophy in Counselor Education and Supervision (Ph.D.) May 2021
with a Graduate Minor in Applied Statistics
The University of Mississippi, University, MS (CACREP Accredited)


Committee Members: Richard S. Balkin, PhD, LPC, NCC (Chair); A. Stephen Lenz, PhD, LPC, NCC (Methodologist); Stephanie L. Lusk, PhD, CRC; Alicia C. Stapp, Ed.D.

Master of Science in Clinical Mental Health Counseling (M.S.) December 2017
The University of Texas at San Antonio, San Antonio, TX (CACREP Accredited)

Bachelor of Arts in Psychology (B.A.) May 2014
The University of Texas at San Antonio, San Antonio, TX

TEACHING AND SUPERVISION

Courses Instructed

CTC 655-1: Advanced Clinical Interventions in Trauma Treatment II
Instructor of Record (Affiliate Faculty)
Spring, 2021
Thomas Jefferson University, Philadelphia, PA (Distance-based instruction)
Courses Co-Instructed

**COUN 608: Issues and Ethics in Counseling (Oxford Campus)**
Co-Instructor
Summer, 2020
Instructor of record: Mandy L. Perryman, Ph.D., LPC, NCC
The University of Mississippi, University, MS (Distance-based instruction)

**COUN 608: Issues and Ethics in Counseling (Tupelo Campus)**
Co-Instructor
Summer, 2020
Instructor of record: Mandy L. Perryman, Ph.D., LPC, NCC
The University of Mississippi, Tupelo, MS (Distance-based instruction)

**COUN 611: Assessment in Counseling (Combined Tupelo & Oxford Campus)**
Co-Instructor
Summer, 2019
Instructor of record: Richard S. Balkin, Ph.D., LPC, NCC
The University of Mississippi, University, MS (In person and Live, Distance-based instruction)

**COUN 607: Group Procedures (Tupelo Campus)**
Co-Instructor
Spring, 2019
Instructor of record: Joshua Magruder, Ph.D., LPC-S, NCC
The University of Mississippi, Tupelo, MS

**COUN 674: Diagnostic Systems in Counseling**
Co-Instructor
Fall, 2018
Instructor of record: Marc Showalter, Ph.D., LPC-S
The University of Mississippi, University, MS

**COU 6973: SI: Intro to Theory/Prac Neuro**
Neurofeedback Teaching Assistant
Fall, 2015
Instructor of record: Mark S. Jones, DMin, LPC-S, LMFT, BCN, qEEG-D
The University of Texas at San Antonio, San Antonio, TX

**COU 6973: SI: Intro to Theory/Prac Neuro**
Neurofeedback Teaching Assistant
Summer, 2015
Instructor of record: Mark S. Jones, DMin, LPC-S, LMFT, BCN, qEEG-D
The University of Texas at San Antonio, San Antonio, TX

**COU 6973: SI: Intro to Theory/Prac Neuro**
Neurofeedback Teaching Assistant
Spring, 2015
Instructor of record: Mark S. Jones, DMin, LPC-S, LMFT, BCN, qEEG-D
The University of Texas at San Antonio, San Antonio, TX

**Guest Lectures**

**COUN 569: Seminar: Professional Counseling**
Guest lecture titled: Life Post-Masters: Doctoral Degree Experiences
Fall, 2020
Instructor of record: Raissa Miller, Ph.D., LPC
Boise State University, Boise, ID (Distance-based lecture)

COUN 606: Counseling Theories
Guest lecture titled: Bringing the Person into Person-Centered Counseling
Fall, 2019
Instructor of record: Kenya G. Bledsoe, Ph.D., LPC-S, NCC, NCSC
The University of Mississippi, University, MS

COUN 798: Transitioning into the Professoriate
Guest lecture titled: Supervision and Gatekeeping in Counselor Education
Spring, 2019
Instructor of record: Amanda Winburn, Ph.D., SB-RPT, NCSC, NCC
The University of Mississippi, University, MS

COUN 787: Advanced Professional Identity and Ethics in Counselor Education
Guest lecture titled: Ethical Decision Making in Counselor Education
Fall, 2018
Instructor of record: Alexandria Kerwin, Ph.D., LPC-S, NCC
The University of Mississippi, University, MS

COU 6883: Trauma, Crisis, and Grief Counseling
Guest lecture titled: Crisis! What Do I Do?!
Summer, 2018
Instructor of record: Thelma Duffey, Ph.D., LPC, LMFT
The University of Texas at San Antonio, San Antonio, TX

COU 6883: Trauma, Crisis, and Grief Counseling
Guest lecture titled: PTSD Treatment with Neurofeedback
Spring, 2017
Instructor of record: Allison Marsh Pow, Ph.D., LPC, NCC
The University of Texas at San Antonio, San Antonio, TX

