ABSTRACT

A Process Evaluation of the Use of a Training Protocol Integrating Biofeedback and Neurofeedback in a Counseling Setting: Consideration of the Working Alliance and Treatment Satisfaction

by Tami Maes Fragedakis

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Director: Dr. Paul J. Toriello

Department of Addictions and Rehabilitation Studies

Often individuals enroll in counseling services during times of distress, seeking help with a variety of situations and conditions. However, many individuals do not complete treatment for a variety of reasons. A possible way of increasing client compliance is to enrich the counseling services provided. While talk therapy is effective, implementing technology into counseling with the use of biofeedback applications may enhance the working alliance, increase treatment satisfaction, and further augment the field of counseling.

The purpose of this study was to conduct a preliminary process evaluation of the use of a training protocol integrating biofeedback and neurofeedback applications to alleviate symptomology of mental health conditions. Biofeedback and neurofeedback measurements provide a lens to better understand the physiological basis of mental health conditions. Biofeedback and neurofeedback training allows individuals to interact with their physiology further teaching clients to control and manipulate internal states related to mental health conditions.

Participants were clients enrolled for services at a university based counseling clinic and consented to participate in the study (N = 10). Clients engaging in a novel training protocol integrating biofeedback and neurofeedback applications designed to help alleviate symptomology associated with the physiological basis to mental health conditions. The objective data obtained from the biofeedback measurements and the subjective reports given by the clients were used to evaluate the integrated training protocol and explore the research questions. The data obtained in this study was used to construct a prospective model for the implementation of an integrated training protocol into counseling. The model proposes the utilization of biofeedback applications may enrich the counseling experience defined through the working alliance and treatment satisfaction. If clients feel a stronger working alliance and are more satisfied with counseling that implements biofeedback applications, they may be more likely to attend and complete the counseling process. Future research is needed to determine causal relationships between the integrated training protocol and the working alliance and treatment satisfaction.

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Tami Maes Fragedakis

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by

Tami Maes Fragedakis

APPROVED BY:

DIRECTOR OF DISSERTATION:_____
Paul Toriello, Ph.D.

COMMITTEE MEMBER:_____
Stephen Leierer, Ph.D.

COMMITTEE MEMBER:_____
Carmen Russoniello, Ph.D.

COMMITTEE MEMBER:_____
Leslie Sherlin, Ph.D.

CHAIR OF THE DEPARTMENT OF ADDICTIONS AND REHABILITATION STUDES: _____
Paul Toriello, Ph.D.

DEAN OF THE GRADUATE SCHOOL:_____
Paul J. Gemperline, PhD

DEDICATION

I would like to dedicate this dissertation to Michael Duquette. I am a better person because I was privileged to know you. You were such an amazing therapist, and I am lucky to have had the opportunity to work with you and see this first hand. You were an even better friend. Thank you for always checking on me, making sure I was staying the course. I do pray this study will do you justice for all you have taught me. You will forever live in my heart.

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CHAPTER 1: INTRODUCTION

Introduction to the Study

This chapter provides an introduction to this research study that retrospectively examined clients' subjective reactions to physiological changes that were captured while engaging in a training program integrating biofeedback and neurofeedback. This chapter includes the background of the study, statement of problem, justification for the study, research questions explored, significance of the study, and definition of terms.

Background of the Study

Stress contributes to most conditions experienced and impacts individuals' mental and emotional well-being, and psychosocial and physical health (Du et al., 2009; NIMH, 2009; Sapolsky, 2004; Thayer & Brosschot, 2005). Approximately 75 to 90% of visits to primary care physicians are attributed to stress related conditions (American Psychological Association, [APA, 2013). Chronic stress contributes to poor psychosocial health impacting the life of the individual on both personal and professional levels. Commonly experienced mental health conditions including anxiety and depression manifest from chronic stress (Lambert & Cattani-Thompson, 1996; Makingson & Young, 2012; Myers & Young, 2012). In addition, chronic stress impairs the immune system, increasing susceptibility and vulnerability to additional medical conditions and intensifies physical ailments (American Institute of Stress, 2013; NIMH, 2009; Gervitz & Lehrer, 2003; McGrady & Linden, 2003; Sapolsky, 2004; Schwartz & Achem, 2003). Furthermore, chronic stress has an economic impact on society. Employers report approximately $300 billion dollars lost annually is due to missed work from stress related conditions and spent on stress related health care (American Institute of Stress, 2013;

NIMH, 2009). While individuals may recognize high levels of stress and the detrimental effects stress causes their health and wellbeing, they continue to struggle with managing stress effectively and attribute this mostly to a lack of awareness and willpower (APA, 2013; Du et al., 2009; NIMH, 2009).

Counseling has been identified as an effective form of treatment, assisting individuals in dealing with stress, fulfilling their personal goals and establishing healthy lifestyles (Corey, 2012). However, clients are required to comply with treatment guidelines and procedures for services to be effective. In counseling, noncompliance typically refers to poor attendance. Researchers have found clients miss counseling appointments for a variety of reasons related to symptomology, practical concerns, issues with motivation, and personal reactions to counseling (Defife, Conclin, Smith, & Poole, 2010). Personal reactions which inhibit clients from returning to counseling include interpersonal distress (Ogrodniczuk, Piper, & Joyce, 2006), feeling a personal disconnect with the provider or lack of a quality working alliance (Woody & Adessky, 2002), and perceived disrespect from the health care provider (Lacy, Paulman, Reuter, & Lovejoy, 2004).

Missing appointments and dropout rates is a serious issue in the mental health care field. Noncompliance with treatment leads to further implications including the following: social, clinical, and economic costs related to higher rates of relapse and re-hospitalization (Edlund,Wang, Berglund, Katz, Lin, & Kessler, 2002). To receive the optimal benefits of counseling, clients are encouraged to comply with regulations regarding their care (Ogrodniczuk, Piper, & Joyce, 2006). A possible way of increasing client compliance is to enrich the counseling services provided. While talk therapy is

effective, implementing technology into counseling with the use of biofeedback applications may enhance the working alliance, increase treatment satisfaction, and further augment the field of counseling.

Modern technology has provided researchers with sophisticated equipment to better enhance the understanding of the human body and mental illnesses (National Institutes of Mental Health, [NIMH, 2010). Researchers have discovered a physiological basis to mental health conditions consisting of imbalances found in both the brain and the body (Danskin & Walters, 1973; Makinson & Young, 2012; NIMH, 2010; Robbins, 2000; Saplosky, 2004; Schwartz, Weinberger, & Singer, 1981; Thayer & Brosschot, 2005; Westerhaus & Loewy, 2001). For the purpose of this study, the term physiology therefore encompasses electrical activity produced in both the brain and the body. Viewing mental health conditions through a physiological lens may provide a deeper understanding of human behavior and symptomology (Lambert & Cattani-Thompson, 1996; Makinson & Young, 2012; Myers & Young, 2012; Porges, 2009; Sapolsky, 2004; Thayer & Brosschot, 2005). Biofeedback measurements provide a visual representation of the internal states coinciding with mental health conditions (Carmichael, 2009; Peek, 2003; Schwartz & Olsen, 2003; Thompson & Thompson, 1998) and biofeedback training allows individuals to interact with and manipulate their physiology, further alleviating symptomology (Arena & Schwartz, 2003; Danskin & Walters, 1973; Makinson & Young, 2012; Myers & Young, 2012). In addition, the physiological lens which biofeedback offers may enhance the working alliance between the counselor and the client and increase clients' satisfaction with treatment (Carmichael, 2009; Larson, Ryan, & Baerentzen, 2010; Myers & Young, 2012; Thompson & Thompson, 1998; Romano,

1982); key components which may enrich the counseling experience (Bordin, 1979; Corey, 2013; Davis & Hobbs, 1989; Tetzlaff et al., 2005).

Problem Statement

Often individuals enroll in counseling services during times of distress, seeking help with a variety of situations and conditions (Corey, 2013). However, many individuals do not complete treatment for a variety of reasons. As a foundation to the counseling experience, a healthy therapeutic relationship must be established. The therapeutic relationship, often defined by the working alliance between the counselor and the client, involves the following: mutual trust, a mutual agreement of the current issue, and a mutual perspective of an approach to resolve the presenting problem (Bordin, 1979). Once a healthy working alliance is established, mental health counselors utilize different techniques and strategies to help clients learn appropriate coping skills to better manage stress and gain control of maladaptive thoughts and behaviors (Corey, 2013) which ultimately alters physiological functioning (Makinson & Young, 2012).

During the counseling process, counselors may continuously obtain clients' subjective experience of counseling and use this information to evaluate quality of care and identify areas of improvement (Davis & Hobbs, 1989). For example, clients' satisfaction with counseling received often correlates with their perception of the counselor's interpersonal skills (Davis & Hobbs, 1989), which suggests a relationship exists between working alliance and clients' satisfaction with counseling. However, to date, this relationship has yet to account for the internal physiological states related to mental health conditions. A physiological lens established through the use of biofeedback may help counselors better understand and formulate strategies to address mental health

conditions. A model is needed to identify how the implementation of a training protocol integrating biofeedback and neurofeedback impacts the counseling relationship as defined by process variables including the working alliance and treatment satisfaction.

Study Justification

Implementing biofeedback measurements into counseling is beneficial to the counselor, the client (Carmichael, 2009; Danskin & Walters, 1973; Larson et al., 2010; Makinson & Young, 2012; Myers & Young, 2012; Peek, 2003; Romano, 1982; Schwartz et al., 1981; Thompson & Thompson, 1998), and the field of counseling (Danskin & Walters, 1973; Makinson & Young, 2012; Myers & Young, 2012). Biofeedback measurements calculate, monitor, and display clients' physiological states further clarifying the physiological basis of the presenting condition (Carmichael, 2009; Danskin & Walters, 1973; Larson et al., 2010; Makinson & Young, 2012; Myers & Young, 2012; Peek, 2003; Romano, 1982; Schwartz et al., 1981; Thompson & Thompson, 1998). Explaining visual representation of clients' internal states validates symptoms experienced. Clients are then able to gain an awareness of and correctly interpret and understand their physiological responses to stress. The information provided by the biofeedback output enables both the counselor and the client to efficiently engage in the following: 1) identify and agree upon current conditions, 2) develop goals for treatment, 3) establish duties within the therapeutic process, 4) delineate the process of treatment, and as a result 5) develop mutual trust for one another. In addition, the objective data gathered by the biofeedback measurements optimizes the counselor's ability to empathize with the clients' struggles (Carmichael, 2009; Thompson & Thompson, 1998). Improved empathy may enhance clients' trust in their counselor which could improve the working

alliance and satisfaction of counseling. Moreover, utilizing the biofeedback output as a guide, gives the counselor a sophisticated tool to tailor treatment based on the needs of the client (Makinson & Young, 2012; Peek, 2003). Personalizing counseling with this level of sophistication may also improve client satisfaction of treatment (Carmichael, 2009; Hammond, 2007; Henschem, 1976; Makinson & Young, 2012; Myers & Young, 2012; Romano, 1982; Schwartz & Schwartz, 2003; Thompson & Thompson, 1998).

While biofeedback measurements are utilized as a microscope providing a visual representation to the physiological basis of mental health conditions, biofeedback training engages clients in the manipulation of these internal responses to further gain control of physiology and decrease symptomology (Makinson & Young, 2012; Myers & Young, 2012). Counselors train clients on how to interact with their physiological responses and manage these reactions more efficiently (Yucha & Gilbert, 2004). Viewing these internal adaptations in real time through use of the biofeedback output may enhance confidence in the competence of the counselor, which could further solidify the working alliance. As a result, clients gain control over physiological responses to stress and symptomology decreases, satisfaction of treatment increases (Carmichael, 2009; Danskin & Walters, 1973; Hammond, 2007; Henschem, 1976; Makinson & Young, 2012; Myers & Young, 2012; Romano, 1982; Thompson & Thompson, 1998). Biofeedback measurements and training may be implemented into counseling as a means to enrich the counseling process with consideration of the working alliance and treatment satisfaction.

Research Questions

Implementing biofeedback measurements and training into counseling could augment the field by enhancing our understanding of mental health conditions and the

relationship between the working alliance, satisfaction of treatment, and biofeedback. study evaluated a novel training protocol integrating biofeedback and neurofeedback applications designed to help clients alleviate symptomology associated with the physiological basis to mental health conditions. Clients reported on their perspective of the counseling services provided based on the working alliance, their satisfaction with treatment, and which biofeedback measurements they found most helpful to alleviate symptomology.

The purpose of this study was to conduct a preliminary process evaluation of the use of a novel training protocol integrating biofeedback and neurofeedback to alleviate symptomology of mental health conditions. Results of this study were used to define a prospective model to guide future practice and support outcome research of implementing an integrated training protocol into counseling. This study answered the following research questions.

Research question 1: Is there a difference between clients' baseline physiological scores and their post-training physiological scores?

Research question 2: How do clients rate the working alliance after completing the integrated training protocol?

Research question 3: How do clients rate their treatment satisfaction after completing the integrated training protocol?

Research question 4: How do clients rank their preferences of biofeedback measurements after completing the integrated training protocol?

Research question 5: After completing the integrated training protocol, is there a relationship between clients' perception of the working alliance and changes in physiological scores taken pre and post training?

Research question 6: After completing the integrated training protocol, is there a relationship between the clients' perception of treatment satisfaction and changes in physiological scores taken pre and post training?

Research question 7: After completing the integrated training protocol, is there a relationship between the clients' ranking of biofeedback measurements and changes in physiological scores taken pre and post training?

Study Significance

Biofeedback applications have already been deemed efficacious for helping alleviate symptoms of stress related conditions. While there are typical physiological responses to stress, each individual client may respond somewhat differently, displaying a range of reactions. Therefore, there is a need for a biofeedback training protocol that utilizes multiple biofeedback measurements, providing an accurate physiological lens to mental health conditions thus improving working alliance and satisfaction of counseling. Furthermore, a protocol that is flexibly implemented and tailored to the clients' individual needs will provide a sophisticated physiological lens, as a means to enhance the process of counseling as defined by clients' subjective experiences of the working alliance and treatment satisfaction.

Definition of Terms

The definitions for the independent and dependent variables in the study are explained in this section. The independent variables are defined as follows:

Integrated training protocol: A multi-modality training protocol developed by Maes (2012) in which clients are educated on physiological responses to stress and learn to gain control over these reactions through training with biofeedback, neurofeedback, and a combination of the measurements (Appendix B). The biofeedback measurements utilized in this study include the following: 1) Heart Rate Variability (HRV), 2) Skin Temperature, 3) Skin Conductance, and 4) Neurofeedback.

Physiological data: Physiological data may be described as relating to physiology or the internal functioning within the human body. For purposes of this study, the physiological data deals with the electrical activity that portrays functioning of the autonomic nervous system (ANS) and the central nervous system (CNS) and was captured with biofeedback measurements including:

- Heart Rate Variability - Power spectral analysis of heart rate variability (HRV) measures the sympathetic and vagal regulation of heart rate. During physiological arousal, heart rate increases as the heart pumps blood through the body at a faster rate. Heart rate changes with each beat and should vary, increasing during inhalation and decreasing during exhalation. HRV monitoring captures the beat-to-beat intervals of the heart rate, measuring the time between and frequency of each heartbeat as blood is pumped through the blood vessels, further defining the overall cardiac condition of the individual. (Gervitz & Lehrer, 2003; Schipke, Arnold, & Pelzer, 1999; Wheat & Larkin, 2010; Zucker, Samuelson, Muench, Greenberg, & Gevirtz 2009). Counselors may teach clients to engage in HRV training to create a balance within the ANS by increasing the regulatory power captured by the HRV output (Gervitz & Lehrer, 2003.

- Skin Temperature - During physiological arousal, vasoconstriction, the tightening of the blood vessels, may occur in the hands and the feet, allowing the blood to pool in the core area of the body to protect vital organs such as the heart and lungs. As a result, core temperature will increase while the temperature in the hands and feet cools. As the heart continues to pump blood, the constriction of the blood vessels creates insufficient blood flow throughout the body and increases the amount of blood force that is pressed against the heart's arteries (McGrady & Linden, 2003). Counselors may utilize skin temperature training to help individuals increase the skin temperature measured in the peripherals to achieve a relaxation response further decreasing sympathetic activity (Danskin & Walters, 1973; Hauri & Esther, 1990; McGrady & Linden, 2003; Schwartz & Sedlacek, 2003).
- Skin Conductance - During a stress response, an increase in sweat production occurs as the body releases toxins and cool down. Each sweat gland may be described as an electrical pathway. Biofeedback measures the skin conductance, or sweat gland activity. High skin conductance is associated with high levels of arousal and alertness, and correlates with a stress response. Counselors may help individuals train to decrease skin conductivity further decreasing sympathetic activity (Peek, 2003).
- Theta Brainwaves- Theta brainwaves are produced between 4 to 8 hertz and should be kept at a minimum in the frontal cortex while engaging in a processing task. Too much theta produced within the frontal regions of the brain will result in

grogginess and day-dreaming and has been associated with depression. Counselors may help individuals train to decrease the amount of theta brainwaves through use of neurofeedback to help alleviate symptomology of mental health conditions (Hammond, 2007; Hill & Castro, 2003; Neumann et al., 2003; Thatcher & Lubar, 2009).

- Sensory Motor Rhythm (SMR) Brainwaves - SMR brainwaves are produced between 12 to 15 hertz when measured along the sensory motor cortex (Neumann et al., 2003). Producing the appropriate amount of SMR may equate to feeling calm and focused. Counselors may help individuals train to increase SMR activity through use of neurofeedback to help alleviate symptomology of mental health conditions (Hammond, 2007; Hill &astro, 2002; Thatcher & Lubar, 2009; Thompson & Thompson, 2005).
- High Beta Brainwaves - High beta brainwaves are produced between 18 to 30 hertz. High beta found in the frontal cortex is associated with hyper-alertness, anxiety, pain, irritability, and poor integration. An individual experiencing much high beta in this region may experience panic like symptoms and feel fearful, making learning new material difficult. Counselors may help individuals to decrease high beta brainwave activity through use of neurofeedback to help alleviate symptomology of mental health conditions (Hill & Castro, 2002; Thatcher & Lubar, 2009).

Physiological data was obtained before, during, and after biofeedback training (See Appendix B for step by step procedures of these measurements).

Working Alliance Inventory-Short Revision: Working alliance is defined as the therapeutic relationship between the counselor and the client and involves 1) mutual trust, 2) mutual agreement of the current issue, and 3) mutual perspective of an approach to resolve the presenting issue (Bordin, 1979). The quality of the relationship is based on both client and counselor personal characteristics, including client motivation and openness to counseling and counselor ability to form interpersonal relationships. The Working Alliance Inventory (WAI) is designed to assess and determine the strength of the relationship between the counselor and the client. In this study, the Working Alliance Inventory – Short Revision (WAI-SR) will be used to determine how clients rate the working alliance after engaging in the integrated training protocol. Scores on the three subscales will be reported: bonding, goals, and tasks.

Treatment Satisfaction Index: Treatment satisfaction is defined as client contentment with treatment due to the fulfillment of their wants, wishes, and desires through the services received (Tetzlaff et al., 2005). The Treatment Satisfaction Inventory (TxSI) measures the effectiveness of counseling, considering not only the counseling relationship, but also the client's satisfaction with their overall counseling experience (Tetzlaff et al., 2005). This inventory was used in this study to determine how clients evaluated the training protocol integrating biofeedback and neurofeedback.

Ranking of Biofeedback Measurements: After completing the biofeedback training protocol, each client ranked his/her preferences of the five biofeedback training measurements including 1) HRV, 2) skin temperature, 3) skin conductance, 4) neurofeedback, and 5) a combination of HRV training and neurofeedback. Viewing these scores will indicate if a relationship exists between the clients' perspective of which

biofeedback measurement was most helpful and amount of change produced in physiology.