COU 5203: Introduction to Clinical Mental Health Counseling
Guest lecture titled: The Hope Behind the Squiggles: Neurocounseling and Neurofeedback
Fall, 2015
Instructor of record: Kim Lee-Hughes, Ph.D.
The University of Texas at San Antonio, San Antonio, TX

PSY 3543: Introduction to Clinical Psychology
Guest lecture titled: Appropriate Mental Health Diagnosis
Spring, 2014
Instructor of record: Epherim Fernandez, Ph.D.
The University of Texas at San Antonio, San Antonio, TX

PSY 3543: Introduction to Clinical Psychology
Guest lecture titled: Appropriate Mental Health Diagnosis
Fall, 2013
Instructor of record: Epherim Fernandez, Ph.D.
The University of Texas at San Antonio, San Antonio, TX
PSY 4953: Special Studies in Psychology: Stress Management
Guest lecture titled: Neurofeedback Therapy in San Antonio
Summer, 2013
Instructor of record: Mary McNaughton-Cassill, Ph.D.
The University of Texas at San Antonio, San Antonio, TX

Supervisory Experiences

Oxford Treatment Center
*Doctoral Student Supervisor, Oxford, MS*
March 2020– August 2020
- Provided individual supervision of master’s level counselors-in-training that worked with individuals in various stages of recovery.
- Individual supervision was provided via weekly, synchronous, distance-based methods such as phone and/or zoom formats. Asynchronous methods such as email and text were also utilized as a secondary form of communication.

Waller and Associates Counseling, LLC
*Doctoral Student Supervisor, Oxford, MS*
March 2020– August 2020
- Provided individual supervision of graduate level counselors-in-training which saw clients in a private practice setting.
- Individual supervision was provided via weekly, synchronous, distance-based methods such as phone and/or zoom formats. Asynchronous methods such as email and text were also utilized as a secondary form of communication.

The University of Mississippi, Center for Student Success
*Doctoral Student Supervisor, University, MS*
March 2020– May 2020
- Provided individual supervision of mindfulness-based psychoeducational groups completed by master’s level counselors-in-training throughout COVID-19 pandemic.
- Individual supervision was provided via weekly, synchronous, distance-based methods such as phone and/or zoom formats. Asynchronous methods such as email and text were also utilized as a secondary form of communication.

The University of Mississippi, University Counseling Center
*Doctoral Student Supervisor, University, MS*
January 2020– March 2020
- Provided weekly individual and group supervision to graduate-level students enrolled in CACREP accredited internship courses.
- Students provided counseling to address a wide range of clinical goals for students at The University of Mississippi.
- Provided feedback to students based on direct clinical observation of live and recorded counseling sessions, assisted in the development of clear and concise clinical notes, and upheld a supportive environment to enhance the development of their professional counseling identity.

RESEARCH INTEREST AND SCHOLARLY PRODUCTIVITY

Primary Research Interests:
- Neuroscience-informed counseling
- Neurofeedback
• Anxiety

Manuscripts in Preparation


Peer-reviewed Publications


https://doi.org/10.1080/21501378.2020.1776598


**Book Chapters**


**Non-Refereed Publications**


**Russo, G. M.** (2015, February). What is neurofeedback?. *Sigma Alpha Chi Chapter of Chi Sigma Iota Newsletter*, 3(3), 4. UTSA Department of Counseling.


**External Grants and Scholarships**

**Total External Funding Awarded:** $3,545.00

**Russo, G. M.** (2020). *Student neurofeedback research equipment grant*. BrainMaster Technologies, Inc.
Student Research Equipment Grant: $2,245.00


Unfunded Proposal Amount: $2,000.00


Student Paper Award: $850.00


Scholarship Amount Awarded: $250.00


Scholarship Amount Awarded: $200.00


Unfunded Proposal Amount: $2,000.00

**Internal Grants and Scholarships**

**Total Internal Funding Awarded: $13,213.25**


Dissertation Fellowship Award: $10,913.25

**Russo, G. M.** (2019). *Treatment trends in male adolescent substance use: A time series analysis for adolescents in recovery*. The University of Mississippi Graduate Student Travel Award.

Travel Grant Award: $300.00

**Russo, G. M.** (2019). *Treatment trends in male adolescent substance use: A time series analysis for adolescents in recovery*. The University of Mississippi School of Education Student Travel Grant.

Travel Grant Award: $300.00
Travel Grant Award: $300.00

Russo, G. M. (2019). *Training clinical mental health counselors in the biological basis of behavior: Aims of the AMHCA neuroscience taskforce.* The University of Mississippi Graduate Student Travel Award.
Travel Grant Award: $300.00

Russo, G. M. (2019). *Training clinical mental health counselors in the biological basis of behavior: Aims of the AMHCA neuroscience taskforce.* The University of Mississippi School of Education Student Travel Grant.
Travel Grant Award: $300.00

Russo, G. M. (2019). *Training clinical mental health counselors in the biological basis of behavior: Aims of the AMHCA neuroscience taskforce.* The University of Mississippi Department of Leadership and Counselor Education Student Travel Grant.
Travel Grant Award: $300.00

Russo, G. M. (2015). *Blueprints for university-based neurofeedback program or student group.* The University of Texas at San Antonio Graduate Student Professional Development Award.
Scholarship Amount Award: $500.00

**Peer-reviewed International and National Conference Presentations**


Using neurofeedback to lower anxiety symptoms using individualized QEEG protocols: A pilot study [Conference session]. The International Society for Neurofeedback and Research 23rd Annual Conference, Denver, Colorado, USA.

https://theisnr.wixsite.com/isnr-2015-conference/schedule

Peer-reviewed State Conference Presentations

21. Russo, G. M. & Russo, J. N. (2021, April 27). Introduction to the art and science of neurofeedback [Conference session]. The 40th Annual F. E. Woodall Spring Conference for the Helping Professions, Cleveland, Mississippi, USA.


https://www.tickettailor.com/events/deltastateuniversitycounseloreducation/232761


17. Russo, G. M. (2015, September 19). To go fast, go alone; to go far, go together: The mutual growth in the process of professional mentorship. The 41st Annual Biofeedback Society of Texas Conference, Houston, Texas, USA.
Conducted Training Seminars, Webinars, and Workshops


     https://nucounseling.adobeconnect.com/_a1316639349/ppn4v2azqgb3/?proto=true


7. Russo, G. M., & Estrada, V. (2012, October 2). *What we wish we knew: Mentorship seminar* [Seminar]. Student Psychology Association of The University of Texas at San Antonio, San Antonio, Texas, USA.

**Invited Presentations**


Published Interviews and Media Involvement


The University of Texas at San Antonio. (2015). *UTSA - Your Best Choice* [Television commercial]. [https://www.youtube.com/watch?v=DNGm9m6z6jo](https://www.youtube.com/watch?v=DNGm9m6z6jo)


Program Evaluations and Needs Assessments

**BUILD PODER**
*Transcript Analyst, Multiple Locations, MS and CA*  
July 2020–December 2020
• Oversaw transcript analysis for the Building Infrastructure Leading to Diversity Promoting Opportunities 
for Diversity in Education and Research (BUILD PODER) project at California State University, 
Northridge (CSUN).
  o BUILD PODER at CSUN has been funded since 2014 by a $22 million grant from the National 
Institutes of Health, Diversity Program Consortium.
• Ensured transcription accuracy of faculty and student interviews. Interviews were conducted for purposes of 
evaluating participant experiences. Services provided through a partnership between CSUN and the Center 
for Research Evaluation (CERE) at The University of Mississippi.

Pathways 2 Possibilities (P2P)  
Project Manager, Multiple Locations, MS and SC  
May 2020–July 2020

• Analyzed quasi-experimental data pertaining to students’ perceptions and sense of self-efficacy surrounding 
post-high school career trajectories.
• Students attended schools located in the Mississippi Delta, Mississippi Costal areas, as well as the state of 
South Carolina.
• Data was analyzed in partnership between The University of Mississippi, Center for Research Evaluation 
(CERE) and Costal Carolina University’s Office of Institutional Research, Assessment and Analysis (IRAA).
• Prepared detailed reports, executive summaries, concise technical reports, infographics, and PowerPoint 
presentations in concert with project administrators, Sarah Mason and Hope Gilbert.

Tallahatchie County Public Library  
Data Analyst and Community Engagement Specialist, Charleston, MS  
January 2020–May 2020

• Worked as part of an interdisciplinary team to collect and analyze data which benefitted stakeholders of the 
Tallahatchie County Public Library.
• Contributed to the creation and distribution of surveys to assess stakeholder perceptions of library services.

Other Research Experience

The University of Mississippi, Center for Research Evaluation (CERE)  
Graduate Research Assistant, University, MS  
May 2020–December 2020

• Conducted program evaluations as well as needs assessments on behalf of organizational and/or institutional 
clients.
• Served as a mentor to junior-level colleagues as part of an interdisciplinary team.
• Completed technical reports, executive reports, and 2-page programmatic overviews which were used in 
advocating from continuation of funding from the Mississippi State Legislature.
• Provided evaluation services for projects funded by organizations such as: The W. K. Kellogg Foundation, 
Bloomberg Philanthropies, and The National Institute of Health Diversity Program Consortium.