Summary

Utilizing a biological lens enhances the understanding of mental health conditions (Porges, 2009). The goal of this study was to evaluate the implementation of an integrated training protocol which encompasses multiple biofeedback measurements through the use of the working alliance, treatment satisfaction, and how clients ranked the biofeedback measurements. The findings of this study may be used help counselors identify an innovative treatment option for stress related conditions that clients find appealing. Results of this study were used to define a prospective model to identify how the implementation of a training protocol integrating biofeedback and neurofeedback impacts the counseling relationship as defined by process variables including the working alliance and treatment satisfaction.

This chapter introduced the purpose of this study, which was to evaluate an integrated training protocol by examining both objective data captured by physiological changes and clients' subjective reports of their perception of the working alliance and treatment satisfaction. The physiological basis of mental health conditions was explained and biofeedback and neurofeedback measurements and training were defined. A rational for integrating biofeedback and neurofeedback training was provided, and the benefits of incorporating biofeedback measurements and training in conjunction with counseling were explained. The following chapter provides a comprehensive review of the relevant theoretical and empirical literature related to the physiological basis of mental health

conditions and applicable biofeedback techniques which may improve the quality of care delivered and advance the counseling field.

Chapter 2: LITERATURE REVIEW

Introduction to Literature Review

This literature review begins with a description of current concerns in the counseling field. The physiological basis of mental health conditions and the relationship between the autonomic nervous system (ANS) and the central nervous system (CNS) are explained. An overview of measuring clients' subjective perceptions of counseling through use of the working alliance and treatment satisfaction is provided. Enriching these elements of counseling through use of biofeedback applications is explained. Biofeedback and neurofeedback training protocols are described, and a rational of integrating the two is provided. The review concludes with explaining the need for an integrated training protocol that is administered flexibly as a means to enrich the counseling experience through process variables identified as the working alliance and treatment satisfaction.

The Problem: A Physiological Basis of Mental Health Conditions

Stress is a main culprit of the United States' mental health conditions. Approximately 75 to 90% of visits to primary care physicians are attributed to stress related conditions (American Institute of Stress, 2013; APA, 2013). Stress affects individuals' mental and emotional well-being as well as his or her psychosocial and physical health (American Institute of Stress, 2013; APA, 2013; NIMH, 2009). A common tendency of an individual experiencing an extreme stress response involves ruminating on a past event or threatening future events, making it difficult to cognitively process a situation and stay present focused. This activated state may also interfere with the capacity to learn and ability to remember (Sapolsky, 2004). As the body demands an

increased level of energy for an extended period of time, alterations to brain chemistry increases susceptibility to psychosomatic conditions. During a stress response, dopamine, the neurotransmitter responsible for regulating emotions and pleasure centers in the brain, is unable to bind to receptor sites in the brain. With lower dopamine levels, individuals have a decreased tolerance for pain and experience less happiness as well as additional emotional turmoil that coincide with mental health conditions (American Institute of Stress, 2013; APA, 2013; NIMH, 2009; Sapolsky, 2004).

Mental health conditions manifest from experiencing chronic stress (American Institute of Stress, 2013; APA, 2013; Makinson & Young, 2012; Myers & Young, 2012; NIMH, 2009; Porges, 2009; Sapolsky, 2004). Approximately 73% of individuals impacted by stress experience psychological symptoms identified as irritability, anger, nervousness, fatigue and a lack of energy (American Institute of Stress, 2013; NIMH, 2009). As the stress response intensifies, individuals may develop psychiatric disorders, including clinical depression, anxiety, and bipolar disorder (Lambert & Cattani-Thompson, 1996; Makingson & Young, 2012; Myers & Young, 2012; NIMH, 2009). Moreover, chronic stress impairs psychosocial health and interferes with the ability to fully function and engage in activities of daily living, limiting independence and hindering individuals' vocational capabilities (Corey, 2013; NIMH, 2009; Sapolsky, 2004). Worried about their condition, or seeing it as a personal flaw, may lead to an additional stress response (Corey, 2013; Westerhaus & Loewy, 2001), followed by low self-esteem, poor self-concept, and feelings of hopelessness (Corey, 2013; Myers & Young, 2012; Sapolsky, 2004). As a result, individuals may experience difficulty forming and maintaining healthy relationships and even become socially withdrawn, passive,

apathetic, or aggressive (Thayer & Brosschot, 2005; Westerhaus & Loewy, 2001). These responses may intensify and exacerbate physical ailments that commonly coexist with mental health conditions (Leaf, 2007; Makinson & Young, 2012; NIMH, 2009; Perlmutter & Colman, 2004; Sapolsky, 2004).

Approximately 77% of individuals impacted by stress experience physical symptoms that often include fatigue, headaches, upset stomach, teeth grinding, and change in appetite and sex drive (American Institute of Stress, 2013; NIMH, 2009). In addition, experiencing chronic stress decreases the effectiveness of the body's natural immune system leading to additional medical conditions including the following: high blood pressure (McGrady & Linden, 2003; Mohd, 2008), gastrointestinal problems such as ulcers (Sapolsky, 2004) and irritable bowel syndrome (Schwartz & Achem, 2003), and cardiac arrhythmias (Gervitz & Lehrer 2003; Mohd, 2008). Emotional stress continues to remain a leading culprit to high mortality rates and life-threatening diseases including cancer, coronary heart disease, and respiratory disorders (Mohd, 2008). With an impaired immune system, individuals also become more susceptible to developing cardiovascular diseases - including heart attacks and strokes - as well as other health concerns such as obesity and type 2 diabetes (Mohd, 2008; Sapolsky, 2004). Overall, experiencing an unnecessary heightened stress response for long periods of time can lead to the deterioration of clients' mental, emotional, and physical health (American Institute of Stress, 2013; Leaf, 2007; Makinson & Young, 2012; Mohd, 2008; NIMH, 2009; Perlmutter & Colman, 2004; Sapolsky, 2004).

While counseling has been deemed an effective form to assist individuals in dealing with stress, fulfilling life goals, and establishing healthy lifestyles (Corey, 2013),

concerns exist within the field. Clients are expected to attend counseling services and comply with treatment regulations in order to optimize the benefits of counseling (Ogrodniczuk et al., 2006). Noncompliance in counseling generally refers to no show rates that encompass missed appointments and drop outs (Edlund et al., 2002). Noncompliance may occur for a variety of reasons related to symptomology, practical concerns, issues with motivation, and personal reactions to counseling (Defife et al., 2010).

Researchers have identified reasons clients may struggle to comply with treatment regulations in regards to their mental health care (Defife et al., 2010; Lacy et al., 2004; Ogrodniczuk et al., 2006;Woody & Adessky, 2002). Initially clients may schedule counseling appointments due to symptoms experienced but may fail to attend the session out of anticipatory anxiety of procedures and/or what they may consider news of their self that may be threatening to their emotional wellbeing (Lacy et al., 2004). Symptomology of mental health conditions as well as acute illnesses or active substance use may interfere with clients' ability to attend scheduled counseling appointments (Defife et al., 2010). A lack of motivation due to symptomology experienced may result in clients' noncompliance (Ogrodniczuk et al., 2006). Clients may also experience personal reactions to previous sessions that cause them distress and inhibit them from continuing to seek services (Ogrodniczuk et al., 2006). Clients who perceive to have been disrespected from the health care provider do not feel obligated to follow through with their appointment (Defife et al., 2010; Edlund et al., 2002; Lacy et al., 2004). Negative and pessimistic attitudes of mental health care such as viewing treatment as ineffective or experiencing feelings of embarrassment for seeking treatment may also lead to

noncompliance (Edlund et al., 2002). In addition, clients who feel as if the counselor is not fully attending to their needs will likely become noncompliant with treatment (Woody & Adessky, 2002).

External variables such as distractions from other life events, limited access to transportation and conflicts with scheduled appointments due to work restraints and/or childcare are common reasons for missed sessions (Defife et al., 2010). Drop-out rates are higher for individuals who have lower incomes (Edlund et al., 2002) and lack insurance (Defife et al., 2010; Edlund et al., 2002). Researchers have also found clients who are offered single-modality treatments, such as solely talk therapy, also are more likely to have higher drop-out rates than clients receiving multi-modality treatments including medication management in conjunction with psychotherapy (Edlund et al., 2002).

Dropping out of mental health care is common (Edlund et al., 2002). Less progress is made therapeutically and treatment may be deemed ineffective when clients terminate treatment earlier than recommended (Edlund et al., 2002; Ogrodniczuk et al., 2006). Early termination may cause the individual to experience a sense of failure and dissatisfaction, which may worsen their problems and cause additional psychological distress. In addition, if a group member was to abandon group counseling prior to the conclusion of the group sessions, members may experience the sense of insecurity, worry, and anger. Leaving a group early may be disruptive and has the potential to delay meaningful progress (Ogrodniczuk et al., 2006).

Clients are encouraged to attend counseling sessions for the given duration to receive optimal benefits of the services provided (Ogrodniczuk et al., 2006). A possible

way of increasing client compliance is to enrich the counseling experience by incorporating innovative techniques. While talk therapy is effective, the field of counseling may be augmented by implementing the use of technology through biofeedback applications.

Advancements in technology and increased knowledge of human anatomy and physiology have led to a better understanding of complicated mental health conditions (NIMH, 2010). Researchers found changes and imbalances in the brain and body contributes to mental health conditions. An understanding of basic principles regarding these changes may help counselors assist clients in recovery (Danskin & Walters, 1973; Makinson & Young, 2012; Myers & Young, 2012). A brief overview of the nervous system provides an understanding of the physiological basis of mental health conditions.

The human body is complex, comprised of many integrated systems. The nervous system's primary functions include monitoring and managing organ function in addition to adapting to environmental changes (Marieb, 2004). This system is comprised of two main branches: the CNS that consists of the brain and the spinal cord, and the peripheral nervous system (PNS), which contains sensory and motor neurons. The CNS processes and evaluates information to make decisions in order to send instructions throughout the body, communicating with the PNS. The PNS is divided into the ANS, which maintains homeostasis of involuntary actions, regulating smooth and cardiac muscles, and the somatic nervous system (SNS) that is responsible for regulating skeletal muscles. The ANS is further divided into two branches: the sympathetic branch and the parasympathetic branch (Marieb, 2004; Sapolsky, 2004; Thayer & Brosschot, 2005). The ANS is regulated by the vagus nerve, a primary component of the parasympathetic

nervous system. The vagus nerve serves as the body's natural pacemaker, regulating heart rate through what is known as a vagal brake (Porges, 2009). The vagal brake is removed during physiological arousal, allowing the body to active the fight-or-flight response corresponding with sympathetic nervous system arousal. The vagal brake is applied during allostasis, allowing the body to return to homeostasis corresponding with parasympathetic nervous system activity (Porges, 2009). When the vagal brake is applied, the parasympathetic branch serves as the decelerator, enabling restorative functions (Porges, 2009).

While all systems of the body work together accordingly, the CNS and the ANS especially do so during times of distress (Thayer & Brosschot, 2005). Functioning together, researchers have defined this relationship as the central autonomic network (CAN) (Thayer & Brosschot, 2005). Therefore, an imbalance within one of the systems leads to a dysfunction in others (Thayer & Brosschot, 2005). Cognitive distortions known as inaccurate thoughts (Corey, 2013; Sapolsky, 2004) along with corresponding chemical activity produced in the brain and prolonged patterns of heightened sympathetic nervous system activity leads to a rigidly functioning and imbalanced CAN (Thayer & Brosschot, 2005), contributing to mental health conditions (Lambert & Cattani-Thompson, 1996; Makinson & Young, 2012; Myers & Young, 2012). The following sections delineate how both the "thought life" of the CNS and the fight-or-flight response of the ANS contribute to mental health conditions.

Thought Life

The brain, the main component of the CNS, is considered the control center of the body, constantly sending, receiving, and translating signals to and from the body,

enabling it to function properly. Electrical and chemical processes occur simultaneously in the brain with any given thought. This ongoing series of electrochemical actions and reactions is also referred to as "thought life" (Leaf, 2007; Perlmutter & Colman, 2004). Individuals experiencing a stress response may become aware of certain irrational thoughts, resulting in electrochemical and physiological reactions and the continuation of irrational thinking (Perlmutter & Colman, 2004). This dysfunctional thought pattern often exacerbates an individual's anxiety and continues to feed into irrational thoughts (Burns, 2006).

From a physiological standpoint, the brain produces approximately 400 billion functions at any given moment (Perlmutter & Colman, 2004), as nearly 100 billion neurons send and receive messages, firing over synaptic gaps (Makinson & Young, 2012; NIMH, 2010). This electrical activity in the brain causes chemicals to be released and flow through the body, stimulating a response constructed and controlled by the ANS. The firing rate of the neurons along with the chemicals produced in the brain influence the thoughts created, just as thoughts determine the firing rate of neurons and chemicals produced. As a result, distinct firing patterns in the brain and specific hormones have been found to correspond with different emotions and functionality (Makinson & Young, 2012; NIMH, 2010).

Negative thoughts that occur during or stimulate a stress response are accompanied by chemical reactions and a distinct firing pattern in the brain (Sapolsky, 2004). A negative electrochemical pattern activates the sympathetic nervous system and properly prepares individuals for danger in order to properly assist in their removal from a dangerous situation. However, when no real danger is present, reactions to perceived

threats may lead to emotional, mental, and physical conditions associated with psychological illnesses (Leaf, 2007; Sapolsky, 2004).

Cognitive behavioral theorists may explain the physiological basis of psychological manifestations according to Albert Ellis's rational emotive behavioral therapy and Aaron Beck's cognitive therapy (Corey, 2013). With this viewpoint, theorists rationalize certain thoughts will lead to specific feelings, which influence attitudes and result in a behavior (Corey, 2013; Makinson & Young, 2012; NIMH, 2010; Perlmutter & Colman, 2004). Neurons fire continuously in accordance with repetitious thoughts, creating electrical and chemical patterns in the brain that coincides with physiological reactions in the body. For example, thoughts that elicit a fear response causes the neurons in the brain to fire at a faster rate to produce an increased level of adrenaline that rushes through the body, stimulating an over-activation of the ANS and resulting in the physiological response referred to as "fight-or-flight" (Marieb, 2004; Sapolsky, 2003).

The Fight-or-Flight Response

The fight-or-flight response is the body's natural defense activated in times of stress (Marieb, 2004; Sapolsky, 2004). While responding to stress is a normal response, experiencing an unnecessary amount, typically as a result to an irrational fear, along with an intense reaction to stress may be detrimental to one's health. When the body goes into fight-or-flight during a stress response, physiological reactions occur in both the body and the brain to assist in escaping danger. In certain situations, individuals experiencing distorted thought patterns typically react as if real danger were present in which they would need the assistance of an exit path when, in reality, no real danger exists

(Sapolsky, 2004). This heightened stress response reinforces certain ways of thinking and contributes to maladaptive behaviors (Leaf, 2007; Marieb, 2004; Sapolsky, 2004).

The following example explains a typical stress response to a common stressor. Jane, a single mother of three children - ages two, five, and seven years - leads a busy life. Jane's day begins in a rush of panic as she wakes abruptly realizing she overslept. Still feeling exhausted from a night of restless sleep, Jane hurries to wake her children and begin their morning routine. After attempting to get herself ready and rushing her children into the car, Jane races down the street only to slam on the brake as she becomes entangled in a traffic jam. Jane begins to feel hot and flushed and reaches to turn on the air conditioning only to realize it is not working. She rolls down her windows and is greeted by a hot and humid day with temperatures already in the 90s. Traffic remains at a standstill for the next fifteen minutes. Jane is acutely aware of how late her children will be for school and how late she will be for her job she does not enjoy. She is aware of how frustrated and annoyed she is feeling yet unaware of the physiological reactions that are occurring internally as her body is reacting to this situation.

With the central and autonomic nervous system working together, specific physiological reactions occur once the fight-or-flight response begins (Leaf, 2007; Sapolsky, 2004). Jane's mind and body are already functioning in "overdrive" from the second she frantically awakes. Jane may be aware of her racing heart, sweaty palms, and the knot in her stomach or oncoming headache, but she may be oblivious to the electrical activity in her brain. At this time, the quickened firing and increased chemical activity in her brain is signaling hormones to rapidly respond to the stressors by rushing through her

body and activating physiological responses to occur in the body (Marieb, 2004; Sapolsky, 2004).

While Jane may be aware of her frustration level, she may be unaware of her physiological reactions due to the fight-or-flight response. Removal of the vagal brake during times of distress activates the sympathetic nervous system (Porges, 2009). In order to preserve energy for survival, Jane's body immediately turns off any functions not essential to escape from danger, including reproduction, tissue repair, digestion, and immune functioning (Porges, 2009; Sapolsky, 2004). Respiration rate increases and breathing becomes quick and shallow, allowing the lungs to pump more oxygen into the bloodstream. Heart rate also increases, decreasing the beat-to-beat intervals and enabling the heart to pump the oxygen-rich blood at a faster rate throughout the body (Marieb, 2004; Sapolsky, 2004). The blood is concentrated to the muscles, allowing Jane to physically escape from danger more efficiently. Blood pressure increases as the peripheral blood vessels constrict, enabling efficient delivery of energy throughout the body and allowing the blood to pool in her core to protect vital organs. This stress response increases Jane's core temperature and decreases temperature in her hands and feet. In addition, to cool off and rid the body of toxins, sweat production increases. These physiological responses of the sympathetic nervous system occur within one second of experiencing stress (Sapolsky, 2004) and allow Jane to make a quick getaway from danger or put up a fight.

Seconds after activation of the sympathetic nervous system, the parasympathetic nervous system should respond reapplying the body's vagal brake to restore and assist Jane in returning to normal states of functioning (Porges, 2009). Humans, however, have

a tendency to develop rigidity within both the fight-or-flight and the braking system responses (Porges, 2009; Sapolsky, 2004). Unlike a zebra that may be able to easily switch off a fight-or-flight response once out of immediate danger, humans often misinterpret and continue to respond physiologically to certain stressor as if immediate danger exists and their life depends on escaping harm (Porges, 2009; Sapolsky, 2004). The stress response required to escape from danger is not necessary for stressors such as Jane's.

In addition to the physiological reactions to stress, an individual's perception is included in the stress response (Leaf, 2007; Sapolsky, 2004). Personalizing a situation may create a misperception of the event, leading to feelings of fear, anxiety, depression, and anger (Leaf, 2007; Sapolsky, 2004). Individuals may become aware of heightened physiological changes and convince themselves danger must truly be present. This false perception of present danger along with the emotional reaction to the situation will often perpetuate and intensify physiological reactions in both the brain and the body. In turn, these physiological reactions exacerbate misperceptions, reinforcing the belief that danger is present, creating a dysfunctional feedback loop (Leaf, 2007; Sapolsky, 2004). In other words, Jane's perception of her situation strengthens a feedback loop toxic to her health as she reacts to her situation with a heightened stress response that exceeds the amount of energy needed given her stressors.

Unaware and incapable of intentionally changing these thoughts and the concomitant biological reactions, the feedback loop strengthens, creating a dysfunctional pattern of thinking and behaving. Living in such chaos, one may struggle to accurately process any irrational thoughts they may be experiencing (Corey, 2013; Leaf, 2007). For

Jane, this may be the inability to rationally process through her given situation, knowing that she is doing the best she is able and being tardy to work is not a matter of life or death. Frequent irrational ways of thinking and dysfunctional behaving can become a pattern which may create a new normal, albeit unhealthy, homeostatic state for the individual (Corey, 2013; Leaf, 2007). When the stress response is greater than the stressor itself, the individual remains in an activated state of fight-or-flight; therefore, a continuous physiological reaction and brain bath of stress hormones creates an imbalance in the CAN, contributing to poor mental health conditions and causing damaging physical effects on the individual (Sapolsky, 2004). Jane's way of thinking and perception of her current situation may result in stress related conditions that affect her mental, emotional, and physical wellbeing.

Many mental health issues have been related to an imbalance in the CAN (Lambert & Cattani-Thompson, 1996; Makinson & Young, 2012; Myers & Young, 2012). To work efficiently, the vagal brake of the ANS must be intact, allowing the ANS flexibility and adaptability for both the sympathetic and parasympathetic nervous system to work together. Rigidity and decreased adaptability within the ANS occurs when maladaptive patterns are reinforced (Sapolsky, 2004) further effecting the individual's overall wellbeing (Du et al., 2009; Sapolsky, 2004).

Even with the above understanding of the connection of physiology, stress, emotion, thought, and behavior, many people may be unaware of how damaging experiencing chronic stress may be to their whole person. Therefore, mental health professionals, specifically counselors, should incorporate a physiological lens to accurately determine the internal states of clients. Furthermore, counseling approaches

should focus on techniques, training, and interventions that help individuals to learn appropriate skills to better manage physiological and psychological responses to stress, thereby improving upon the physiological states and decreasing symptomology of mental health conditions (Larson et al., 2010; Makinson & Young, 2012; Myers & Young, 2012), and perhaps increasing compliance with counseling.

Biofeedback and Counseling

As discussed above, physiological imbalances contribute to and perpetuate mental health conditions. Often individuals seek counseling during times of distress (Corey, 2013). Counselors implement various techniques to assist clients with changing these biological attributes (Hauser & Hays, 2010; Lambert & Cattani-Thompson, 1996; Makinson & Young, 2012). Common mental health counseling approaches include relaxation training to slow breathing promoting decrease in symptomology and cognitive behavioral therapy (CBT) to dispute and reconstruct faulty thinking, maladaptive coping techniques, and disruptive ways of functioning (Corey, 2013). These interventions employed by counselors have a positive impact on the CAN, promoting healthy changes to occur both in brain activity and physiological responses; thereby, improving these clients' mental and emotional health, and psychosocial well-being (Maguschak & Ressler, 2008; Myers & Young, 2012; Quirk & Mueller, 2008). Despite the chosen intervention, a strong working alliance must exist between the counselor and the client for counseling to be effective (Al-Darmaki & Kivlighan, 1993; Bordin, 1979; Corey, 2013; Leibert, Smith, & Agaskar, 2011). In addition, the process of counseling must be somewhat appealing to clients in order for clients to be receptive to and complete the

process (Corey, 2013; Horvath & Greenberg, 1989; Masdonati, Massoudi, & Rossier, 2009; Tetzlaff et al., 2005).

The Working Alliance

The working alliance is defined as the therapeutic relationship that exists between the counselor and the client. This relationship provides the means necessary for engagement in the process of therapy essentially to promote beneficial change within the client (Bordin, 1979; Corey, 2013). The working alliance requires the following from both the counselor and the client: 1) mutual trust in each other, 2) mutual agreement of the current issue, and 3) mutual perspective of an approach to resolve the presenting problem (Al-Darmaki & Kivlighan, 1993; Bordin, 1979). These key factors of the working alliance coincide with personal characteristics commonly expected of the counselor and the client (Al-Darmaki & Kivlighan, 1993; Bordin, 1979).

The nature of counseling involves an intimate learning process which requires an environment where clients feel safe enough to explore personal conflicts (Corey, 2013). Therefore, counselors often have personal qualities to facilitate an emotionally safe working alliance. Such characteristics may include the following: 1) congruence or genuineness; as the counselor's internal thoughts and feelings match their expressed behaviors toward the client, 2) unconditional positive regard; accepting the client for who they are, and 3) empathy; being able to compassionately understand the client's view point (Corey, 2013). Counselors need to have confidence in their clients, believing they have the ability to change and the means necessary to uphold their responsibilities during the therapeutic process (Al-Darmaki & Kivlighan, 1993; Bordin, 1979). A counselor who cultivates hope and creates a safe space conducive for catharsis to occur ultimately

enables clients to engage in risks necessary for change (Sloan, Staples, Cristol, Yorkston, & Whipple, 1975). As a result, clients begin to feel acceptance and become less defensive, which continues to facilitate the development of a healthy therapeutic relationship. A strong working alliance is the grounds necessary to instill realistic yet hopeful expectations, further enabling clients to engage in the process of self-exploration (Corey, 2013; Costa & McCrae, 1992; Kakhnovets, 2011; Raue, Goldried, & Barkham, 1997; Sloan et al., 1975).

To assess the therapeutic relationship, counselors have often utilized the Working Alliance Inventory (WAI) (Al-Darmaki & Kivlighan, 1993; Bordin, 1979). Based on Bordin's theory of a working alliance, The WAI is the most widely used assessment to determine the strength of a therapeutic relationship (Horvath & Greenberg, 1989). Both the counselor and the client assess the main components of the therapeutic relationship ranking items on a Likert scale from never to always (Horvath & Greenberg, 1989). A meta-analysis conducted on the WAI revealed a relationship between the working alliance and outcomes in psychotherapy. Researchers found associations exist between the working alliance and outcomes of therapy (Hatcher & Gillaspy, 2006; Horvath & Symonds, 1991). Researchers also identified a correlation between the expectations both the client and counselor had for the relationship and the working alliance (Al-Darmaki & Kivlighan, 1993). In addition, at times when clients identified having low social support, the working alliance became a more important piece in predicting positive results of therapy (Leibert et al., 2011).

The WAI has been used to research the effectiveness of several counseling programs. For instance, researchers implemented the WAI to compare the effectiveness

of psychodaynamic-interpersonal therapy with CBT. Split into two groups, 57 clients diagnosed with major depression engaged in 16 therapy sessions. Results indicated a greater alliance existed in CBT sessions. Within the group of clients that engaged in CBT, results indicated a stronger working alliance positively correlated with the therapists' ratings of the depth and smoothness of the session. Researchers also found a strong correlation between the working alliance and the clients' mood as rated by the clients (Raue et al., 1997). Connors and associates (1997) found the working alliance to be a predictive factor of client participation, amount of days abstinent from drinking, and drinks consumed per drinking day, for clients who were enrolled in an alcoholic outpatient treatment program. Researchers also utilized the WAI to determine if a therapeutic relationship may be facilitated when counseling is conducted by means of the internet. Compared to traditional face to face counseling, results of the WAI indicated no significant differences in the therapeutic relationship, suggesting a strong working alliance may be constructed when counseling is conducted online (Cooke & Doyle, 2002). In addition to psychotherapy and rehabilitation counseling, the working alliance plays an important role in career counseling. Assessing the working alliance helps researchers to better understand the satisfaction with career counseling interventions (Masdonati et al., 2009).

The working alliance may be seen as a predictive factor for therapeutic outcomes and accounts for approximately 30% of the change made within the counseling process (Baldwin, Wampold, & Imel, 2007). A positive perspective of the working alliance correlates with positive outcomes of the therapeutic process (Castonguay, Constantino, &

Grosse Holtforth, 2006). Therefore, assessing the therapeutic relationship enhances and may even be seen as a predicting factor for treatment satisfaction (Baldwin et al., 2007).

Treatment Satisfaction

Having confidence in the counselor and feeling treatment received was effective further influences positive therapeutic outcomes (Corey, 2013). Treatment satisfaction is considered in the field of counseling as an outcome to measure quality of care provided. Clients are satisfied with treatment when they feel their wishes and desires have been met through the services they received and the program fulfills their expectations. Rating satisfaction of services includes being pleased with additional variables such as location, cost, and convenience of the services provided (Tetzlaff et al., 2005). Feedback from clients may be utilized to further evaluate the program, identifying areas of improvement and assisting in future program planning. In addition, treatment satisfaction may be an indicator of client behaviors. When clients are satisfied with the treatment received they will typically utilize skills obtained in real life settings that take place outside of therapy (Davis & Hobbs, 1989). To assess treatment satisfaction, researchers have often used the Treatment Satisfaction Index (Tetzlaff et al., 2005).

The Treatment Satisfaction Index (TxSI) considers not only the working alliance but also the client's satisfaction with their overall counseling experience (Tetzlaff et al., 2005). The TxSI was developed as a standalone portion of the Global Appraisal of Individual Needs (GAIN-M90) to measure client participation engagement and satisfaction of a treatment (Dennis, Chan, & Funk, 2006). This self-administered assessment allows clients to identify how they felt about the treatment process, assessing how effective they found the services to be to meet their wants, wishes, and desires

(Dennis et al., 2006; Tetzlaff et al., 2005). Counselors are encouraged to utilize the TxSI to improve services provided (Tetzlaff et al., 2005).

The TxSI has been administered in various studies as a variable of counseling program quality. A longitudinal study utilized the TxSI to determine if a relationship existed between predictability of substance use and satisfaction with the treatment. While results indicated there was not a strong correlation between these two variables, valuable information regarding how to improve upon services was provided through use of the TxSI (Tetzlaff et al., 2005). The TxSI has also been utilized to determine the quality of an outpatient substance abuse treatment implementing Motivational Enhancement Therapy in conjunction with CBT for adolescents. In this study, 275 participants rated their satisfaction with the treatment twice during the five session program; once after the second session and again after the fifth. Results indicated high levels of satisfaction with the treatment program (Brown, 2007).

Treatment satisfaction is often measured to view the clients' perceptions of services provided and determine practice improvements (Brown, 2007; Dennis et al., 2006; Glombiewski, Hartwich-Tersek, & Rief, 2010; Tetzlaff et al., 2005). For example, Glombiewski and associates (2010) assessed the satisfaction of treatment to determine pretreatment factors associated with dropout rates from outpatient services that utilized CBT to help alleviate symptoms of chronic back pain. Treatment satisfaction was assessed after the third CBT session. Of the 128 patients that enrolled in the treatment program consisting of 25 individualized sessions, 23 patients were categorized as dropouts due to their low satisfaction with treatment in addition to reporting low

psychological distress and low medication consumption. Results suggested tailoring CBT treatment for individuals experiencing less psychological distress to avoid high dropout rates (Glombiewski et al., 2010).

Both the WAI and the TxSI are often implemented into counseling to identify components of treatment which clients perceive as particularly effective (Leibert, 2006; Seligman, 1995). While utilizing these self-administered checklists may offer helpful information, relying solely on this subjective data to evaluate the effectiveness of treatment may be lacking. In addition, while a good portion of counseling effectiveness relies on the therapeutic relationship, bonding solely through personality attributes as a means to establish a sense of mutual trust and acceptance is limiting. In contrast to counseling alone, biofeedback measurements offers a third source of information which could enrich the counseling experience, particularly cleints' perception of the working alliance and treatment satisfaction (Carmichael, 2009; Larson et al., 2010; Myers & Young, 2012; Thompson & Thompson, 1998; Romano, 1982).

Evaluating the Implementation of the Integrated Training Protocol by Rating the Working Alliance

Implementing a training protocol integrating biofeedback and neurofeedback may enrich the counseling experience. Biofeedback measurements provide an internal microscope enabling both the client and the counselor to view imbalances of the CAN that are associated with mental health conditions (Carmichael, 2009; Danskin & Walters, 1973; Hammond, 2007; Henschem, 1976; Myers & Young, 2012; Thompson & Thompson, 1998; Romano, 1982; Schwartz & Schwartz, 2003). Clients are often

unaware of the physiological imbalances that contribute to mental health problems (Makinson & Young, 2012). In the example of Jane (above), experiencing irrational thoughts triggered a physiological response which resulted in Jane feeling anxious. While Jane was aware of feeling anxious, she may have been oblivious to the internal changes occurring in her body. Talk therapy alone does not inform the client of what is occurring in their brain or provide a physiological representation of what is happening in their body during times of distress. Incorporating biofeedback measurements into counseling helps clients witness how distorted thought patterns may either result from or cause abnormal firing in the brain, leading to overactive physiological responses in the body; just as an overactive ANS will result in misfiring in the brain (Arena & Schwartz, 2003; Danskin & Walters, 1973; Henschem, 1976; Larson et al., 2010; Myers & Young, 2010; Romano, 1982; Watral, 1984). This information may enrich the process of counseling. Therefore, the physiological lens provided by biofeedback measurements may be beneficial to the process of counseling (Frank, Khorshid, Kiffer, Moravec, & McKee, 2010; Kemper, 2010; Leibert, 2006; Myers & Young, 2012; Russell-Chapin & Chapin, 2011) particularly with process variables such as the working alliance and treatment satisfaction.

During the initial stages of a biofeedback-training program, the counselor educates the clients on interactions between physiological responses to stress and biofeedback principles and procedures (Fritz & Fehmi, 1982; Taub & Emurian, 1981; Watral, 1984). To do so effectively, the counselor must possess the following abilities: 1) knowledge of psychophysiological concepts as they relate to mental health conditions, 2) competence in a skillset to utilize the biofeedback equipment and understand the

recordings, 3) ability to explain the equipment and the biofeedback output in relation to physiological responses to stress, and 4) ability to use the biofeedback output to help coach clients in training these internal states (BCIA, 2013; Fritz & Fehmi, 1982; Taub & Emurian, 1981; Watral, 1984). Being proficient in these skills and demonstrating this competence may increase clients' trust in the therapist (Fritz & Fehmi, 1982), a key component of the working alliance.

Viewing clients' internal physiological data in real time may create an augmented learning environment and validate emotions clients experience while assisting them in making sense of symptomology (Arena & Schwartz, 2003; Danskin & Walters, 1973; Eisenberg, Ben-Daniel, Mei-Tal, & Wertman, 2004; Gruzelier & Egner, 2005; Hammond, 2007; Larson et al., 2010; Myers & Young, 2010; Nugent, Bain, Thayer, Sollers, & Drevets, 2011; Sherlin, Muench, & Wyckoff, 2010; Sutarto, Wahab, & Zin, 2010; Yu, Zhang, Xie, Wand, & Zhang, 2009). With the use of the biofeedback output, the counselor and the client can view the physiological basis of the presenting issue (Frank et al., 2010; Kemper, 2010; Leibert, 2006; Myers & Young, 2012; Russell-Chapin & Chapin, 2011) and therefore mutually agree on the origin of the presenting issue, another key component of the working alliance (Davis & Hobbs, 1989; Horvath & Greenberg, 1989). In addition, explaining symptomology in terms of physiological imbalances may be less threatening when compared to suggesting symptomology results from a psychological disorder (Porges, 2009). Moreover, utilizing the biofeedback output and seeing the internal states a client may be experiencing may allow the counselor to empathize more with the client (Davis & Hobbs, 1989; Horvath & Greenberg, 1989). Due to the increased empathy, the client may feel more accepted by the counselor, which in

turn may enable the client to accept themselves (Corey, 2013) and further increase the client's trust in the counselor, an attribute required for a strong working alliance (Davis & Hobbs, 1989). As no two individuals are alike, utilizing the biofeedback output as a way to accurately identify internal states enables the counselor to meet the client where they are, designing a treatment protocol based on the needs of the individual (Arena & Schwartz, 2003), as opposed to relying on a checklist provided by a diagnostic manual (Makinson & Young, 2012). This tactic may continue to enhance the client's trust in the counselor. Working together, the counselor and the client may agree upon methods of treatment, yet another component of the working alliance (Davis & Hobbs, 1989; Horvath & Greenberg, 1989), by developing a protocol based on the needs of the client identified through the biofeedback output.

Being able to visibly review changes in clients' physiology through the biofeedback output provides an opportunity for both the counselor and the client to continue to agree on the clients' current internal state and further decide if a change in the counseling techniques needs to be made (Crockett & Bilsker, 1984; Danskin & Walters, 1973; Henschem, 1976; Romano, 1982). Counselors solely implementing counseling interventions lack the ability to provide a visual representation of the internal physiological changes clients may experience when engaging in counseling techniques. It is imperative for counselors to be aware of the physiological changes in order to implement counseling techniques appropriate for each individual client (Makinson & Young, 2012). Using the biofeedback output as a guide, the counselor may adjust the interventions accordingly (Crockett & Bilsker, 1984; Danskin & Walters, 1973;

Henschem, 1976; Romano, 1982), which may enrich the counseling experience by enhancing the client's confidence in the counselor, an attribute of the working alliance.

Biofeedback training involves the direct manipulation of one's physiology. When compared to CBT and other counseling techniques, biofeedback is considered to be a more active approach to treatment as talk therapy does not involve the participation of directly manipulating physiological responses (Carmichael, 2009; Frank et al., 2010). Biofeedback training screens typically represent clients' physiology graphically, and through principles of operant conditioning, training efforts are reinforced through the use of an animation (Frank et al., 2010; Kemper, 2010; Leibert, 2006; Myers & Young, 2012; Russell-Chapin & Chapin, 2011). Thereby manipulating one's physiology will result in changes in the animation. For instance, increased skin conductivity is indicative of a stress response. When viewing this output on the screen, the amount of skin conductivity may be represented by a bar graph, digital data, and an animation such as a roller coaster ride. The goal of training then would be to decrease skin conductivity (Peek, 2003) and as a reward the roller coaster would move along its tracks. Constantly viewing physiological states in real time may enhance clients' trust in both the counselor and the process. Therefore, the client receives feedback from both the counselor's verbal praise in addition to seeing the internal changes presented by the biofeedback output. Viewing the physiological changes in real time validates the clients' experiences, and their training efforts, which may reinforce trust in the counselor's knowledge and coaching abilities. Furthermore, as clients gain control over responses they may have previously considered uncontrollable, (Frank et al., 2010; Fritz & Fehmi, 1982; Kemper, 2010; Leibert, 2006; Myers & Young, 2012; Russell-Chapin & Chapin, 2011; Taub & Emurian, 1981; Watral,

1984), they find it easier to address and cope with any emotional distress they may be experiencing. As clients gain more control of their physical and psychological reactions to stress, they experience an increase of self-worth and an improved sense of self-confidence (Carmichael, 2009; Henschem, 1976; Othmer & Othmer, 2009; Romano, 1976; Schwartz & Schwartz, 2003; Watral, 1976; Wilson, 2009). Clients appreciate this training approach, which reinforces the mutual agreement regarding the approach to treatment, an attribute of a strong working alliance. Clients also report they enjoy the internal microscope which biofeedback measurements provide, in addition to the many other attributes biofeedback training offers (Carmichael, 2009; Danskin & Walters, 1973; Hammond, 2007; Henschem, 1976; Myers & Young, 2012; Othmer & Othmer, 2009; Thompson & Thompson, 1998; Romano, 1982), which may increase their satisfaction of treatment.

Evaluating the Implementation of the Integrated Training Protocol by Rating Treatment Satisfaction

In addition to the multiple benefits of incorporating biofeedback measurements and training into counseling previously mentioned, there are multiple reasons clients find biofeedback applications appealing, all which may increase clients' overall satisfaction of treatment (Carmichael, 2009; Danskin & Walters, 1973; Hammond, 2007; Henschem, 1976; Myers & Young, 2012; Thompson & Thompson, 1998; Romano, 1982; Othmer & Othmer, 2009). First, biofeedback training is an unobtrusive approach to treatment. The sensors used are non-invasive and attach to clients' skin to only record electrical activity as opposed to producing it. Therefore, few side effects of biofeedback have been reported making it an attractive form of healthcare (Danskin & Walters, 1973; Frank et al., 2010;

Henschem, 1976; Larson et al., 2010; Myers & Young, 2012; Othmer & Othmer, 2009; Romano, 1982; Watral, 1976). For instance, since biofeedback training has been shown to help individuals decrease physiological arousal, training results may change clients' cortisol levels, which in turn will affect blood sugar levels. Clients diagnosed with diabetes are advised to monitor levels of blood sugar while engaging in a biofeedback training protocol (McGrady & Bailey, 2003). Some clients have also reported experiencing headaches after engaging in neurofeedback training, but reports indicate these headaches typically only last for a short duration immediately after training (Hammond, 2007; Myers & Young, 2012; Othmer & Othmer, 2009). With little side-effects, clients find this method of treatment appealing. Therefore, implementing biofeedback training into counseling may further improve treatment satisfaction. Second, through use of the biofeedback output, counselors are able to better attend to the immediate concerns of the client by viewing the biological basis of the stress related condition (Henschem, 1976), providing an accelerated pace to successful outcomes (Henschem, 1976; Larson et al., 2010). With the ability to control physiology, clients often gain a new perspective and no longer find the same situations stressful. There is little need to continue biofeedback training when clients report they are able to successfully generalize their new found skills to everyday situations. Therefore, a high frequency of sessions is not typically required. Functioning individuals may experience positive results from biofeedback training within the first five to eight sessions (Vernon et al., 2003) and symptom reduction may be seen within as little as six to twelve sessions (Frank et al., 2010). In addition, approximately 80-90% of clients successfully experience a decrease in symptomology due to biofeedback and neurofeedback training (Evans &

Rubi, 2009; Gunkelman & Johnstone, 2005; Larson et al., 2010; Lubar, 1991; Myers & Young 2012; Thatcher & Lubar, 2009). Third, with these lifelong skills to better manage symptomology, clients also find less need for medication (Barowsky, Moskowitz, & Zweig, 1990; Cannici, Malcolm, & Peek, 1983; Carmichael, 2009; Crockett & Bilsker, 1984; Henschem, 1976; McGrady & Linden, 2003; Schwartz & Sedlacek, 2003).