University of Memphis, Dept. of Counseling, Educational Psychology and Research, BRAIN CENTER  
Consultant (unfunded), Memphis, TN  
November 2019–Present

• Evaluated efficacy of neurofeedback sessions provided to empower individuals who have aversive childhood 
experiences.
• Provided consultation about the nature of changes which occurred during neurofeedback sessions whilst 
collaborating with a multidisciplinary, grant funded team consisting of representatives from: University of 
Tennessee Health Science Center, University of North Texas, The New Mind Center, and COMPASS 
Intervention Center. All research procedures/techniques were performed under the supervision of the 
Principle Investigator, Eraina Schauss.
UTSA, Department of Psychology, DYAD Research Lab  
Graduate Research Assistant, San Antonio, TX  
August 2014–May 2015

- Studied the effects of alcohol on females' ability to negotiate healthy condom use behaviors to protect against sexually transmitted infections.
- Performed scripted and recorded interactions with participants during double-blind research conditions.
- Conducted para-verbal and verbal video coding.
- Ensured grant-compliance through the following funding sources:
  - The National Institute on Drug Abuse/NIH (SC1 DA031962) Total Award: $1,408,875
  - The National Institute on Alcohol and Alcoholism/NIH (R21 AA018403) Total Award: $408,620
  - The National Institute on Alcohol and Alcoholism/NIH (R01 AA014512-06-10) Total Award: $2,897,992

UTSA, Department of Psychology, Psychoneuroendocrinology Research Lab  
Undergraduate Research Assistant (unfunded), San Antonio, TX  
April 2013–May 2014

- Explored epigenetic mediators of childhood trauma and the effects of trauma on the cortisol awakening response.
- Administered psychometric batteries.
- Maintained compliance with IRB requirements and standards.

Other Projects and Creative Works

G. Michael Russo served as the liaison between UTSA and The Biofeedback Certification International Alliance (BCIA) to negotiate a contract to allow UTSA students the opportunity to take the Board Certification in Neurofeedback (BCN) exam on campus. UTSA was already offering all of the additional components necessary for students to obtain their BCN with the exception of a location where the exam could be proctored. To eliminate this gap, Russo worked in concert with the following organizations: BCIA, The UTSA Business Contracts Office, The UTSA Department of Counseling, UTSA Student Government Association, and UTSA chapter of Students of The International Society for Neurofeedback and Research (SISNR). Collaboratively, the organizations were successfully able to collaborate to address this need, thus allowing students to sit for their BCIA BCN exam on campus.

Created the Students of The International Society for Neurofeedback and Research (SISNR) organizational constitution. Constitution designed to be used by students who wished to start a chapter of SISNR at their local college/university. Constitution approved by ISNR's Legal Affairs and approved by The ISNR Board of Directors on February 23, 2015.

Primary author of 38 GA 104: "Resolution for Veteran Success". Resolution created to assist UTSA student veterans, active duty members, and their dependents in acquiring a central location to access resources. Examples of resources include: mental health resources, study room, and information about tuition/fees compensation. Prior to this resolution, individuals would have to attempt to navigate numerous systems on their own or with word-of-mouth assistance. Resolution 104 was unanimously passed by The 38th General Assembly of The UTSA Student Government Association and signed by SGA President, Zack Dunn.

PROFESSIONAL LICENSE / CERTIFICATION / TRAININGS

Licensure
Provisionally Licensed Professional Counselor (P-LPC)  
Mississippi State Board of Examiners for Licensed Professional Counselors  
Licensure Number: P-0505  
August 2018–Present

Certifications

National Certified Counselor  
National Board for Certified Counselors  
Certification Number: 997528  
June 2018–Present

Board Certified in Neurofeedback, Associate Fellow*  
Biofeedback Certification International Alliance  
Certification Number: E5800  
July 2015–Present  
*Internationally recognized in 2015 as one of the youngest individuals to obtain clinician-level certification

Nonviolent Crisis Intervention  
Crisis Prevention Institute  
Certification Number: NCA0C312  
June 2014–June 2016

Trainings (Selected)

Neurocounseling: Brain-Based Clinical Approaches  
The American Counseling Association (ACA), San Francisco, CA  
March 2017

Columbia-Suicide Severity Rating Scale (C-SSRS)  
The Columbia Lighthouse Project  
February 2017; February 2018

Psychological First Aid (PFA)  
The National Child Traumatic Stress Network (NCTSN)  
February 2017

Strategic Planning Approach to Suicide Prevention  
Suicide Prevention Resource Center (SPRC)  
January 2017

Counseling on Access to Lethal Means (CALM)  
Suicide Prevention Resource Center (SPRC)  
February 2016

Social, Behavioral, and Education (SBE) Sciences Responsible Conduct of Research Course  
Collaborative Institute Training Initiative (CITI Program)  
August 2013

Social/Behavioral Research Course  
Collaborative Institute Training Initiative (CITI Program)  
August 2013; October 2019

Didactic Neurofeedback Course  
Stens Biofeedback Corporation, Austin, TX  
November 2012

Question Persuade Refer (QPR)  
UTSA Counseling Services, San Antonio, TX  
December 2011