Incorporating biofeedback measurements and training into counseling may enrich the counseling experience, particularly when considering process variables including the working alliance and treatment satisfaction. In addition, applications of biofeedback may also improve the quality of counseling. Specifically this quality improvement may be accomplished through capturing the physiological changes that occur as a direct result of the intervention. Biofeedback measurements capture these changes (Danskin & Walters, 1973; Frank et al., 2010; Henschem, 1976; Larson et al., 2010; Myers & Young, 2012; Othmer & Othmer, 2009; Romano, 1982; Watral, 1976). In addition, applications of biofeedback have already been deemed an efficacious form of treatment for mental health conditions (Carmichael, 2009; Danskin & Walters, 1973; Hammond, 2007; Henshem, 1976; Kemper, 2010; Moss & Gunkelman, 2002; Myers & Young, 2012; Othmer & Othmer, 2009; Romano, 1982; Thompson & Thompson, 1998; Wilson, 2009).

The Efficaciousness of Biofeedback

Establishing the efficaciousness of biofeedback has been a complex process. Although biofeedback first gained popularity in the United States in the 1960's (Schwartz & Olson, 2003), individuals who did not understand the technique were skeptical of the efficaciousness and effectiveness (Kater & Spires, 1975; Kimmel, 1981). Some therapists, unfamiliar with the techniques, found it difficult to understand the implications

and accept the fact that individuals were capable of gaining the ability to self-regulate, controlling physiological responses to stress, and decreasing symptoms of mental health conditions (Danskin & Walters, 1973; Kater & Spires, 1975; Kimmel, 1981). At this time, professionals did not have what has been referred to as biomedical technology, or modern technology, which make it possible to monitor the internal physiological processes or what is now considered an efficient knowledge of the human body (Peek, 2003). This lack of understanding caused uncertainty in biofeedback training as a therapeutic modality. The biofeedback academic community was encouraged to provide information explaining the processes of biofeedback training (Kimmel, 1981) in order to ensure that it is not a technique associated with religiosity connotations or mind control (Kater & Spires, 1975). More research regarding biofeedback training as a treatment modality for psychosomatic and mental health disorders was also requested (Blanchard & Young, 1974). As a result, biofeedback-training protocols were developed specifically for certain mental health conditions. Each protocol was researched to establish validity in the training procedures and followed guidelines set forth by the Task Force of the Association for Applied Psychophysiology and Biofeedback and the Society for Neuronal Regulation (Moss & Gunkelman, 2002). Five levels (5 strong) of biofeedback training efficacy are defined as the following:

Level 1) not empirically supported as it has only been supported by subjective reports,

Level 2) possibly efficacious that includes at least one study but lacks randomization,

Level 3) probably efficacious with multiple observational, clinical, wait list, and within subjects designed research studies,

Level 4) efficacious including control groups, determining a population treated for a specific problem, containing specific outcome measures and appropriate data analysis, clearly defined diagnosable procedures, all in at least two independent research studies, and

Level 5) efficacious and specific that is statistically significant (Moss & Gunkelman, 2002).

Research indicates biofeedback training to be efficacious for alleviating symptoms of mental health conditions (Carmichael, 2009; Kemper, 2010; Othmer & Othmer, 2009; Wilson, 2009), improving cognitive functioning, learning disabilities, and peak performance (Hammond, 2007; Myers & Young, 2012; Thompson & Thompson, 1998), enhancing self-worth and self-concept, and increasing autonomy (Danskin & Walters, 1973; Henshem, 1976; Romano, 1982). Utilizing biofeedback training to help individuals gain control over physiology due to anxiety, such as the participants in this study, rates a level 4 on this efficacy scale (Moss & Gunkleman, 2002). Although there have been skeptics of its efficacy, the client's ability to control physiological responses that were once considered uncontrollable and automatic, are immediately displayed on the computer screen (Danskin & Walters, 1973; Kemper, 2010). Most practitioners will capture physiological baselines prior to implementing biofeedback training. After engaging in a training protocol, clinicians will again measure physiological baselines. A comparison of the changes in physiology will be made to determine if training was efficacious. Therefore, there is efficacy in implementing biofeedback training into

counseling in addition to the effectiveness biofeedback measurements provide. However, while training protocols exist, there is a need for a training protocol that targets the CAN and has the ability to be implemented flexibly to meet the needs of the client.

Biofeedback Measurements

Biofeedback training protocols have been established to guide the training process, and typically will target either the ANS or the CNS. Targeting the ANS enables clients to gain control over the physiological responses they experience. These training protocols incorporate specific biofeedback measurements that have been deemed efficacious to alleviate symptoms of certain conditions (Frank et al., 2010; Hammond, 2007; Johnston, Boehm, Healy, Goebel, & Linden, 2010; Rice, 2007; Othmer & Othmer, 2009; Raymond, Varney, Parkinson, & Gruzelier, 2005; Russell-Chapin & Chapin, 2011; Sherlin et al., 2010). Targeting the CNS enables clients to gain control over the neurological responses they experience. This training approach is known as neurofeedback and may be seen as a modality of biofeedback.

Biofeedback training protocols identify specific biofeedback measurements that calculate and monitor certain physiological responses. Similar to measuring temperature with a thermometer, non-invasive sensors are attached to the client on specific areas on the client's body with specific mediums - including paper tape, Velcro, and conductance paste - to record the client's physiological data. These sensors are connected to a biofeedback device that computes the recorded data. The biofeedback device is connected to a computer where the output provides a visual and audio display for clients and the therapist, allowing clients to increase their awareness of their physiological reactions (Henschem, 1976).

The therapist uses multiple indicators to measure a physiological stress response. An activated ANS may be determined through the measurement of common physiological responses including 1) increased heart rate with decreased variance between each heartbeat, 2) vasoconstriction of blood vessels in the extremities that causes a cooling effect in the hands and feet and enables the blood to pool in the core and protect vital organs, and 3) increased skin conductivity as the body excretes toxins to metabolize at a quickened pace (Marieb, 2004).

While there are typical physiological responses to stress that occur within the body, each individual client may respond differently, displaying a range of physiological reactions. For instance, one individual may have a heightened response resulting in skin conductivity while another may show more reaction to skin temperature. Therefore, the biofeedback therapist must accurately collect baseline measurements on all the appropriate physiological reactions and then monitor the clients' responses in order to modify and tailor biofeedback training protocols accordingly. Incorporating many different biofeedback measurements helps therapists achieve an accurate picture of an individual's reaction to stress. Allowing clients to engage in a training protocol that includes a variety of modalities also enables clients to understand their condition while gaining self-control. To obtain physiological data, the current study utilizes biofeedback measurements including 1) HRV, 2) skin temperature, 3) skin conductance, and 4) neurofeedback. The following section explains each of these biofeedback measurements in relation to stress.

Heart Rate Variability. HRV monitoring captures internal changes of the ANS, reflecting both sympathetic and parasympathetic nervous system activity that is obtained

by recording and calculating the inter-beat intervals within the client's heart rate (European Society of Cardiology, [ESC, 1996); Gevirtz & Lehrer, 2003; Gevirtz, & Dalenberg, 2008; Wheat & Larkin, 2010; Zucker, Samuelson, Muench, Greenberg & Gevirtz, 2009). Heart beat is defined as how much contraction of the heart muscles is used to move blood through the body. Heart rate, which calculates the amount of heart beats per interval of time, changes with each heartbeat, in a consistent and coherent manner, pulsating the blood through the body efficiently. Heart rate variability is the difference, or the change, in the beat to beat intervals. Heart rate is controlled by the two branches of the ANS; the sympathetic nervous system and the parasympathetic nervous system (Gevirtz & Lehrer, 2003). During inhalation, heart rate increases, indicating sympathetic nervous system activity. During exhalation, heart rate decreases, indicating parasympathetic nervous system activity. HRV is relative to age and gender. Researchers have discovered younger individuals have higher HRV and distinct differences in HRV exist between men and women (Umetani, Singer, McCraty, & Atkinso, 1998; Yukishita et al., 2010). Biofeedback therapists incorporate HRV training into counseling to help clients decrease over-arousal of the ANS and induce a state of balance between the two branches of the ANS (ESC, 1996; Gervitz & Dalenberg, 2008; Gervitz & Lehrer, 2003; Wheat & Larkin, 2010; Zucker et al., 2009).

HRV biofeedback measurements display the functioning of the ANS in real time quantified in terms of both a time and frequency domain (ESC, 1996; Gervitz & Dalenberg, 2008; Gervitz & Lehrer, 2003; Wheat & Larkin, 2010; Zucker, et al., 2009). In the time domain, information displayed quantifies heart beats per minute and variation in heart rate. When in a fight or flight state, fast, shallow breaths will increase the heart

rate and decrease the variation. Plotted on a time domain consisting of time on the x-axis and heart rate on the y-axis, the heart rate of a client in a state of over-arousal will look scattered and chaotic. Researchers may consider the intervals between what are known as successive normal complexes of a heartbeat. Successive normal complexes are defined as the QRS complex, which represents one full heart beat and is recorded during an electrocardiograph. Within the time domain of the HRV measurement, researchers may look at the time intervals between each QRS complex within a certain time frame to determine overall cardiac functioning (ESC, 1996). When functioning with the ANS in a balanced state, heart rate should automatically increase during inhalation and decrease during exhalation. In addition, there should be variation or fluctuation among heart rate, at a coherent degree (Gervitz & Dalenberg, 2008; Gervitz & Lehrer, 2003; Wheat & Larkin, 2010; Zucker et al., 2009)

The frequency domain of HRV measure quantifies the variation, or fluctuation of the heart rate that occurs during each heartbeat (ESC, 1996; Gervitz & Dalenberg, 2008; Gervitz & Lehrer, 2003; Wheat & Larkin, 2010). On a spectral analysis, four frequencies are measured in hertz (HZ), or cycles per second, and are plotted as either Ultra low frequency (ULF), Very low frequency (VLF), Low Frequency (LF), or High Frequency (HF) rhythms. ULF rhythms are produced between .0001 and .003 Hz. VLF rhythms are produced between .003 to .08 Hz and are regulated by the sympathetic nervous system. HF rhythms are produced between .15 and .4 Hz and are mediated by respiration and regulated by the parasympathetic nervous system activation. LF rhythms are produced between .08 and .14 Hz and are a combination of both VLF and HF oscillations and are indicative of a relative balance in the autonomic nervous system (Gevirtz & Lehrer,

2003). As a client's heart begins to fire rapidly during a heightened state of physiological arousal, there is little or no rhythmic coherence within the inter-beat intervals of the heart rate (Bernston, Cacioppo, Quigley, & Fabro, 1994; Gevirtz & Lehrer, 2003; Gevirtz, & Dalenberg, 2008; Zucker et al., 2009). Functioning in this manner creates a maladaptive pattern within the ANS, leading to an imbalance and resulting in physical and psychological issues (Gervitz & Lehrer, 2003; Porges, 2009; Wheat & Larkin, 2010; Zucker et al., 2009). In this current study, clients will focus on achieving an increase in their HRV as measured by regulatory power. Regulatory power, or total power of variance, is based on a power analysis which measures the sympathetic and vagal regulation of heart rate (ESC, 1996).

By displaying the HRV output, clients are able to view the oscillation between the sympathetic and the parasympathetic nervous systems in real time (Gervitz & Dalenberg, 2008; Gervitz & Lehrer, 2003; Wheat & Larkin, 2010). The biofeedback therapist teaches individuals to gain control of and manipulate these parameters. HRV biofeedback training incorporates diaphragmatic breathing to increase parasympathetic involvement which will in turn decrease heart rate and increase variability between each heartbeat. As a result, the client may achieve what is known as cardiorespiratory coherence, or appropriate fluctuation in heart rate (Tiller, McCraty, & Atkinson, 1996). Cardiac coherence produces Respiratory Sinus Arrhythmia (RSA) which is defined as synchronicity between respiration and heart rate. RSA allows the individual to achieve vagal tone, thus creating a balance within the ANS (Gevirtz & Lehrer, 2003). Incorporating HRV training into counseling allows clients to visually witness the internal

changes within their ANS when in compliance with therapeutic interventions led by the therapist (Gervitz & Dalenberg, 2008; Gervitz & Lehrer, 2003; Wheat & Larkin, 2010).

Many mental health and medical conditions have been associated with decreased HRV and low cardiorespiratory coherence including 1) anxiety, 2) depression, 3) anger, 4) asthma, 5) irritable bowel syndrome, 6) chronic pain, and 7) chronic fatigue (Wheat & Larkin, 2010). Very low HRV also leads to life threatening conditions like immune dysfunction, coronary heart diseases, and chronic obstructive pulmonary disorder and increases the risk of a heart attack and stroke. HRV training is efficacious for improving emotional, psychological, and physical well-being by increasing the variability of between each heartbeat and decreasing heart rate. Enhancing HRV by increasing the variability in heart rate while maintaining coherence between each heart beat may improve physical ailments (Sutarto et al., 2010; Wheat & Larkin, 2010), mood, cognition and mental clarity (Gevitz & Dalenberg, 2008; Sherlin et al., 2010; Sutarto et al., 2010) and have lasting effects (Wheat & Larkin, 2010).

Skin Temperature. During a stress response, vasoconstriction occurs in the peripherals, which allows the blood to pool in the core area of the body, but results in cooler temperatures when measured in the hands and feet. Remaining in this state of physiological arousal for extended periods of time has physical implications including 1) high blood pressure (McGrady & Linden, 2003), 2) tension headaches and migraines (Schwartz & Andrasik, 2003), 3) Raynaud's phenomenon (Schwartz & Sedlacek, 2003), and 4) sleep disorders (Danskin & Walters, 1973; Hauri & Esther, 1990). Without treatment, symptoms may worsen and result in life threatening conditions including coronary heart disease and increased risk of experiencing a heart attack and a stroke

(McGrady & Linden, 2003). Skin temperature biofeedback training is often used to help clients gain control over physiological responses to stress and decrease symptomology (Cannici et al., 1983).

Biofeedback therapists instruct clients to induce a state of relaxation, thus increasing vasodilation, or the widening of the blood vessels, which in turn allows the blood to circulate throughout the body and the temperature in the hands and feet to increase (Crockett & Bilsker, 1984). Incorporating skin temperature biofeedback training into counseling allows clients to visually witness their ability to control vasodilation of their blood vessels while feeling a warming sensation occur in their peripherals. This technique is related to HRV training. As individuals increase vasodilation and induce a relaxation response, HRV should typically increase allowing a relative balance to occur in the ANS. Visualizing this new-found control over blood circulation enables trust in one's counselor, which may help to facilitate the working alliance between the counselor and the client and possibly enhance the client's satisfaction with their treatment (Tetzlaff et al., 2005). As clients learn to increase blood circulation throughout their body, they gain the potential to establish healthy sleep patterns (Barowsky et al., 1990; Hauri & Esther, 1990; Cannici et al., 1983), decrease frequency and intensity of vascular headaches (Schwartz & Andrasik, 2003), decrease and manage symptoms of Raynaud's phenomenon (Schwartz & Sedlacek, 2003), and maintain a healthy blood pressure (McGrady & Linden, 2003) without the need for medication (Barowsky et al., 1990; Cannici et al., 1983; Crockett & Bilsker, 1984; McGrady & Linden, 2003; Schwartz & Sedlacek, 2003).

Skin Conductance. During physiological arousal, skin conductivity increases, allowing the body to rid itself of toxins in order to metabolize quicker. Therefore, a high measurement of skin conductance is associated with high levels of arousal and alertness and correlates with sympathetic nervous system activation. In addition, certain thoughts trigger specific physiological reactions that may be measured by skin conductivity. Skin conductance biofeedback training integrated with mindfulness meditation (Wilson, 2009) and behavioral therapies (Carmichael, 2009; Thompson & Thompson, 1998) provides a visual for clients to understand the physiological responses that are a direct result of distorted and maladaptive thought patterns (Franket al., 2010). In addition, skin conductance training relates to neurofeedback as certain thoughts will result in a distinct firing rate in the brain (Thompson & Thompson, 1998). Therefore, skin conductance is a physiological representation of emotional well-being and mental state, as it changes with each thought or feeling (Peek, 2003).

As clients abide by the skin conductance training led by the biofeedback therapist, they are able to visibly witness their new-found control over this physiological reaction. The biofeedback therapist may incorporate skin conductance biofeedback training into protocols to teach individuals how to gain control over emotional and physiological reactions to certain situations and develop skills needed to differentiate between the feelings regarding a situation and the reality of the situation itself. Learning to control skin conductance has been associated with the ability to reduce symptoms of clients' physiological arousal, including hypertension and anxiety (Benson, Shapiro, Tursky, & Schwartz, 1971; McGrady & Linden, 2003; Patel, 1977).

Neurofeedback. While biofeedback targets the ANS, neurofeedback is implemented to target the CNS. Biofeedback therapists train clients to gain control over the physiological processes, thus changing the firing rate of their brain and further decreasing symptomology through neurofeedback training. Through the use of an electroencephalograph (EEG) which measures the electrical activity of the brain, therapists define the dominant brainwaves produced in a certain location of the brain as well as the interaction of brainwave patterns. This information allows the therapist to determine the state of consciousness or mood of an individual (Hill & Castro, 2002). Brainwaves are identified based on the amplitude, frequency, and morphology of the wave when measured in hertz, or cycles per second, produced within a frequency band (Hill & Castro, 2002). Human brainwave activity occurs within a range of approximately 1-40 hertz. This range is further divided into specific brainwaves identified as delta, theta, alpha, Sensory Motor Rhythm (SMR), and beta (Duffy, 2000; Hammond, 2007; Johntson et al, 2010; Othmer & Othmer, 2009; Raymond et al., 2004).

All brainwaves are produced throughout the brain, but some are meant to be more prevalent than others in certain areas. To function efficiently, normal brainwave patterns consist of faster brainwaves, preferably low beta, dominating the frontal cortex of the brain while slower brainwaves are located in the occipital lobe (Hammond, 2007; Thompson & Thompson, 2005). If excessive amounts of brainwaves exist in atypical regions, individuals may experience emotional distress and present with maladaptive behaviors (Hammond, 2007; Johntson et al, 2010; Othmer & Othmer, 2009; Raymond et al., 2004).