PROFESSIONAL & CLINICAL EXPERIENCE
The University of Mississippi, University Counseling Center
Clinical Graduate Assistant, University, MS
August 2018–May 2019; August 2019–May 2020

- Worked as part of an interdisciplinary team to provide evidence-based clinical services from a humanistic and neuroscience-informed counseling framework under the direct supervision of J. McCormick, Ph.D., LPC-S (8/18–12/18); K. Harrison, M.Ed., LPC-S (1/19–4/1/2020); and, Marc Showalter, Ph.D., LPC-S (4/1/20–5/2020).
- Provided crisis intervention to individuals who were considering suicide/homicide, some of which also experienced delusional thoughts/psychosis.
- Provided field-based clinical supervision to master’s level counselors-in-training as part of the requirements of their CACREP-accredited internship experience. Addressed the following CACREP Standards: Section 3A-E and J-V, Section 4F-H, and Section 5-C3a-e.
- Co-facilitated clinical groups which focus on empowering loved ones and children of individuals who struggle with addiction.
- Maintained client records in accordance with the state of Mississippi Licensed Professional Counselors Board Rules, HIPPA requirements, and the University Counseling Center rules/regulations.

Mississippi Department of Mental Health
Behavioral Health Specialist II, North Mississippi Regional Center, Oxford, MS
May 2019–August 2019

- Provided individual, group, and family therapy to adults with severe or profound levels of Intellectual/Developmental Disability.
- Created individualized service plans and trained staff on appropriate implementation using an Applied Behavioral Analysis and Humanistic framework.
- Worked as part of a multidisciplinary team under the supervision of S. Beard, M.Ed., LPC-S.

BCFS Health and Human Services
Internship Coordinator & Case Manager, Resiliency Through Healing, San Antonio, TX
February 2018–August 2018

- Created internship coordination and crisis intervention procedures that have been utilized in multiple programs including: Services To At Risk (STAR) Youth, Preparation for Adult Living (PAL), Texas Family Together and Safe (TFTS), and Resiliency through Healing (RTH).
- Worked with individuals aged 18 to 25 who experienced trauma, abuse, and/or neglect during their childhood and/or adolescence. Assisted with emotional support, resource acquisition, and referral to in-house mental health clinicians.
- Supervised master’s level mental health interns (CMHC, MFT, and social work) on crisis hotline protocols, walk-in procedures and daily operations.
- Assisted in the development of the RTH program by providing grass roots efforts to create and maintain partnerships with local mental health practices, organizations, and universities.

Student Counselor, Preparation for Adult Living (PAL), San Antonio, TX
March 2017–December 2017

- Provided therapeutic support to youth and young adults who are currently in the foster care system, or have recently transitioned out of foster care. Therapy was provided under professorial supervision of Dr. G. Juhnke and Dr. B. Jones. On-site supervision was provided under R. Fletcher and K. Rodriguez.
- Assisted in the development of The Resiliency Through Healing Program by providing mentorship to case management staff under the supervision and guidance of Ms. K. Rodriguez.
- Facilitated Department of Family and Protective Services (DFPS) Preparation for Adult Living (PAL) groups covering the following topics: (1) Health and Safety; (2) Housing and Transportation; (3) Job Readiness; (4) Financial Management; (5) Life Decisions and Responsibility; (6) Personal and Social Relationships.

Restore Behavioral Health, PLLC
Clinical Care Coordinator, San Antonio, TX
April 2016–February 2018
• Empowered client growth through the completion of over: 2,000 neurofeedback sessions, 400 clinician-ordered psychological batteries, and 100 QEEG recordings. All sessions completed under the supervision of Dr. M. Down.
• Coordinated 3 pro bono, neurofeedback research studies to provide treatment for clients suffering from: (1) PTSD, (2) Traumatic Brain Injury, or (3) Autism Spectrum Disorder.
• Updated crisis intervention procedures by providing training resources for the C-SSRS. Clients who were at high-risk for suicide met with a clinician for same-day appointments.
• Supervised undergraduate-level student interns in administration of self-report clinical assessments, assessment scoring, and creation of clinical reports that were reviewed by licensed clinical psychologists.

Archdioceses of San Antonio, Catholic Charities  
Student Counselor, San Antonio, TX  
January 2017–May 2017

• Provided counseling services to under-served client populations under professorial supervision of Dr. G. Juhnke and on-site supervision of J. Locke.
• Provided therapeutic services to clients of various backgrounds including individuals who were refugees from the war in Uganda, individuals in a homeless environment, and/or in an active state of crisis.
• Held grief and loss groups for adolescent males at St. Anthony High School.