The brain has always been a perplexing and complicated organ to understand. The invention of different technological equipment have made it possible for researchers to begin to understand the brain and further localize brain regions in relation to functionality, behaviors, memory, and emotions (Robbins, 2000). The first non-invasive electroencephalograph (EEG) of a living human was recorded by German psychiatrist Hans Bergerin 1924. Berger determined mental functioning was related to the electrical activity of the brain that changes with each mental task. He identified specific EEG patterns and categorized frequencies based on the presented characteristic, labeling the brain wave frequency produced from 8 to 12 hertz as alpha and 13 to 30 hertz as beta. In response, other researchers began to expand on Berger's work, mapping out brain hemispheres and regions, discovering various structures within the brain, and further identifying human functioning as a direct response of the electrical activity produced by certain networks in the brain (Robbins, 2000). This new knowledge allowed the brain to be seen as a complex organ made of integral components that are capable of change (Sterman, 1977).

As technology became more sophisticated, scientists were able to capture and discover additional, minute functions of the brain through the use of non-invasive EEG recordings. Distinguishable brainwave patterns were identified and related to certain emotional, mental, and physical functionality, and the degree of brain development was linked with personality traits and mental capabilities. Scientists could see why any structural impairment in the brain would typically result in some sort of dysfunction (Robbins, 2000). Not only was it possible to record the electrical activity of the brain, but

it also became evident that individuals could manipulate the firing rate of their brain through training utilizing the EEG recordings.

In the 1960s, Barry Sterman, a psychologist and neuroscientist, examined how individuals engaging in brainwave training could produce certain brainwave patterns and, as a result, reduce neurological conditions (Robbins, 2000). This discovery provided an innovative, non-invasive, and non-pharmacological form of treatment for seizures (Robbins, 2000; Sterman, 1977; Wyricka & Sterman, 1968). Joel Lubar expanded on Sterman's research, finding that brain training was also effective in helping individuals reduce the symptoms and associated behaviors of attention deficit disorder (ADD) and attention deficit hyperactive disorder (ADHD). In addition, brain training improved an individual's ability to attend to tasks and focus. Using EEG recordings to train electrical activity of the brain came to be known as neurofeedback (Robbins, 2000).

Specific neurofeedback protocols have been designed to target certain brainwaves in specific brain locations to help clients manipulate the firing of the brain and change behaviors, alleviate symptoms of psychological conditions, and gain increased performance. As numerous neurofeedback protocols exist, this study is based upon Lubar's findings. Lubar found that increasing SMR activity while decreasing theta led to a calming effect and improved the ability to attend to tasks (Lubar & Shouse, 1976; Thatcher & Lubar, 2009). The current study will focus on increasing SMR brainwaves while decreasing theta and high beta brainwaves.

Theta brainwaves are produced between four to eight hertz and are the dominant rhythm of wakefulness found in toddlers, ages one to three, located in the posterior cortex region of their brain. With age, mild amounts of theta brainwaves may be found scattered

throughout the posterior regions (Neumann, Strehl, & Birbaumer, 2003). Theta brainwaves enable creativity and are appropriate while in a meditative state, but should be kept at a minimum in the frontal cortex while engaging in a processing task. Too much theta produced within the frontal regions of the brain will result in grogginess and day-dreaming. In a healthy human being, theta brainwaves produce a relaxed or hypnotic state desirable prior to falling asleep, or may be experienced when aroused from a sleeping state (Hammond, 2007; Hill & Castro, 2003; Neumann et al., 2003; Thatcher & Lubar, 2009).

Beta brainwaves are produced between thirteen to thirty hertz and may be clustered together and identified as either low (13-18 hertz) or high beta (18-30 hertz). Low beta found in the frontal cortex is associated with alertness and concentration and is needed for learning and attending to tasks. An individual producing a healthy amount of low beta in the frontal region of the brain will be able to focus easily and respond quickly. High beta found in the frontal cortex is associated with hyper-alertness, anxiety, pain, irritability, and poor integration. An individual experiencing much high beta in this region may experience panic like symptoms and feel fearful, making learning new material difficult (Hill & Castro, 2002; Thatcher & Lubar, 2009).

Sensory Motor Rhythm falls within the beta bandwidth as it is produced at 12-15 hertz but only when measured along the sensory motor cortex, running directly on top of the head from ear to ear (Neumann et al., 2003). Producing the appropriate amount of SMR may equate to feeling calm but focused, in order for individuals to learn and concentrate without intensity. Training to increase SMR activity through neurofeedback may improve the individual's ability to attend to tasks, sustaining attention for longer

durations of time in both healthy subjects and those diagnosed with learning disabilities and attention deficit disorders (Hammond, 2007; Hill & Castro, 2002; Thatcher & Lubar, 2009; Thompson & Thompson, 2005).

Since its discovery, Lubar's protocol has been replicated and expanded upon. Researchers explored the applications of neurofeedback and have determined neurofeedback training to be efficacious for many different conditions including 1) anxiety, 2) obsessive compulsive disorder (Hill & Castro, 2002), 3) depression, 4) learning disabilities, and 5) attention deficit disorders (Hammond, 2005; Hill & Castro, 2002; Thatcher & Lubar, 2009; Thompson & Thompson, 2005). Participants in the current study will follow a modified version of Lubar's protocol, engaging in training to learn to decrease theta and high beta brainwaves and increase SMR brainwaves. While neurofeedback training may seem complex, it is a safe and non-invasive form of therapy and seen as an alternative to medication (Carmichael, 2009; Thatcher & Lubar, 2009; Walker, 2009; Wilson, 2009).

Certain emotions and behaviors may be explained by viewing brainwave patterns expressed through the use of an EEG. Neurofeedback training helps clients learn to better control brainwave patterns and further gain control over specific emotional networks (Johnston et al., 2010), improving behaviors and learning skills to self-regulate (Duffy, 2000; Hammond, 2007; Lubar, 2003). Clients often report positive changes in mood, an increase of energy, and a decrease of symptoms after engaging in a neurofeedback protocol (Hammond, 2007; Othmer & Othmer, 2009; Peniston & Kulkosky, 1991; Peniston, Marrinan, Deming & Kulkosky, 1993; Raymond et al., 2005; Thatcher & Lubar, 2009; Walker, 2009). Research found training certain brainwave patterns may

reduce symptoms associated with specific psychological illnesses including anxiety disorders (Garrett & Silver, 1976; Rice, Blanchard, and Purcell, 1993), PTSD and panic attacks (Peniston & Kulkosky, 1991). In addition, through use of neurofeedback, individuals may learn skills to better cope with and combat substance abuse disorders (Saxby & Peniston, 2006) and decrease impairments associated with learning disorders (Thatcher & Lubar, 2009; Thompson & Thompson 1998).

Clients appreciate how brainwaves are converted into a visual representation so they are able to better understand and gain techniques over their neurological functioning (Carmichael, 2009; Wilson, 2009). Incorporating neurofeedback training into counseling aids clients to visually witness the internal changes made within their CNS when in compliance with therapeutic interventions led by the therapist. Viewing the changes made within their brain instills trust in the counselor which may help to facilitate the working alliance between the counselor and the client. A strong working alliance has been known to enhance the client's satisfaction with their treatment (Tetzlaff et al., 2005). Neurofeedback training has been deemed an efficacious approach to altering dysfunctional brainwave patterns (Duffy, 2000; Hammond, 2007; Johnston, et al., 2012; Othmer & Othmer, 2009; Peniston et al., 1993; Raymond et al., 2005; Wilson, 2009).

Integrating Biofeedback and Neurofeedback Protocols

Biofeedback protocols are typically designed to target physiological responses of the ANS while neurofeedback protocols target brainwave dysfunctions to help individuals with certain behavioral issues and emotional conditions. Research indicates a correlation between the ANS and electrical activity of the brain (Thayer & Brosschot, 2005). Therefore, training the CNS impacts physiological states and behaviors (Larson et

al., 2010; Russell-Chapin & Chapin, 2012), just as training the ANS system affects neurological states. For example, therapists have utilized neurofeedback to help individuals control physiological responses of anxiety to achieve a state of calmness and further decrease maladaptive behaviors including impulsivity and hyperactivity (Hammond, 2007; Larson et al., 2010). The process is bi-directional as neurological changes results in physiological changes and vice versa (Thayer & Brosschot, 2005). Few studies have demonstrated an integrative approach, implementing both biofeedback measurements and neurofeedback protocols, though research suggests that this would make sense (Budzynski, 1972; Danskin & Walters, 1973; Othmer & Othmer, 2009; Peniston & Kulkosky, 1991; Thompson & Thompson, 1998) as the ANS and the CNS work together to form the CAN (Thayer & Brosschot, 2005).

Researchers began integrating alpha brainwave training with various modalities of biofeedback training in the 1970s. Early studies of neurofeedback focused on training individuals to increase alpha brainwaves, causing a heightened sense of awareness similar to a hypnotic state (Green, Green, & Walters, 1970). Combining alpha brainwave training with EMG biofeedback allowed clients to learn to completely relax their mind and body, as they manipulated the electrical activity in both their brain and their muscles (Green et al., 1970; Henschen, 1976). This combination of biofeedback and neurofeedback training provided access to repressed memories (Green et al., 1970). Individuals reported they found the effects they experienced from the training to be more appealing than the effects received due to the use of drugs. As a result, EMG and alpha brainwave training was proposed as an alternative to using drugs (Budzynski, 1972), enabling participants to tap into their unconscious without the use of medication (Henschen, 1976).

Alpha brainwave training was used in conjunction with skin temperature biofeedback training, deep breathing, and various counseling techniques to help individuals gain control over their symptomology. Training to increase the frequency of alpha waves while engaging in skin temperature and respiration training induced a sense of self-awareness and self-relaxation (Danskin & Walters, 1973). Adding imagery techniques to this training was shown to help improve mood and increase self-confidence (Henschen, 1976). Implementing alpha-theta neurofeedback with skin temperature biofeedback training was also used to help Vietnam Veterans decrease symptoms of hyper-arousal due to PTSD (Peniston & Kulkosky, 1991.) Results from this study also indicated a decrease in comorbidity symptoms of PTSD including substance abuse and depression (Peniston & Kulkosky, 1991). Integrating skin temperature biofeedback training with alpha brainwave neurofeedback has since been utilized to help individuals with alcoholism better control cravings (Saxby & Peniston, 1995) and has been found effective for decreasing severity and intensity of migraine headaches (Stokes & Lappin, 2010). Witnessing the benefits of integrating biofeedback and neurofeedback modalities, therapists continued to explore various combinations of biofeedback and neurofeedback to better help their clients.

Biofeedback measurements and various counseling techniques such as CBT, relaxation training, and mindfulness drills, may be added into training protocols based on the needs of the clients. For instance, Thompson and Thompson (1998) explored the effects of increasing low beta (15-18hz) while decreasing theta (4-7hz) for students with symptoms of ADD. When needed, biofeedback measurements, including skin temperature and skin conductance training, would be integrated into the training protocol,

teaching students to increase their self-awareness and gain the ability to self-regulate in order to change maladaptive behaviors. Mindfulness drills were also implemented to enable students to increase their awareness of their thought process and reconstruct faulty thinking, resulting in improvements in their self-esteem and self-worth (Thompson & Thompson, 1998).

Combining biofeedback and neurofeedback training is implemented as an alternative treatment of various conditions. The simple skill of deep breathing alters the electrical activity of the brain (Sherlin et al., 2010; Yu et al., 2009), improves cognition (Sutarto et al., 2010), and decreases symptoms of ADHD (Eisenberg et al., 2004). Thompson and Thompson (2005) integrated diaphragmatic breathing and EMG biofeedback with neurofeedback to help individuals decrease symptoms of ADHD and anxiety. They found this combination allowed participants to improve their ability to focus and pay attention while feeling less panicky and experiencing less compulsive symptoms (Thompson & Thompson, 2005).

Both the body and the brain concurrently respond to stressors and emotions (Nugent et al., 2011). Implementing neurofeedback training of the CNS has profound effects on one's physiology. Neurofeedback has helped individuals decrease the physiological arousal due to anxiety, and alter maladaptive behaviors including impulsivity and hyperactivity (Hammond, 2007; Larson et al., 2010). Controlling physiological arousal with modalities of biofeedback also has an effect on the CNS. Applications of biofeedback training enhances cognitive functioning and mental clarity, and improves mood (Eisenberg et al., 2004; Nugent et al., 2011; Sherlin et al., 2010; Yu et al., 2009). Therefore, integrating biofeedback and neurofeedback would be substantial

to increase clients' understanding and awareness of their own self and conditions they experience to further gain ultimate control over the mind and body connection (Danskin & Walters, 1973; Myers & Young, 2012). This study will incorporate an integrated approach to training, engaging clients in both biofeedback and neurofeedback applications to further gain an understanding of and control over their physiological and neurological responses to stress.

Summary

There is a physiological basis to mental health conditions (Makinson & Young, 2012; Porges, 2009). Biofeedback measurements are used to calculate internal physiological states, providing a physiological lens for mental health conditions (Carmichael, 2009; Frank et al, 2010; Kemper, 2010; Leibert, 2006; Myers & Young, 2012; Russell-Chapin & Chapin, 2011; Thompson & Thompson, 1998). With the visual representation, the counselor educates clients on their CAN in relation to their condition and teaches skills to gain control over these responses thus enhancing their ability to self-regulate (Frank et al, 2010; Kemper, 2010; Leibert, 2006; Myers & Young, 2012; Russell-Chapin & Chapin, 2011). While counseling aids individuals during times of distress, this process may be enriched by incorporating biofeedback applications particularly when considering the working alliance and treatment satisfaction

Biofeedback and neurofeedback protocols focus on physiological arousal and neurological functioning. This study incorporates the following modalities to train the CAN; HRV, skin conductance biofeedback, skin temperature biofeedback, and neurofeedback. The purpose of this study was to conduct a preliminary process evaluation of the use of a training protocol integrating biofeedback and neurofeedback

applications to alleviate symptomology of mental health conditions. The following chapter describes the methods for this study, exploring the integrated training protocol by examining objective data through use of physiology measurements and subjective data through the evaluation of the working alliance and treatment satisfaction.

CHAPTER 3: METHODS

Introduction

This chapter describes the methodological approach used in this study. The following sections are included in this chapter: the description of the research questions, description of the data source, and a description of the research design including the sample population, study procedures, and instrumentation. A statistical analysis is provided to explore the research questions. Ethical considerations and limitations for the study are given.

Research Questions

The purpose of this study was to conduct a preliminary process evaluation of the use of a training protocol integrating biofeedback and neurofeedback applications to alleviate symptomology of mental health conditions. Results of this study were used to construct a prospective model to identify how the implementation of a training protocol integrating biofeedback and neurofeedback impacts the counseling experience as defined by process variables including the working alliance and treatment satisfaction. This study answered the following research questions.

Research question 1: Is there a difference between clients' baseline physiological scores and their post-training physiological scores?

Research question 2: How do clients rate the working alliance after completing the integrated training protocol?

Research question 3: How do clients rate their treatment satisfaction after completing the integrated training protocol?

Research question 4: How do clients rank their preferences of biofeedback measurements after completing the integrated training protocol?

Research question 5: After completing the integrated training protocol, is there a relationship between clients' perception of the working alliance and changes in physiological scores taken pre and post training?

Research question 6: After completing the integrated training protocol, is there a relationship between the clients' perception of treatment satisfaction and changes in physiological scores taken pre and post training?

Research question 7: After completing the integrated training protocol, is there a relationship between the clients' ranking of biofeedback measurements and changes in physiological scores taken pre and post training?

Archival Data

This study utilized data collected from a research study conducted within the Department of Addictions and Rehabilitation Studies at East Carolina University (ECU). The data was collected over an eight month period (September, 2012-May, 2013), solely by the counselor enrolled in the same department at ECU. This doctoral student is a licensed professional counselor in the state of North Carolina and nationally certified in biofeedback as a clinical psycho-physiologist. She has been practicing biofeedback for more than 10 years and has more than 8 years of clinical experience implementing biofeedback and counseling with individuals who experience stress related conditions. Her approach is both behavioral, assisting clients in changing behaviors that are causing or enhancing the current problem, and cognitive, assisting individuals to learn how to change negative thought patterns to subsequently improve health. As a counselor, she is

passionate about the opportunity to teach individuals appropriate tools to self-regulate physiological responses to stress to alleviate medical symptoms and mental health concerns. She has also been hired at the university level to teach biofeedback courses, training other practitioners in the service delivery of biofeedback applications.

Research Design

This study incorporated a descriptive field design with an emphasis on process evaluation to assess the clients' perspective of implementing the integrated training protocol into counseling. As a field experiment, the study must be conducted in a natural setting where there is little interference from the researcher who is the counselor providing services in this study. In this study, the data were archival, collected in the naturalistic environment of an outpatient clinic. The purpose of this study was to conduct a preliminary process evaluation of the use of a training protocol integrating biofeedback and neurofeedback applications to alleviate symptomology of mental health conditions. With an emphasis on process evaluation, the researcher in this study explored both objective and subjective variables. The objective variables included the physiological changes that occur after participation in the integrated training protocol. The subjective variables included how clients rated the working alliance and treatment satisfaction, and how clients ranked the biofeedback measurements according to which measurement they found most helpful. While the integrated training protocol was administered flexibly according to the clients' needs, much detail regarding the flow of the protocol was provided which allows for this research to be replicated.

Population and Sample

Participant selection in this study utilized a convenience sampling, or nonprobability, method in which participants will be deliberately chosen due to their availability and willingness to participate in the study (Trochim, 2006). Therefore, random selection was not involved in nonprobability sampling. In this study, all clients were referred to the university based counseling clinic by their mental health therapist for biofeedback training. All clients reported experiencing anxiety and were interested in biofeedback training as a different approach to control the symptoms of their stress response. Due to the convenience sampling method, the researcher in this study is unable to conclude if the sample population represents the general population experiencing stress related conditions. In addition, no medical pre-screening was administered in this study to determine if the clients were equivalent. However, the researcher may conclude clients were probabilistically equivalent (Trochim, 2006) as they were all referred by the same mental health therapist in the community, specifically to engage biofeedback training to gain control over symptomology associated with anxiety disorders.

Clinical data such as severity of symptoms, activity level, enrollment of additional therapeutic activities, and comorbidities, were recorded. All participants were physically abled individuals and all were able to meet the financial obligations for the services delivered based on the sliding fee scale issued by the clinic. All participants attended more than 90% of their scheduled sessions. Demographic information of clients includes age, gender, and ethnicity as shown in Table 1. This study sample consists of ten clients, eight females and two males, enrolled at the university based counseling clinic and consented to participate in this study. The age of the clients ranged from 32 to 81, with the mean age of 54.

Table 1

Demographic Information of Study Participants

Client Id	Age	Gender	Ethnicity
1	34	Male	Belizean-Creole
2	48	Female	Caucasian
3	64	Female	Caucasian
4	61	Female	Caucasian
5	45	Female	African American
6	81	Female	Caucasian
7	68	Female	Caucasian
8	66	Female	Caucasian
9	32	Female	Caucasian
10	60	Male	Caucasian

Note. The mean age of participants is 56 years with a standard deviation of 15.70. 80% of the participants were female and 20% were male. 80% of the participants were Caucasian, 10% were African American, and 10% were Belizean-Creole.

Procedure

Prior to data collection, the University and Medical Center Institutional Review Board (IRB) approved this study with clients in the university based counseling clinic (Appendix A). Clients were identified and referred by their therapist in the community based on their elevated level of experienced stress and expressed desire for additional therapeutic tools to help gain self-control. Clients were instructed to contact the university based counseling clinic and schedule an initial appointment.

At the initial appointment, clients met with either the primary counselor, who would be administering the biofeedback training, or another counselor on duty. At that time, clients engaged in an initial interview and completed the initial psychological intake assessments, a standard procedure required by the university based counseling clinic. Clients were then scheduled to meet with the biofeedback counselor at their next visit and work through the biofeedback training protocol developed by Maes (2012) through her previous education and training in biofeedback and experience applying biofeedback applications within the counseling field (See Appendix B for complete detail of integrated training protocol). The following section provides an overview of the biofeedback training protocol developed by Maes (2012), which delineates the procedures that were implemented in this current study.

During the first session, participants were introduced to the training protocol integrating biofeedback and neurofeedback. Participants identified their personal goals for attending biofeedback training sessions. The counselor delineated the process of training. Participants were educated on the physiological basis to mental health conditions, in relation to biofeedback measurements. An explanation of how biofeedback training would help them gain the skills necessary to interact with and manipulate these responses, thus gaining control over symptomology, was provided. Duties within the counseling process were identified and tasks were clarified by both the participant and the counselor. Pre-training physiological scores were then obtained. This process involved the counselor defining each biofeedback sensor which was used while attaching the sensor to the participant and explaining how each sensor would be utilized to collect the physiological measurement. The follow physiological measurements were obtained:

1) HRV, 2) skin temperature, 3) skin conductance, and 4) theta/SMR ratios. After pre-training physiological scores were obtained, participants scheduled their next visit in which they would then begin the training process.

Participants in this were coached on how to interact with and manipulate their physiological responses to stress using the physiological measurements in the following order: 1) HRV, 2) skin temperature, 3) skin conductance, 4) neurofeedback, and 5) a combination of training HRV and neurofeedback simultaneously. Participants were coached in how to interact with and manipulate these responses, which often involved CBT and mindfulness drills to help participants identify how they thought and felt about the training process. Clients were coached to attend biofeedback training with an effortless approach to further gain control of their physiological reactions. Previous research has indicated thinking a certain way, often negatively, in regards to how one may be handling the training process, will impact the training results (Femi & Fitz, 1982). Becoming aware of their own cognitions and emotions regarding the training is an important component of the training as the clients' perceptions will lead to a physiological response that has an effect on their training. When participants were able to demonstrate control over the physiological parameter in which they were engaging in training, the next physiological measurement would be introduced.

Beginning each session, clients were asked to report current symptoms or any difficulties they may have experienced since the previous meeting. Sensors were attached following the same procedures as when physiological baselines were obtained. Most sessions would involve the following flow; 1) training, 2) a dialogue between the therapist and client regarding the training results and incorporating CBT techniques if

needed, 3) recalling a stressor, 4) a dialogue reviewing the physiological results captured while recalling the stressor and incorporating CBT techniques, 5) training and, 6) a dialogue reviewing the training results and incorporating CBT techniques if needed. Clients were then given the opportunity to identify their own personal homework according to what they thought they would be appropriate to work on, or practice, in between sessions. At the following session clients would report back on successes, difficulties, and stressors since the previous training session.

All training sessions were 50 minutes in length. Physiological data were collected during each session. The number of sessions clients completed ranged from seven to fifteen, depending on how quickly physiological control was demonstrated. After completion of the training protocol, clients engaged in physiological assessments for the second time and the post-training scores were obtained. After completing the training protocol, clients rated their experience through use of the WAI-SR and the TxSI. Clients also ranked the biofeedback measurements from most helpful to least helpful which included: 1) HRV, 2) skin conductance, 3) skin temperature, 4) neurofeedback, and 5) a combination of HRV training and neurofeedback.

Instrumentation

This study incorporated the WAI-SR (Appendix C) and the TxSI (Appendix D) to provide a detailed overview of clients' personal experience of the biofeedback training protocol developed by Maes (2012) (Appendix B). In addition, clients ranked the biofeedback measurements according to which modality they found most helpful. These data will be used to explore the proposed research questions.

The Working Alliance Inventory – Short Revision

There are two parts to the WAI-SR; a client assessment and a counselor assessment. Tracey and Kokotovic (1989) revised the original WAI which contained 91 total items to a shortened version consisting of 36 items. Both the counselor and the client versions are self-administered. Both the counselor and the client rate the therapeutic relationship on a seven point Likert scale from never to always, assessing the main components of the working alliance; the bond between the two parties and the agreed upon goals and tasks (Horvath & Greenberg, 1989). Studies were conducted to determine the reliability and validity of the WAI. Results from Kokotovic and Tracey's study (1990) indicated reliability estimates for subscales of the client's index according to Cronbach's alpha included the following; .88 for bond, .90 for tasks, and .91 for goals. The counselor's scale indicated .88 for bond, .91 for tasks, and .93 for goals (Kocotovic & Tracey, 1990). While the three subscales are highly correlated, researchers typically report on the average of each subscale as opposed to the total score (Hatcher & Gillaspy, 2006).

Significant correlations were made to establish validity of the WAI through the following studies: 1) Horvath and Greenberg (1989) found a relationship between counseling outcomes and WAI ratings, 2) Kokotovic & Tracey (1990) found a relationship between client characteristics and WAI ratings, and 3) Kivlighan (1990) found a relationship between counselor technical activity and WAI ratings. Evidence suggests convergent validity exists on all three subscales of the WAI when compared to the Empathy Scale of the Relationship Inventory (RI) developed by Barrett-Lennard in 1962, and the Counselor Rating Form (CFR) developed by LaCrosse and Barak in 1976. Mitchell and associates (1977) determined the empathy scale of the RI is positively

correlated with outcomes of counseling. Results assessing the CRF, which was developed to assess Strong's social influence theory (1968) of the counseling relationship concludes this measurement to be valid and reliable (Horvath & Greenberg, 1989; LaCrosse & Barak, 1976). In addition, Hatcher and Gillaspy (2006) found the WAI comparable to both the California Psychotherapy Alliance Scale with a correlation of .85, and the Penn Helping Alliance Questionnaire with a correlation of .74. These data suggests the WAI is a reliable and valid instrument to assess the therapeutic relationship (Hatcher & Gillaspy, 2006; Kokotovic & Tracey, 1990; LaCrosse & Barak, 1976; Mitchell, Bozarth, & Krauft, 1977).

This study incorporated the revised short version of the WAI (WAI-SR), which is consistent with Bordin's WAI (Hatcher & Gillaspy, 2006). Both scales were implemented to a sample consisting of 231 participants enrolled in therapeutic services for mental health conditions. Correlations indicate strong relationships exist between the WAI and the WAI-SR for all three subscales as follows: 1) bond = 0.94, 2) goal = 0.91, and 3) task = 0.83 (Hatcher & Gillaspy, 2006). The WAI-SR consists of two portions in which the client and the counselor complete self-administered assessments, rating the therapeutic working alliance by ranking 12 items on a seven point Likert scale from never to always (Hatcher & Gillaspy, 2006). Results indicate the three subscales of the WAI-SR to be highly correlated with both the California Psychotherapy Alliance Scale at .80 and the Penn Helping Alliance Questionnaire at .74 (Hatcher & Gillaspy, 2006). The researcher reported both the total score for each subscale, along with the means and standard deviations to explore the research questions in this study.

The Treatment Satisfaction Index

The TxSI is a valuable item that has been administered in various substance abuse treatment programs as a means to evaluate satisfaction of the services delivered according to the participants' perception (Dennis et al., 2006; Tetzlaff et al., 2007). The TxSI has also been used to evaluate treatment satisfaction of services to help decrease symptoms of chronic pain (Glomiewski et al., 2010), as well as various counseling interventions (Brown, 2007). When used in the counseling field, clients' are asked to evaluate their satisfaction of the overall counseling experience, including their perception of the counseling relationship. Clinicians are encouraged to utilize the TxSI to improve services provided (Tetzlaff et al., 2005). The TxSI may be given to the client several times during a treatment program to determine effectiveness of services received (Brown, 2007). In this study, the TxSI was given to the clients immediately after they had completed the training program.

The TxSI was developed as a standalone portion of the GAIN, a valid instrument ($r = .84$), to determine if there is a relationship between treatment satisfaction and effectiveness of the treatment (Dennis et al., 2006). The TxSI is a self-administered assessment, containing 14 items in which clients are to identify how they felt about the treatment process, assessing how effective they found the services to be to meet their wants, wishes, and desires (Dennis et al., 2006; Tetzlaff et al., 2005). Clients also rate other components of treatment, including the location, cost, and convenience (Tetzlaff et al., 2005). All 14 items use a Likert scale ranging from one to five, indicating strongly disagrees to strongly agrees (Dennis et al., 2006). Scores may range from 14 to 70. The higher the score the more satisfied the consumer was with the treatment. The TxSI in this study has been adapted. There are three additional questions that specifically ask clients

about their experience with the biofeedback training. Therefore the scores on the TxSI for this study range from 16 to 80.

The TxSI was renamed to the Treatment Satisfaction Scale_ Likert (TxSS_L) (Dennis et al., 2006) and a psychometric analysis according to the Rasch measurement model (Rasch, 1980) was conducted to determine construct of satisfaction according to the instrument (Conrad, Conrad, Riley, Funk, & Dennis, 2011). Data were collected from 13,348 persons enrolled in one of the twelve different substance abuse treatment programs across the country, who completed the TxSS_L regarding their satisfaction with the services received. The results indicated the TxSS_L an internal consistency of .87, a Cronbach's alpha of .96, and item reliability of 1.00. With an item reliability of 1.00, we can be confident in the consistency of the item responses if the TxSI were administered to another sample with equivalent ability levels (Bond & Fox, 2007). Overall, these data indicate strong reliability, indicating the TxSS_L will produce stable and consistent results, and internal consistency, indicating the test items that examine the same construct will produce similar results (Trochim, 2006). In addition, Conrad and associates (2011) identified the TxSS_L a valid assessment to determine treatment satisfaction of substance abuse programs. The scale uni-dimensional scale is utilized to assess customer service, specific diagnosis and treatment.. Due to the strong psychometric properties, the TxSS_L may be implemented to over 80% of the target population when client responses match the Rasch model (Conrad et al., 2011).

This study was conducted in a clinical setting which administers the GAIN and the TxSI to all clientele to evaluate treatment satisfaction regarding services received. Administering the TxSI to clients who have participated in a biofeedback training

program has never been done before. Therefore, a reliability analysis will be conducted on the sample in this study to rate the biofeedback training program as measured by the TxSI.

Ranking Biofeedback Measurements

The current study examined clients' satisfaction with a specific biofeedback training protocol used in conjunction with counseling for clients with stress related conditions. After the counselor explained the training procedures-1) HRV, 2) skin conductance, 3) skin temperature, and 4) neurofeedback, the clients were given an opportunity to engage in training as a form of practice to develop skills to control their physiology. In addition, all clients engaged in a combination of HRV training and neurofeedback to gain control over both the ANS and the CNS simultaneously, to manipulate the CAN. After completing the biofeedback training protocol, clients ranked the biofeedback measurements according to how helpful they found each one to be for their situation. Clients were handed five notecards, which were labeled accordingly 1) HRV, 2) skin conductance, 3) skin temperature, 4) neurofeedback, and 5) combo (HRV & neurofeedback). Clients were asked to put these notecards in order from most helpful to least helpful.

Statistical Analysis

The data from the clinic was entered in an SPSS 20.0.0 spreadsheet. For research questions one, a one way repeated measures MANOVA was conducted to analyze the treatment variables. A difference between the mean scores obtained from the initial physiological baseline scores was compared with mean scores obtained after engaging in the Maes (2012) integrated training protocol for the following variables: regulatory

power of HRV, skin temperature, skin conductance, and changes in ratio scores of theta/SMR brainwaves. Results were reported to determine if physiological changes occurred. An alpha level of .05 will be used to help prevent making both Type I and Type II errors when reporting results (Trochim, 2006).

For research questions two, three, and four, a one way ANOVA was conducted utilizing scores from the WAI, TxSI, and ranking of treatment measurements. The mean scores and standard deviations were reported for all analyses. Results were used to determine how individuals evaluated the integrated training protocol. For research question five, a Pearson-product correlation was conducted to determine if a relationship exists between the objective data gathered by the biofeedback measurements looking at the difference in scores taken pre and post training and the clients' subjective experience as measured by the WAI. For research question six, a Pearson-product correlation was conducted to determine if a relationship exists between the objective data gathered by the biofeedback measurements looking at the difference in scores taken pre and post training and the clients' subjective experience as measured by the TxSI. For research question seven, a Spearman correlation was conducted to determine if a relationship exists between the objective data gathered by the biofeedback measurements looking at the difference in scores taken pre and post training and the clients' subjective experience as measured by how clients ranked the biofeedback measurements according to which measurement they found most helpful.

Ethical Considerations of the Study

Prior to data collection, the university based counseling clinic completed an Institutional Review Board and obtained approval to conduct studies on the effectiveness

of various types of treatment protocols. The following ethical considerations were taken to protect client confidentiality 1) the university based counseling clinic abides by standards set forth by HIPPA, 2) client data for each client was stored in a locked filing cabinet located in the clinic, 3) only supervisors and coordinators of the clinic had keys to unlock the filing cabinet. In addition, the counselor providing services is a licensed professional counselor in the state of North Carolina, and nationally certified in biofeedback through BCIA. The counselor upholds standards set in place by both the North Carolina Board for Licensed Professional Counselors and BCIA.

Because of the design of the intervention, the therapist explained the clients' psychophysiological responses to stress with biofeedback measurements. While this training experience had the potential to feel intrusive to the client, the counselor prepared for and monitored the client for physiological signs of extreme distress. During the session, the therapist encouraged clients to discuss their personal responses and feelings during the initial baselines and throughout engaging in the training protocol. If at any time during a stress recall the client reported feeling incapable of handling the activity of speaking of a stressor, the client would be given the opportunity to solely engage in physiological training without recalling a stressful event. If in the event a client expressed heightened concerns regarding personal safety and emotional stability, the counselor followed the designated protocol of the clinic for handling a crisis. This emergency plan of action involved reporting the crisis to a senior staff, which was present on site at all times in the event of an emergency. If necessary, clients were to be admitted to the emergency room for precautionary care.

Limitations of the Study

Limitations of the study involve issues concerning the research design. This study examined archival data that was obtained in a natural setting and incorporated a convenience sampling method. Therefore, the following threats to internal validity exist. Archival data may be biased due to selective survival meaning due to incomplete or missing records, or archival records may be subject to errors due to record-keeping procedures. To ensure there were no errors due to the record-keeping, the researcher saved the data on an external hard drive and made a hard copy. When interpreting the results, the researcher must also be cautious of spurious relationships, inaccurately inferring a causal relationship exists between two variables (Moore, McCabe, & Craig, 2009). In addition, because the sampling population was that of a convenience or nonprobability sample, therefore, the researcher will not be able to conclude the probability of this sample representing the population well (Trochim, 2006).

Because this study did not use a control group, the following threats to internal validity were examined (Moore et al., 2009; Trochim, 2006). The researcher must consider threats to internal validity due to a lack of random selection when reporting on the results. With such a small sample there is a high probability of a Type two error, accepting a false null hypothesis (Moore et al., 2009). There was a limited number of clients in this study (n=10). A small number of participants may make the researcher less confidence in any differences that may be concluded. However, each client engaged in at least seven training sessions and all were exposed to all biofeedback measurements of the training protocol.

All assessments were administered by the counselor implementing the integrated training protocol. Therefore, the therapeutic relationship may be problematic for research

purposes. As the therapist and client have already established a relationship, the client may respond according to please the therapist. Experimenter bias may influence or hinder the results of a study as clients alter responses to meet the expectations of the researcher instead of completing the assessments free of preconceived judgments (Moore et al., 2009). Also, because the natural setting of the experiment, the researcher was not able to prevent or control for events (family crises, relationship statuses, career changes, involvement in other therapeutic interventions) occurring outside of the study. Such events may change clients' responses on the assessments given, thus increasing chances of history threats defined as change that occurred due to the influence of sources separate from the study (Moore et al., 2009). The researcher will consider these threats while reporting the results.

Summary

The purpose of this study was to conduct a preliminary process evaluation of the use of a training protocol integrating biofeedback and neurofeedback applications to alleviate symptomology of mental health conditions. Physiological data gathered from biofeedback training were compared to the assessments completed by the clients, providing an overall evaluation of the training program. The purpose of this study was supported by the chosen research design and methods. The study analyzed the data collected from the training sessions and the assessments that were administered after completing the integrated training protocol. Data were analyzed with the Repeated Measures ANOVA, Pearson-Product Correlation procedures, and a Spearman's Correlation in SPSS 20.0.0.

Chapter 4: RESULTS

Introduction to the Chapter

The purpose of this study was to conduct a process evaluation of the use of a training protocol integrating biofeedback and neurofeedback applications to alleviate symptomology of mental health conditions. Both objective and subjective data were gathered. This chapter begins with a description of the sample demographics followed by the descriptive statistics for the objective and subjective data. Relationships between these variables were explored. This chapter concludes with a summary of the results. Results of this study will be used to define a prospective model to identify how the implementation of a training protocol integrating biofeedback and neurofeedback impacts the counseling relationship as defined by process variables including the working alliance and treatment satisfaction.

Sample Demographics

This section reports a description of the sample using participant demographic information. The sample consisted of 10 adults, age 32 to 81 years, who reported to experience symptoms of anxiety and engaged in the integrated training protocol. Out of the 10 participants, 2 were male and 8 were female. The distribution of ethnicity was 1 African-American, 1 Belizean-Creole, and 8 Caucasian. Table 2 shows a summary of these demographics.

Table 2

Participant Demographic Information

Client Id	Age	Gender	Ethnicity
1	34	Male	Belizean-Creole
2	48	Female	Caucasian
3	64	Female	Caucasian
4	61	Female	Caucasian
5	45	Female	African American
6	81	Female	Caucasian
7	68	Female	Caucasian
8	66	Female	Caucasian
9	32	Female	Caucasian
10	60	Male	Caucasian

Note. The mean age of participants is 56 years with a standard deviation of 15.70. 80% of the participants were female and 20% were male. 80% of the participants were Caucasian, 10% were African American, and 10% were Belizean-Creole.

The following section presents the descriptive statistics of the objective and subjective data collected during this study.

Descriptive Statistics

This section consists of the descriptive statistics for the objective data and subjective data. The objective data, which was gathered before and after engaging in the integrated training protocol, consists of the following physiological measurements: 1) HRV, 2) skin temperature, 3) skin conductance, and 4) theta/SMR ratios. The subjective data, gathered from clients after they had completed the integrated training protocol, consists of the WAI and the TxSI. Participants also ranked the following biofeedback training measurements from most to least helpful: 1) HRV, 2) skin temperature, 3) skin conductance, 4) neurofeedback, and 5) combination of HRV training and neurofeedback. Both objective and subjective data are included in Appendix E.

Data Analysis Results

This section includes the results of the analyses for each research question. This information is followed by a summary of the research question and testing results.

Research Question 1 Data Analyses

Research Question 1: Is there a difference between clients' baseline physiological scores and their post-training physiological scores? Specifically, the following physiological scores taken before and after engaging in the integrated training protocol were compared: 1) regulatory power of HRV, 2) skin temperature, 3) skin conductance, and 4) theta/SMR ratios. A one-way repeated measures MANOVA was conducted to determine changes in physiology measured before and after engaging in the integrated training protocol in regards to each physiological measurement. Data were gathered at the pre-training and at the post-training. The mean differences and the percent of change of these physiological scores are reported. Significant changes are evaluated through the F and p – values as shown in Table 3.

Table 3

Results of MANOVA for Objective Data

	Pre-train Mean	Pre-train SD	Post-train Mean	Post-train SD	Mean Diff	% Diff	F	Sig
HRV	96.80	162.17	752.00	911.22	902.03	38.09	5.28	.047*
ST	87.44	8.10	90.94	5.19	6.58	0.09	2.82	.127
SC	2.63	2.09	1.50	1.01	1.39	0.47	6.55	.031*
T/S	0.46	0.07	0.64	0.27	0.27	0.62	4.13	.073

Note. Biofeedback measurements have been abbreviated as follows: ST = skin temperature, SC = skin conductance, T/S = theta/SMR ratio. $p<.05$*

The first within subject variable was the regulatory power captured by HRV. A one-way repeated measures MANOVA revealed a significant change in the within-subjects HRV scores [$F (1, 9) = 5.78$, $p = .047$, partial $\eta^2 = .37$]. The mean for the pre-training was 96.80 Hz and the mean for the post-training was 752.00 Hz. These findings suggest that HRV scores improved (increased) as shown in the Figure 1.