The University of Texas at San Antonio, Department of Counseling  
Student Counselor, Sarabia Family Counseling Center, San Antonio, TX  
January 2016–December 2016

• Counseled individuals and families from the community who were aiming to implement lifestyle changes. Therapy was brief (7–10 sessions on average) and utilized a solution focused theoretical orientation. Counseling was provided under the professorial supervision of Dr. G. Juhnke and Dr. M. Rosales.
• Administered vocational and clinical assessments including: O*net Interest Profiler, The SAD PERSONS Scale, Session Rating Scale (SRS), and Outcome Rating Scale (ORS).
• Maintained client records in accordance with The State of Texas Licensed Professional Counselors Board Rules, HIPPA requirements, and Sarabia Family Counseling Center rules/regulations.

Texas Department of Corrections  
Group Facilitator, Bexar County Juvenile Justice Program, San Antonio, TX  
August 2016–December 2016

• Provided court mandated psychoeducational groups to at-risk youth and their caregivers under professorial supervision of Dr. G. Juhnke.
• Youth groups focused on the topics of healthy communication, character building, and problem-solving strategies.
• Parenting groups focused on parenting skills, communication styles, and familial wellness.

La Paz Community Mental Health Care Center  
Clinical Group Facilitator, San Antonio, TX  
January 2016–May 2016

• Provided therapeutic groups to adults with chronic psychological pathology and/or intellectual disabilities.
• Advocated for increased availability of resources whilst promoting client autonomy and independence to facilitate a greater sense of welfare.
• Maintained client records in accordance with The State of Texas Licensed Professional Counselors Board Rules, HIPPA requirements, and La Paz rules/regulations.

Laurel Ridge Treatment Center, UHS, INC  
Assistant to The Director of Electroconvulsive Therapy, San Antonio, TX  
November 2014–December 2015

• Advocated on behalf of over 230 clients that sought Electroconvulsive Therapy treatment.
• Provided emotional support to clients before and after treatment under the supervision of Dr. R. A. Faber.
• Verified that appropriate medical clearance and voluntary consent was provided in compliance with The State of Texas Administrative Code (Title 25, Part 1, Chapter 405, Subchapter E) prior to ECT treatment.

Mental Health Worker, San Antonio, TX  
August 2014–December 2015

• Supervised therapeutic milieu on the Psychiatric Intensive Care (P-ICU) and Adult Substance Misuse Unit.
• Monitored individual patient progress and assisted with healthy conflict resolution.
• Assisted patients with individualized therapeutic goals.

Kingwood Pines Hospital, UHS, INC
Mental Health Technician, Houston, TX  
May 2014–August 2014

• Assisted patients in healthy conflict resolution and boundary setting.
• Managed milieu on Psychiatric Intensive Care (P-ICU), Adult Substance Misuse Unit, Adolescent Male and Childhood Units to ensure patient safety and wellness.
• Provided care to clients suffering from pervasive psychological distress.

Lead Instructor of Patient Education, Houston, TX  
May 2012–August 2012

• Taught patient education groups with individuals who ranged from 3 to 66+ years of age. Individuals aimed to learn coping skills to manage acute and/or chronic mental health diagnoses. Services provided under the supervision of Ms. B. Robertson.
• Created patient education handbooks which were used and provided to each unit at the hospital.
• Ensured continuity of patient health education by implementing the Mental Health Technician lead education groups upon my departure.

Integrative Counseling and Neuroeducation Services (iCNS)
Senior Intern, San Antonio, TX  
August 2012–May 2014

• Responsible for updates to The Comprehensive Bibliography for The International Society for Neurofeedback and Research under the supervision of Dr. A. Novian located at: http://www.isnr.org/resources/comprehensive-bibliography.cfm
• Maintained HIPPA compliance when working with client records.
• Trained interns from The UTSA Department of Psychology on office procedures, crisis protocol, and billing practices.

The Rowdy Runner Brain Inventory (RRBI)
Founder, San Antonio, TX  
June 2013–May 2014

• Negotiated and signed a 5-year (June 2014–June 2019) contract with The Princeton Review. Contract designated the donation of testing scholarships valued at $20,985.00 and membership discounts valued at $66,452.50.
• Negotiated and signed a 1-year (June 2013–June 2014) contract with Kaplan, Inc. Contract designated the donation of testing scholarships valued at 2,798.00 and membership discounts valued at 42,669.50.
• Created “The Dr. Mary McNaughton-Cassill Scholarship of Student Success” Scholarship is awarded bi-annually and entitles recipient to enroll in an in-person test preparation course for free.
• Acquired event sponsorship from The UTSA Office of Student Activities with an available operating budget of 5,000 over a 5-year period (April 2014–April 2019).
• Marketing of competition occurred via: Roadrunner Late Night, UTSA Chapter of Psi Chi, Student Psychology Club at UTSA, The UTSA Department of Psychology, and UTSA Student Government Association.
University Oaks at The University of Texas at San Antonio
Community Assistant, San Antonio, TX
December 2011–January 2013

- Provided acculturation assistance for over 500 students, many of whom were of international origin.
- Assisted students in acquisition of mental health services and provided crisis intervention services.
- Provided community-building activities/events that met the interests and needs of the student community.