Figure 1

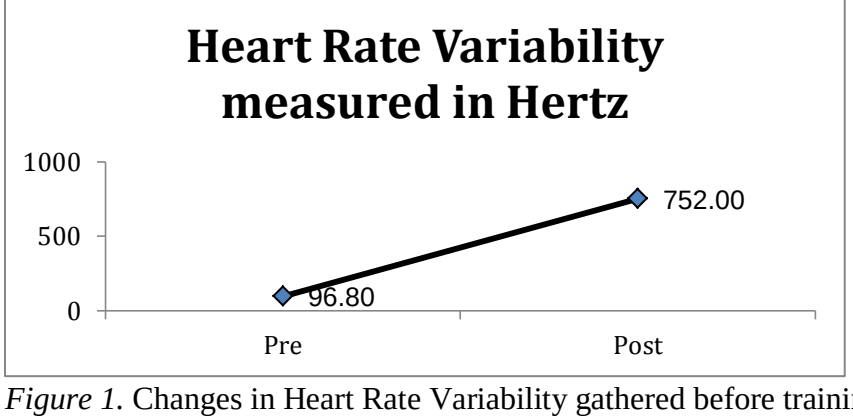


Figure 1. Changes in Heart Rate Variability gathered before training (pre) and after training (post).

The second within-subject variable was skin temperature. A one-way repeated measures MANOVA revealed the difference between pre and post scores in skin temperature was not significant [F (1, 9) = 2.82, p = *ns*, partial η^2 = .32]. The mean for the pre-training was 87.44 degrees Fahrenheit and the mean for the post-training was 90.94 degrees Fahrenheit. Skin temperature scores improved (increased) as shown in the Figure 2, however, the change was not significant.

Figure 2

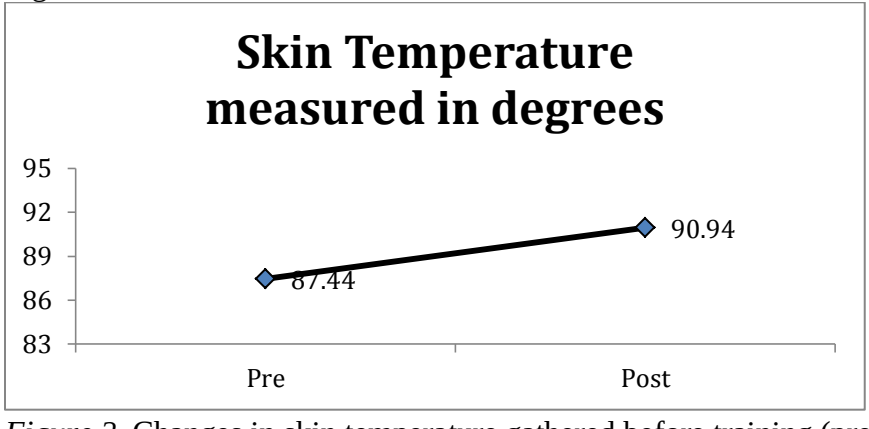


Figure 2. Changes in skin temperature gathered before training (pre) and after training (post).

The next within subject variable was skin conductance. A one-way repeated measures MANOVA revealed a significant change in the within-subjects skin conductance scores [F (1, 9) = 6.55, p = .037, partial η^2 = .63]. The mean for the pre-training was 2.63 mhos and the mean for the post-training was 1.50 mhos. The unit for electric conductance is the siemens. One siemens is equal to 1,000,000 micromho. The term 'mho' is short for 'micromho'. These findings suggest that skin conductance scores improved (decreased) as shown in the Figure 3.

Figure 3

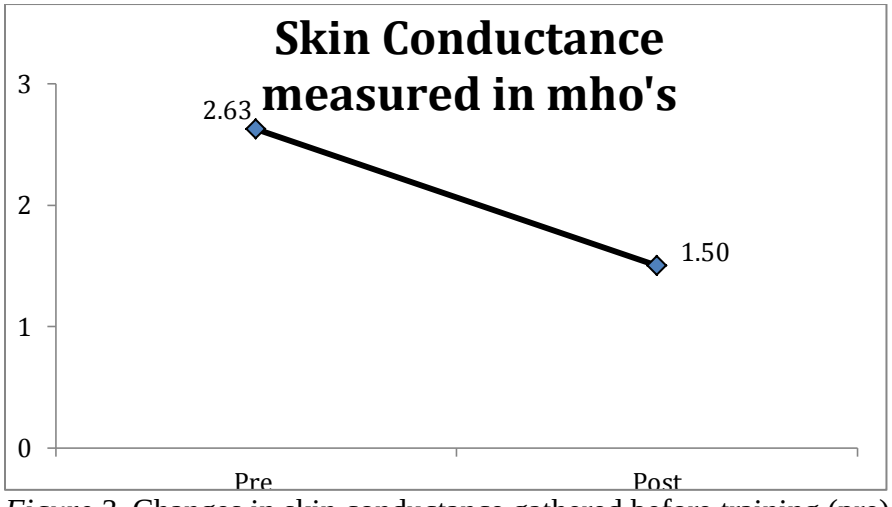


Figure 3. Changes in skin conductance gathered before training (pre) and after training (post).

The last within subject variable was theta/SMR ratios. A one-way repeated measures MANOVA revealed there was not a significant change in the difference between pre and post theta/SMR scores [F (1, 9) = 4.13, p = .073, partial η^2 = .44]. The mean for the pre-training was 0.46 ohms and the mean for the posttest was 0.64 ohms. These findings suggest that while theta/SMR ratio scores improved (increased) as shown in the Figure 4, the change was not statistically significant.

Figure 4

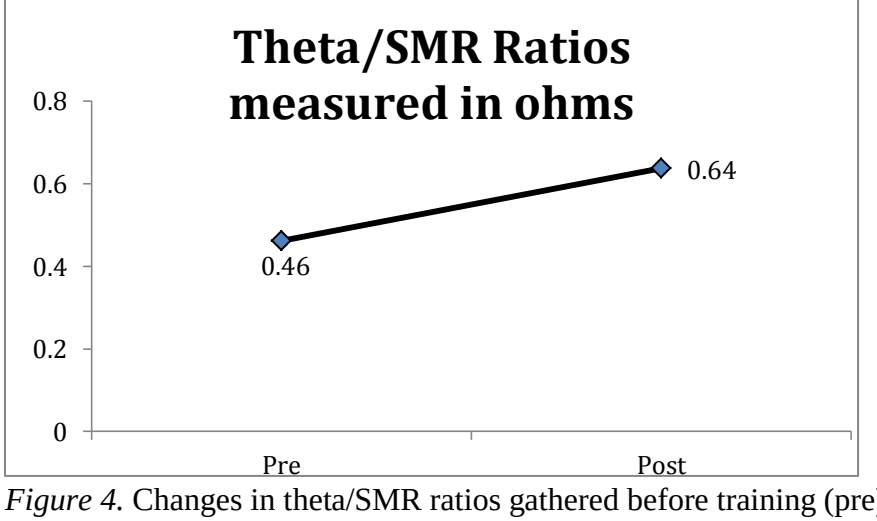


Figure 4. Changes in theta/SMR ratios gathered before training (pre) and after training (post).

The output from one-way repeated measures MANOVA provides results of the changes in physiological scores taken before and after engaging in the integrated training protocol. Results indicate there was significant improvement in skin conductance ($p = 0.031$) and HRV ($p = 0.047$). While skin temperature scores improved (increased), changes made were not significant ($p = 0.127$). There were also changes in theta/SMR ratios when measured before and after engaging in the integrated training protocol, however, these changes were not significant ($p = 0.073$).

Research Question 2 Data Analysis.

Research question 2: How do clients rate the working alliance after completing the integrated training protocol? There are three subscales of the WAI-SR which coincide with the three main components of the working alliance: 1) bonding, 2) goals, and 3) tasks. Scores for each subscale range from 4.00 (minimum) to 28.00 (maximum). The means, standard deviations, and ranges in the results from this study are provided for each subscale and reported in Table 4. Participants in this study rated the subscale, bonding, with a mean score of 7.00. Therefore, no variability occurred within this score resulting in no range between the scores as shown as 'Not Applicable' in Table 4.

Table 4

Descriptive Statistics for the Working Alliance Inventory – Short Revised

	Mean	SD	Range
Bonding	7.00	0.00	NA
Goals	6.83	0.38	6.00-7.00
Tasks	6.68	0.76	5.75-7.00

Note. The abbreviation NA = not applicable.

Research Question 3 Data Analysis.

Research question 3: How do clients rate their treatment satisfaction after completing the integrated training protocol? Scores for the TxSI can range from 16 (minimum) to 80 (maximum) points. The mean score, standard deviation, and range of scores for the TxSI for participants in this study is shown in Table 5.

Table 5

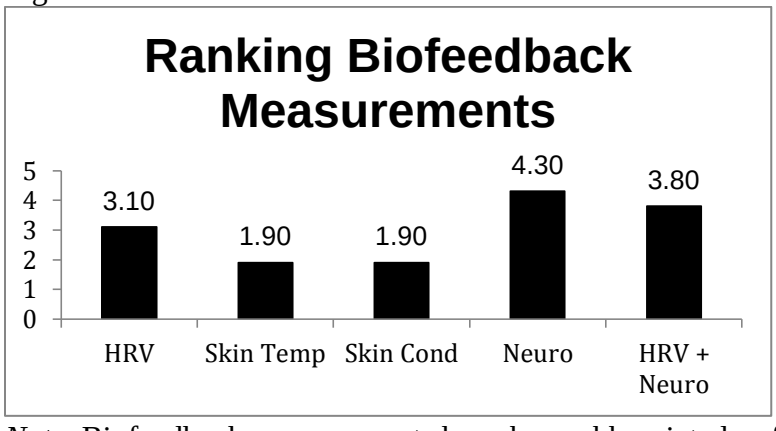
Descriptive Statistics for the Treatment Satisfaction Index

	Mean	SD	Range of Study Results
TxSI	78.90	1.73	75.00 – 80.00

Research Question 4 Data Analysis.

Research question 4: How do clients rank their preferences of biofeedback measurements after completing the integrated training protocol? Participants ranked the following biofeedback training measurements from 5 (most) to 1 (least): HRV, Skin Temperature, Skin Conductance, Neurofeedback, and Combination of HRV and Neurofeedback. The researcher computed mean score for each measurement to determine how each measurement was ranked as shown in Figure 5.

Figure 5



Note. Biofeedback measurements have been abbreviated as follows: skin temp = skin temperature, skin cond = skin conductance, neuro = neurofeedback, HRV + neuro = combination of HRV training and neurofeedback.

Research Question 5 Analysis.

Research question 5: After completing the integrated training protocol, is there a relationship between clients' perception of the working alliance and changes in physiological scores taken pre and post training? A Pearson's correlation was conducted and results indicated no significant relationships existed between difference or percent of changes in physiological scores and the WAI-SR as shown in Table 6. The WAI-SR correlated with the change in HRV was not significant ($r = -0.36$, $p = 0.31$). The WAI-SR correlated with the percent of change in HRV was not significant ($r = 0.14$, $p = 0.70$). The WAI-SR correlated with the change in skin temperature was not significant ($r = -0.07$, $p = 0.84$). The WAI-SR correlated with the percent of change in skin temperature was not significant ($r = -0.03$, $p = 0.94$). The WAI-SR correlated with the change in skin conductance was not significant ($r = -0.22$, $p = 0.55$). The WAI-SR correlated with the percent of change in skin conductance was not significant ($r = -0.45$, $p = 0.20$). The WAI-SR correlated with the change in theta/SMR ratios was not significant ($r = 0.35$, $p =$

0.32). The WAI-SR correlated with the percent of change in theta/SMR ratios was not significant (r = 0.36, p = 0.31).

Table 6

Pearson's Correlation: Relations Between the WAI-SR and Changes & Percent of Change in Physiological Scores

Physiological Measurement	Δ in Pre-training – Post-training Scores	% Δ in Pre-training – Post-training Scores
HRV	-0.36	0.14
ST	-0.07	-0.03
SC	-0.22	-0.45
T/S	0.36	0.36

Note. Biofeedback measurements have been abbreviated as follows: ST = skin temperature, SC = skin conductance, T/S = theta/SMR ratio. *p < .05.

Research Question 6 Data Analysis.

Research question 6: After completing the integrated training protocol, is there a relationship between clients' treatment satisfaction and changes in physiological scores taken pre and post training? A Pearson's correlation was conducted and revealed one of the eight possible relationships was significant as shown in Table 7. The TxSI negatively correlated with the percent of change in skin conductance was significant (r = -0.80, p =0.006). These results indicate a negative relationship exists between improvement (decrease) in skin conductance and high (increase) treatment satisfaction with alpha at .01. None of the other relationships were significant at alpha 0.05 level. Correlations ranged from (r = -0.51to 0.34, p = 0.14 to 0.88) as shown in Table 5.

Table 7

Pearson's Correlation: Relationships between TxSI and Changes & Percent of Changes in Physiological Scores

Physiological Measurement	Δ in Pre-training – Post-training Scores	% Δ in Pre-training – Post-training Scores
HRV	-0.30	0.34
ST	0.06	0.10
SC	-0.51	-0.80**
T/S	0.23	0.24

Note. Biofeedback measurements have been abbreviated as follows: ST = skin temperature, SC = skin conductance, T/S = theta/SMR ratio. *p < 0.05. **p < 0.01

Research Question 7 Data Analysis.

Research question 7: After completing the integrated training protocol, is there a relationship between the clients' ranking of biofeedback measurements and changes in physiological scores taken pre and post training? A Spearman's correlation was conducted between differences and percent of changes in physiological scores and how participants ranked the biofeedback measurements as shown in Table 8. Two of these relationships were significant. A negative significant relationship ($r = -0.65$, $p = 0.04$) existed between an improvement (decrease) in skin conductance as measured by the percent of change between pre and post training, and how clients ranked skin temperature measurement at the alpha = .05 level. A significant positive relationship ($r = .67$, $p = 0.03$) existed between the percent of change in HRV scores as measured before and after

engaging in the integrated training protocol and how clients ranked training combining HRV and neurofeedback.

Table 8

Spearman's Correlation: Physiological Scores and Ranking of Biofeedback Measurements

Physiological Measure	Rank HRV	Rank ST	Rank SC	Rank Neuro	Rank Combo
HRV Δ	-0.10	0.01	0.30	-0.57	0.40
HRV % Δ	-0.23	0.55	-0.05	-0.57	.67*
ST Δ	-0.18	0.31	0.17	-0.48	0.42
ST % Δ	-0.18	0.31	0.17	-0.48	0.42
SC Δ	0.35	-0.55	0.29	-0.15	-0.18
SC % Δ	0.47	-.65*	0.36	-0.13	-0.30
T/S Δ	0.01	-0.13	0.08	0.34	-0.28
T/S % Δ	0.04	-0.18	0.13	0.25	-0.23

Note. Biofeedback measurements have been abbreviated as follows: ST = skin temperature, SC = skin conductance, neuro = neurofeedback, combo = combination of HRV training and neurofeedback, T/S = theta/SMR ratio. *$p < 0.005$.

Chapter Summary

This study explored both objective and subjective data to evaluate the participants' experience of engaging in an integrated training protocol. To examine research question 1, a one-way repeated measures MANOVA was conducted. While changes occurred in all

four physiological scores (HRV, skin temperature, skin conductance, and theta/SMR ratios) after engaging in the integrated training protocol, only those made within HRV and skin conductance were significant. To examine research question 2 and 3, the researcher computed the mean scores and standard deviations of the subjective measurements. Results revealed participants experienced a strong working alliance and a high level of satisfaction with the services provided, measured after engaging in the integrated training protocol. To examine research question 4, the researcher computed the mean scores for how participants ranked their preferences of the biofeedback measurements from most to least helpful. Results revealed participants found neurofeedback to be most helpful, followed by the combination of training HRV and neurofeedback simultaneously, followed by HRV, and then skin temperature and skin conductance.

Pearson's correlations were conducted to examine research questions 5 and 6. For research question 5, results revealed no significant relationship existed between the differences in or percentage of change of physiological scores measured pre and post training and the working alliance. For research question 6, results revealed a negative relationship existed between improvement (decrease) in skin conductivity and high (increase) treatment satisfaction. A Spearman's correlation was conducted to examine research question 7. Results revealed a negative significant relationship existed between an improvement (decrease) in skin conductance as measured by the percent of change between pre and post training, and how clients ranked skin temperature measurement at the alpha = .05 level. In addition, this correlation also revealed a significant positive relationship existed between the percent of change in HRV scores as measured before

and after engaging in the integrated training protocol and how clients ranked training combining HRV and neurofeedback.

Results of these analyses revealed physiological changes occurred after engaging in the integrated training protocol as measured by the objective data, and participants experienced a strong working alliance with the counselor and were satisfied with the services they received as measured by the subjective data. The correlations which were conducted revealed few significant relationships existed between the subjective and objective data. Results from these analyses may be used to develop a prospective model to identify how the implementation of a training protocol integrating biofeedback and neurofeedback impacts the counseling relationship as defined by process variables including the working alliance and treatment satisfaction. Findings from the results of the statistical analyses computed with the data from this study are discussed in the following chapter.

CHAPTER 5: DISCUSSION

Introduction to the Chapter

This chapter begins with a summary of the current study, including the purpose, variables, sample, and data collection procedures which were utilized in this study. An interpretation of the study results is provided along with possible explanations for these results. The limitations of the study are presented, followed by implications for future research and practice. A final summary of the study concludes this chapter.

Summary of the Study

The purpose of this study was to conduct a process evaluation of the use of a training protocol integrating biofeedback and neurofeedback applications to alleviate symptomology of mental health conditions. A descriptive field study design was used to examine archival data collected in the naturalistic environment from the university based counseling clinic. Specifically, this study explored both objective and subjective variables to define a prospective model to support outcome research and guide the future counseling practice of implementing an integrated training protocol into counseling. The objective variables included the physiological changes that occurred after participation in the integrated training protocol captured by the following biofeedback measurements: HRV, skin temperature, skin conductance, and theta/SMR ratios. The subjective variables included how clients rated the working alliance and treatment satisfaction, and ranked the biofeedback measurements from most to least helpful. The current sample consisted of 10 participants who were enrolled at the university based counseling clinic for services between September, 2012 and May, 2013, and consented to participate in the study. Study participants engaged in pretest physiological measurements, the integrated training

protocol, and posttest physiological measurements. After engaging in the integrated training protocol, participants completed the subjective assessments to evaluate the program.

To answer the research questions presented in this study, the raw data for participants were collected, entered, and a variety of analyses were conducted. A one-way repeated measures MANOVA was conducted to reveal physiological changes that occurred after engaging in the training protocol. The means of the subjective measurements and the ranking of the biofeedback measurements were computed and reported. Correlations were conducted comparing the objective and subjective variables to determine if any relationships existed within the data. The following section is an interpretation of the results of this study.

Interpretation of Results

This section provides a discussion of the results of the statistical analyses which were reported in the previous section. First, the findings of the objective variables are discussed to explore the results of research question one. Possible explanations of these findings are provided. Next, the findings of the subjective variables are discussed to explore the results of research question two, three, and four. Possible explanations of these findings are provided. Last, the findings of the correlations comparing the objective and subjective variables are discussed to explore research questions five, six, and seven. Possible explanations of these findings are provided.

Research Question 1: Is there a difference between clients' baseline physiological scores and their post-training physiological scores? Specifically, the following physiological scores obtained before and after engaging in the integrated training

protocol were compared: 1) regulatory power of HRV, 2) skin temperature, 3) skin conductance, and 4) theta/SMR ratios. A one-way repeated measures MANOVA was conducted to interpret the means and standard deviations for each of these physiological measurement. The mean differences and the percent of change of these physiological scores were reported. The following is a discussion of the data analyses results and comparison of results to previous literature.