PROFESSIONAL SERVICE AND LEADERSHIP

Editorial

Association for Assessment and Research in Counseling (AARC)
Editorial Assistant, Counseling Outcome Research & Evaluation (CORE) January 2020–Present

International Service and Leadership

The International Society for Neuroregulation and Research (Formerly: International Society for Neurofeedback and Research)
Co-Chair, Student Advocacy Committee January 2014–December 2019
Abstract Reviewer, Conference Committee May 2017; May 2019

National Service and Leadership

American Counseling Association (ACA)
Mentor, ACA Mentorship Program February 2021–Present
Member, Publications Committee July 2020–Present

American Mental Health Counselors Association (AMHCA)
Member, Neuroscience Taskforce (NTF) December 2018–Present
  Member, NTF Leadership Circle October 2019–Present
  Member, NTF Applications Workgroup January 2020–Present
  Member, NTF Counselor Education & Training Subcommittee December 2018–December 2019

Association for Multicultural Counseling and Diversity (AMCD)
Graduate Student Mentee January 2016–January 2017

Regional/State Service and Leadership

Mississippi Counseling Association (MCA)
Northwest Regional Legislative Contact, Government Relations Committee July 2019–Present
Advocate, Day at the Capital January 2019; January 2020

Southern Association for Counselor Education and Supervision (SACES)
Member, Graduate Student Committee January 2016–December 2018

Texas Counseling Association (TCA)
Advocate, Day at the Capital January 2015
University Service and Leadership

The University of Mississippi

Vice President, Epsilon Mu chapter of Chi Sigma Iota
February 2020–Present
PhD Student Evaluator, CES Assistant Professor Search Committee
January 2019
PhD Student Evaluator, CES Associate/Full Professor Search Committee
November 2018

The University of Texas at San Antonio

Student Liaison, BCIA Neurofeedback Cert. Exam Proctorship
April 2014–December 2017
Advocacy Chair, Sigma Alpha Chi chapter of Chi Sigma Iota
February 2015–February 2016
Founding President, Students of ISNR
January 2015–January 2016
Graduate Senator, Student Government Association (SGA)
January 2015–December 2016
Committee Member, SGA Academic Affairs Committee
January 2015–December 2016
Grad. Student Rep., Council for Accreditation of Cou. & Related Educational Programs (CACREP)
2015
College of Education and Human Development Senator, SGA
January 2014–December 2014
Committee Member, SGA Student Affairs Committee
January 2014–December 2014
President, UTSA Student Psychology Club
January 2012–December 2014
Treasurer, UTSA Chapter of Psi Chi
January 2013–December 2014
Founding Chair, Rowdy Runner Brain Inventory (RRBI)
April 2013
Founding Board Member, Undergraduate Research & Creative Inquiry Showcase
May 2013

Professional Affiliations (Selected)

American Mental Health Counselors Association (AMHCA)
2016–present

Chi Sigma Iota (CSI), Counseling Academic & Professional Honor Society
2015–present
Epsilon Mu Chapter (The University of Mississippi)
2018–present
Sigma Alpha Chi Chapter (The University of Texas at San Antonio)
2015–2018

The International Society for Neuroregulation and Research (ISNR)
2013–present

American Counseling Association (ACA)
2012–present

ACA Division Membership
Association for Assessment and Research in Counseling (AARC)
2018–present
Association for Humanistic Counseling (AHC)
2018–present
Association for Counselor Education and Supervision (ACES)
2015–present
Southern Association for Counselor Education and Supervision (SACES)
2015–present
Association for Creativity in Counseling (ACC)
2014–present
American College Counseling Association (ACCA)
2012–2014

ACA Branch Membership
Mississippi Counseling Association (MCA)
2018–present
Mississippi Association of Counselor Educators and Supervisors (MACES)
2018–present
Mississippi Graduate Student Counselors Association (MGSCA)
2018–present
Mississippi Licensed Professional Counselors Association (MLPCA)
2018–present
Texas Counseling Association (TCA)
2013–2018
Texas Association for Counselor Education and Supervision (TACES)
2015–2018

ACA Organizational Affiliate
International Association for Resilience and Trauma Counseling (IARTC)
2021–present
AWARDS / HONORS

Awards

Outstanding Contributor Research - Student Award
*Mississippi Counseling Association*, Virtual Conference, MS
November 2020

Outstanding Doctoral Student in Counselor Education Research Award
*The University of Mississippi, School of Education*, University, MS
May 2020

President's Volunteer Service Award- Bronze Level
*The President’s Council on Service & Civic Participation*, Washington, DC
April 2017

Most Outstanding Graduate Student at the Masters' Level
*Southern Association for Counselor Education and Supervision* (SACES), Philadelphia, PA
October 2015

Most Outstanding Graduate Student
*The University of Texas at San Antonio*, San Antonio, TX
April 2015

Volunteer of The Year
*Protectors of Animal Welfare and Safety* (PAWS), San Antonio, TX
December 2014

The Jane Findling Award
*The University of Texas at San Antonio*, San Antonio, TX
April 2014

Most Outstanding Senior Student (*Finalist*)
*The University of Texas at San Antonio*, San Antonio, TX
April 2014

President's Volunteer Service Award- Gold Level
*The President’s Council on Service & Civic Participation*, Washington, DC
April 2014; April 2016

Extra Mile Award
*Campus Living Villages*, San Antonio, TX
May 2012

Honors

The Honor Society of Phi Kappa Phi
Baton Rouge, LA
ID Number: 12658638
April 2020

Chi Sigma Iota, The International Counseling Academic and Professional Honor Society
Greensboro, NC
ID Number: 33122906
May 2015

Who's Who Among Students in American Universities and Colleges
The University of Texas System, San Antonio, TX
ID Number: 645714
April 2014

Psi Chi, The International Honors Society in Psychology
January 2012
**Conference Attendance**

**International and National**

- American Counseling Association, *Virtual Conference* 2021
- American Evaluation Association, *Virtual Conference* 2020
- International Society for Neuroregulation and Research, *Virtual Conference* 2020
- Association for Assessment and Research in Counseling, *Virtual Conference* 2020
- American Mental Health Counselors Association, *Virtual Conference* 2020
- American Counseling Association, *San Diego, CA (Canceled due to COVID-19)* 2020
- Association for Assessment and Research in Counseling, *San Antonio, TX* 2019
- American Mental Health Counselors Association, *Herdon, VA* 2019
- American Counseling Association, *San Francisco, CA* 2017
- International Society for Neurofeedback and Research, *Denver, CO* 2015
- Association for Counselor Education and Supervision, *Philadelphia, PA* 2015
- Association for Creativity in Counseling, *San Antonio, TX* 2015
- International Society for Neurofeedback and Research, *Dallas, TX* 2013

**Regional**

- Southern Association for Counselor Education and Supervision, *Myrtle Beach, SC* 2018
- Southern Association for Counselor Education and Supervision, *New Orleans, LA* 2016

**State and Local**

- 40th Annual F. E. Woodall Spring Conference for the Helping Professions, *Cleveland, MS* 2021
- 70th Annual Mississippi Counseling Association Conference, *Virtual Conference* 2020
- 39th Annual F. E. Woodall Spring Conference for the Helping Professions, *Cleveland, MS (Canceled due to COVID-19)* 2020
- 38th Annual F. E. Woodall Spring Conference for the Helping Professions, *Cleveland, MS* 2019
- The Biofeedback Society of Texas, *San Antonio, TX* 2016
- The Biofeedback Society of Texas, *Houston, TX* 2015
- Undergraduate Research and Creative Inquiry Showcase, *San Antonio, TX* 2013
- Texas Counseling Association, *San Antonio, TX* 2013
Hello Michael,

Thank you for your permissions request. Please consider permission to be granted to reproduce the brainwave graph from your Counseling Today article. Please let me know if I can be of any further assistance.

Best wishes,
Nancy

Nancy Driver
Digital and Print Development Editor
Ph/Fx 703-888-4365

Good morning, Michael, and please call me Carolyn.

Thank you for your permissions inquiry. Nancy Driver is our rights and permissions editor and I have copied her on your request (permissions@counseling.org/ndriver@counseling.org). Nancy is out until Monday but will get back to you next week.

Good luck with your dissertation. Have a good weekend.

Carolyn

Carolyn C. Baker
Associate Publisher
Ph/Fx 703-888-4412

Caution: This email originated outside of ACA’s network. Please do not click any links or open attachments unless you were expecting the email.

Good Afternoon Mrs. Baker,

I hope that you are doing well! I am writing to seek permission to reprint a figure
I hope that you are doing well! I am writing to seek permission to reprint a figure that was included in the following article that I co-authored:


The section that I am seeking reprint permission for is the sample brainwave graph that was included on page 15. Additionally, it is important to note that I aim to modify the image in order to better depict the principles of amplitude and frequency in EEG. If approved, this reprint will be included in my dissertation, which is being chaired by Dr. Richard S. Balkin. Attached to this email you will find a screenshot of the image that I aim to use with the included modifications.

Thank you so much for your consideration as well as your time!

Warmest regards,
Michael

--
G. Michael Russo, MS, P-LPC (MS), NCC, BCN- Associate Fellow
Pronouns: he/him/his
Counselor Education Ph.D. Candidate
Editorial Assistant, Counseling Outcome Research & Evaluation (CORE)

University of Mississippi
Department of Leadership & Counselor Education
139 Guyton Hall
University, MS 38677

C: grusso@go.olemiss.edu | gmichaelrusso.com