In previous studies, most practitioners have conducted physiological baselines prior to and after engaging in a biofeedback training protocol. Comparing the changes in physiology was made to determine if the training received was efficacious (Moss & Gunkleman, 2002). Data analyses in this current study revealed changes within all physiological measurements occurred. In addition, the changes made within these measurements were all improvements as follows: 1) increase in regulatory power in HRV, 2) increase in skin temperature, 3) decrease in skin conductance, and 4) increase in theta/SMR ratios. Changes in two of the four physiological measurements, HRV and skin conductance, were statistically significant. Changes in skin temperature and skin conductance were not statistically significant. While the MANOVA was conducted to determine significant change between pre and post-training scores and results indicate improvement in all scores, these results were analyzed to report if changes were statistically significant, not the clinically significant changes.

While no previous study exists which involves training according to the protocol followed in this study, other studies have revealed training with biofeedback is efficacious for controlling physiological imbalances due to stress related conditions (Moss & Gunkleman, 2002). In addition, previous studies have examined integrating

biofeedback and neurofeedback training to target the CAN. The simple skill of deep breathing which may implemented through the use of HRV training alters brainwaves to decrease symptoms of anxiety (Sherlin et al., 2010). Neurofeedback utilized in conjunction with skin temperature training and deep breathing is effective for increasing a sense of self-awareness and self-relaxation (Danskin & Walters, 1973), and decreases symptoms of PTSD (Peniston & Kulkosky, 1991). Also, Administering skin temperature and skin conductance training in conjunction with neurofeedback enhances self-awareness, focus, and attention (Thompson & Thompson, 1998). Therefore, for this current study, a possible explanation for the positive changes in physiology which occurred after engaging in the integrated training protocol may be related to previous studies which deem biofeedback as an efficacious form of treatment for stress related conditions. Results from previous research indicate high success rate for decreasing symptomology as a result of biofeedback and neurofeedback training (Evans & Rubi, 2009; Gunkelman & Johnstone, 2005; Larson et al., 2010; Lubar, 1991; Myers & Young 2012; Thatcher & Lubar, 2009).

Another possible explanation for the improvements in physiology after engaging in the integrated training protocol may be due to the educational piece which is part of the training. Participants in this current study were educated on their condition in terms of physiological responses. Similar to previous studies, participants were able to view their internal states in real time with the use of the biofeedback output thus creating an augmented learning environment and validating their emotional experiences (Arena & Schwartz, 2003; Danskin & Walters, 1973; Eisenberg, Ben-Daniel, Mei-Tal, & Wertman, 2004; Gruzelier & Egner, 2005; Hammond, 2007; Larson et al., 2010; Myers & Young,

2010; Nugent, Bain, Thayer, Sollers, & Drevets, 2011; Sherlin, Muench, & Wyckoff, 2010; Sutarto, Wahab, & Zin, 2010; Yu, Zhang, Xie, Wand, & Zhang, 2009). Participants were then coached by the counselor to manipulate their physiology and, with the use of the biofeedback output, engaged in operant conditioning of their internal states. Coaching participants to engage with and manipulate their physiological responses of stress involves CBT techniques. Participants are first taught to become aware of any irrational thinking as well as their thoughts regarding their performance during the training. Participants are then coached to change these thoughts and engage in a present focused state in order to gain control over physiology.

Research question 2: How do clients rate the working alliance after completing the integrated training protocol? Working alliance is defined as the therapeutic relationship between the counselor and the client and involves 1) mutual trust, 2) mutual agreement of the current issue, and 3) mutual perspective of an approach to resolve the presenting issue (Bordin, 1979). The WAI-SR is designed to assess and determine the strength of the relationship between the counselor and the client. In this study, the WAI-SR was administered to determine how clients evaluated the working alliance after engaging in the integrated training protocol. All participants rated the working alliance to assess their relationship with the counselor. There are three subscales of the WAI-SR which coincide with the three main components of the working alliance: 1) bonding, 2) goals, and 3) tasks. Scores for each subscale range from 4.00 (minimum) to 28.00 (maximum). In this current study, the total scores for the subscales indicated strong alliances for all three subscales as follows: 1) bonding = 28.00, 2) goals = 27.32, and 3) tasks = 26.72. In this current study, the mean scores for the subscales were as follows: 1)

bonding = 7.00, 2) goals = 6.83, and 3) tasks = 6.68. The strong working alliances reported by clients completing the integrated training protocol may be strong for several reasons.

First, biofeedback applications provide a physiological lens of participants' internal states. Clients are able to gain an awareness of and correctly interpret and understand their physiological responses to stress which validates their experiences (Carmichael, 2009; Danskin & Walters, 1973; Larson et al., 2010; Makinson & Young, 2012; Myers & Young, 2012; Peek, 2003; Romano, 1982; Schwartz et al., 1981; Thompson & Thompson, 1998). With this information, the counselor and the client are able to efficiently engage in the following: 1) identify and agree upon current conditions, 2) develop goals for treatment, 3) establish duties within the therapeutic process, 4) delineate the process of treatment, and as a result 5) develop mutual trust for one another. Second, the objective data gathered by the biofeedback measurements optimizes the counselor's ability to empathize with the clients' struggles (Carmichael, 2009; Thompson & Thompson, 1998), which may facilitate clients' trust in their counselor leading to a strong working alliance. Third, utilizing the biofeedback output as a guide, gives the counselor a sophisticated tool to tailor treatment based on the needs of the client (Makinson & Young, 2012; Peek, 2003). Counselors train clients on how to interact with their physiological responses and manage these reactions to stress more efficiently (Yucha & Gilbert, 2004). As a result, viewing these internal adaptations in real time through use of the biofeedback output may support confidence in the competence of the counselor, further solidifying the working alliance. Overall, results indicate clients felt comfortable with the counselor, rating the working alliance as strong. Perhaps the

biofeedback output enabled participants to bond with the counselor, establish tasks, and achieve personal goals.

Research Question 3: How do clients rate their treatment satisfaction after completing the integrated training protocol? Treatment satisfaction is defined as client contentment with treatment due to the fulfillment of their wants, wishes, and desires through the services received (Tetzlaff et al., 2005). The TxSI was utilized in this study to measure clients' overall satisfaction with their experience engaging in the integrated training protocol. Scores for the TxSI range from 16 (minimum) to 80 (maximum) points. The mean score on the TxSI for the participants in this study was 78.90 indicating clients were highly satisfied with services received while engaging in the integrated training protocol. A possible interpretation for these results may be due to the many benefits biofeedback applications offer when utilized in conjunction with counseling.

Previous studies have explained the many benefits of implementing biofeedback applications into counseling (Carmichael, 2009; Danskin & Walters, 1973; Hammond, 2007; Henschem, 1976; Myers & Young, 2012; Thompson & Thompson, 1998; Romano, 1982; Othmer & Othmer, 2009). Biofeedback training is an unobtrusive approach to treatment, utilizing non-invasive technology with few side-effects (Danskin & Walters, 1973; Frank et al., 2010; Henschem, 1976; Larson et al., 2010; Myers & Young, 2012; Othmer & Othmer, 2009; Romano, 1982; Watral, 1976). No participants in this study reported experiencing side effects due to engaging in the integrated training protocol. In addition, the biofeedback output allows counselors to better attend to the immediate concerns of the client and personalize treatment (Henschem, 1976). In this current study, the counselor followed the procedures explained in the integrated training protocol (see

chapter 3 or Appendix B for additional detail) as a guide. However, to tailor treatment to the individual participant, the counselor also referred to self-reports made by the participants and utilized the biofeedback output to make appropriate adjustments in the delivery of the training protocol. With the biofeedback output the counselor is able to tailor treatment according to the needs of the clients and how they are responding to the current interventions. Therefore, personalizing treatment provides an accelerated pace to successful outcomes and a high frequency of sessions is not typically required (Henschem, 1976; Larson et al., 2010). Participants in this study received a varied amount of training, ranging from seven to fifteen total sessions. The variation of this frequency was dependent upon the participants' need for the training. In addition, the integrated training protocol included CBT techniques in which participants became aware of and reconstructed faulty ways of thinking. Reconstructing negative thoughts to positive thoughts has been shown to be an effective form of treatment to elevate mood (Burns, 2008). Perhaps the addition of CBT in conjunction with biofeedback may have added to the high level of treatment satisfaction in this current study. For these reasons, participants in this study may have experienced a high level of satisfaction with the services delivered due to the physiological lens which biofeedback applications provide and implementing biofeedback in conjunction with counseling.

Research question 4: How do clients rank their preferences of biofeedback measurements after completing the integrated training protocol? Participants ranked the following biofeedback training measurements from most (5) to least (1) helpful in respect to symptom reduction. The researcher computed the mean score for each measurement to determine ranking of the measurements. Results indicate the majority of participants

ranked neurofeedback as the most helpful measurement, followed by a combination of HRV training and neurofeedback, followed by HRV training. Scores for skin temperature and skin conductance were the same, ranking these two measurements as least helpful. Where no previous study has been conducted to allow participants to rank biofeedback measurements, there are a few possible explanations for these results.

Neurofeedback. First, participants may have directly experienced the of benefits neurofeedback training. Neurofeedback is implemented to target the CNS and neurological processes (Hammond, 2007; Johntson et al, 2010; Othmer & Othmer, 2009; Raymond et al., 2004; Robbins, 2000). In addition, neurofeedback has been deemed an efficacious form of treatment for decreasing symptomology of anxiety (Hammond, 2005; Hill & Castro, 2002; Thatcher & Lubar, 2009; Thompson & Thompson, 2005). Participants in this study were trained to change the firing rate of their brainwaves thus decreasing symptomology. In previous studies, clients have reported experiencing positive changes in mood, an increase of energy, and a decrease of symptoms after engaging in a neurofeedback protocol (Hammond, 2007; Othmer & Othmer, 2009; Peniston & Kulkosky, 1991; Peniston, Marrinan, Deming & Kulkosky, 1993; Raymond et al., 2005; Thatcher & Lubar, 2009; Walker, 2009). Particularly, training individuals to increase SMR brainwaves, similar to the training participants engaged in during this current study, leads to a calming effect, allowing individuals to attend to tasks with improved focus (Lubar & Shouse, 1976; Thatcher & Lubar, 2009).

Another possible explanation for ranking neurofeedback as most helpful may be that participants enjoyed the visual representation of their brainwaves provided by the biofeedback output. Brainwave data is not as tangible as physiological data collected

from other biofeedback measurements. Previous studies have reported clients appreciate how brainwaves are converted into a visual representation so they are able to better understand and gain techniques over their neurological functioning (Carmichael, 2009; Hammond, 2007; Othmer & Othmer, 2009; Thompson & Thompson, 1998; Wilson, 2009). Incorporating neurofeedback training into counseling aids clients to visually witness the internal changes made within their CNS when in compliance with therapeutic interventions led by the counselor (Carmichael, 2009; Wilson, 2009). An additional consideration for this high ranking may be due to the order in which neurofeedback was taught in this particular study. Neurofeedback was one of the last training measurements implemented in this study. For this reason, participants may have already experienced the physiological benefits from engaging in biofeedback training prior to engaging in neurofeedback and therefore ranked neurofeedback as most helpful.

Combination. Participants in this study ranked the combination of training HRV and neurofeedback simultaneously as the second most helpful of biofeedback training measurements. A possible explanation for this may be because these two measurements target the CAN directly. Research has shown mental health conditions are associated with imbalances in both the CNS and the ANS. These two systems work together particularly during times of distress (Thayer & Brosschot, 2005). Neurofeedback training targets the CNS directly to change the electrical activity of the brain, which in turn has been known to alter physiological responses associated with stress (Hammond, 2007; Larson et al., 2010; Russell-Chapin & Chapin, 2012). HRV training targets the ANS directly, which in turn has been known to alter neurological states associated with mental health conditions (Sherlin et al., 2010; Thayer & Brosschot, 2005; Zucker et al., 2009). Participants in this

study may have ranked the combination of training HRV and neurofeedback simultaneously as second to most helpful as this training approach directly targets the CAN, decreasing symptomology of both the CNS and the ANS.

While no previous study has shown the use of both HRV and neurofeedback training simultaneously, previous research has reported the benefits of integrating biofeedback training with neurofeedback. First, engaging in HRV biofeedback training has also been shown effective to alter brainwave activity (Sherlin et al., 2010; Yu et al., 2010). Respiration training utilized in conjunction with various biofeedback measurements and neurofeedback resulted in an increase in self-awareness and self-relaxation (Danskin & Walters, 1973), in addition to an improvement in focus and attention (Thompson & Thompson, 2005). Also, a combination of skin temperature training and neurofeedback was beneficial for decreasing symptoms of hyper-arousal (Peniston & Kulkosky, 1991). Therefore, participants in this study may have experienced benefits from engaging in the combination of HRV training with neurofeedback that were similar to those reported in previous studies. An additional explanation for ranking this combination of training as second to most helpful may be due to the order in which this combination was conducted in this particular study. Having previously engaged in biofeedback training, participants may have already experienced benefits of training prior to engaging in the combination of training HRV and neurofeedback simultaneously.

HRV. Participants in this study ranked HRV training as the third most helpful biofeedback training measurement. A possible explanation for this may be for the simplicity of the training. HRV training is a powerful technique enabling participants to alter the functioning of their ANS thus creating a balanced state and decreased

symptomology (ESC, 1996; Gervitz & Dalenberg, 2008; Gervitz & Lehrer, 2003; Wheat & Larkin, 2010; Zucker et al., 2009). However, all that is required of participants is to engage in paced breathing to slow heart rate and increase variability within each heartbeat (Zucker et al., 2009). Research has shown that achieving a tone within the vagal nerve through HRV training improves emotional, psychological, and physical wellbeing (Sutarto et al., 2010; Wheat & Larkin, 2010). Therefore, participants engaged in the simple task of deep breathing which has previously been shown to alter brainwave activity (Sherlin et al., 2010; Yu et al., 2010).

An additional explanation for ranking HRV as participants did in this study may be due to the order in which HRV training was conducted. HRV training was the first measurement in which participants were educated on and actively engaged in during this study. HRV training can have lasting effects (Wheat & Larkin, 2010). Participants in this study gained the skills needed to achieve a balance in the ANS and may have been able to continue respiration training without the use of the biofeedback equipment. Furthermore, participants re-experienced HRV training at the end of the protocol, as they engaged in HRV training and neurofeedback simultaneously. Having the opportunity to engage in this combination of training may have resulted in ranking solely HRV training as third most helpful.

Skin Temperature and Skin Conductance. Participants in this study ranked both skin temperature and skin conductance training as least helpful with identical mean scores. A possible explanation for this may be that participants felt they experienced more benefits from the other training measurements utilized in this study.

Skin temperature training is utilized to help individuals increase vasodilation of blood vessels in the hands and feet to decrease a stress response. Skin temperature training is similar to HRV training in that both are administered to help individuals achieve a state of relaxation by increasing blood circulation throughout the body (McGrady & Linden, 2003; Schwartz & Andrasik, 2003). For this reason, participants may have ranked skin temperature lower if they were already experiencing benefits of HRV training. When looking at the data, there were not high gains with this training measurement. Typically a relaxation response may be experienced when skin temperature reaches 92 to 95 degrees Fahrenheit in one's peripherals (Schwartz & Andrasik, 2003). The mean scores prior to engaging in skin temperature training were not very low (88°). Therefore, with skin temperature scores close to those representing a relaxation effect, participants may have found the other measurements more beneficial and ranked skin temperature training as least helpful.

Skin conductance training is utilized to decrease sweat gland activity associated with high levels of arousal (Peek, 2003). Counselors may implement skin conductance training in conjunction with CBT to help clients understand the physiological responses associated with cognitive distortions (Carmichael, 2009; Frank et al., 2010; Thompson & Thompson, 1998; Wilson, 2009). Skin conductance training is a physiological representation of emotional well-being and mental state, as it changes with each thought or feeling (Peek, 2003). This training may be associated with neurofeedback as both targets reconstructing faulty thought patterns to change physiology (Thompson & Thompson, 1998). While changes in skin conductance were statistically significant, participants in this study ranked this measurement lower than neurofeedback training. A

possible explanation for this may be that participants found neurofeedback training, which has similar principles as skin conductance training, more beneficial to help them decrease symptomology. Furthermore, neurofeedback provides a visual representation of thought patterns through the firing of brainwaves. Participants may have found this physiological representation more appealing when compared to skin conductance training.

Another possible explanation for the low ranking of skin conductance training may be due to the order in which it was implemented within this training protocol. Skin conductance training was one of the second biofeedback measurements to be administered. After skin conductance training, participants were educated on and engaged in neurofeedback and the combination of training HRV and neurofeedback simultaneously. Having engaged in these last two training methods prior to the ranking of the biofeedback measurements may have played a role in how participants viewed skin conductance.

Research question 5: After completing the integrated training protocol, is there a relationship between clients' perception of the working alliance and changes in physiological scores taken pre and post training? A Pearson's correlation was conducted and results indicated no significant relationships existed between the difference or percent of changes in physiological scores and the WAI-SR. A possible explanation for these results could be the due to the small sample size. With only ten study participants, no relationships were statistically significant. However, weighting the data to increase the sample size to 20 and 50 participants may result in relationships that are statistically

significant as shown in Table 9. Therefore, had there been more study participants, more relationships may have existed between changes in physiology and the working alliance.

Table 9

Pearson's Correlation: Changes in Physiology and WAI-SR

Physiological Measurement	Δ in Pre/ Post-training Scores			% Δ in Pre/Post-training Scores		
	N = 10	N = 20	N = 50	N = 10	N = 20	N = 50
HRV	-0.36	-0.36	-0.36*	0.14	0.14	0.14
ST	-0.07	0.07	0.07	-0.03	-0.03	-0.03
SC	-0.22	-0.22	-0.22	-0.45	-0.45*	-0.45*
T/S	0.36	0.36	0.36*	0.36	0.36	0.36*

Note. Biofeedback measurements have been abbreviated as follows: ST = skin temperature, SC = skin conductance, neuro = neurofeedback, combo = combination of HRV training and neurofeedback, T/S = theta/SMR ratio. *p < .05.

In addition, results of the current study indicate no variability according to how participants rated the bonding component of the working alliance. Results also indicated little variability was shown in the goals and tasks components of the working alliance. A larger sample size may have increased the variability in ratings of the working alliance and participants' perception of biofeedback. With increased variability as a function of sample size, discerning significant relationships may be more probable.

Research question 6: After completing the integrated training protocol, is there a relationship between clients' treatment satisfaction and changes in physiological scores taken pre and post training? A Pearson's correlation was conducted and revealed one of the eight possible relationships was significant. The TxSI correlated with the percent of

change in skin conductance was significant indicating an inverse relationship exists between improvement (decrease) in skin conductance and high (increase) treatment satisfaction. A possible explanation for this may be that experiencing a decrease in physiological arousal, as measured by skin conductance, after engaging in the integrated training protocol may allow participants to experience an increased level of satisfaction for the training. Similar to previous studies, participants in this study may have appreciated the visual representation of their ability to control this physiological parameter to stress through use of the biofeedback output (Carmichael, 2009; Danskin & Walters, 1973; Hammond, 2007; Henschem, 1976; Myers & Young, 2012; Othmer & Othmer, 2009; Thompson & Thompson, 1998; Romano, 1982). In addition, weighting the data to increase sample size to equate to 20 and 50 participants revealed more potential relationships as shown in Table 10. Therefore, had there been more study participants, more relationships may have existed between changes in physiology and the treatment satisfaction.

Table 10

Pearson's Correlation: Changes in Physiology and the TxSI

Physiological	Δ Pre/ Post-training Scores			% Δ Pre/Post-training Scores		
Measurement	N = 10	N = 20	N = 50	N = 10	N = 20	N = 50
HRV	-0.30	-0.30	-0.30*	0.34	0.34	0.34
ST	0.06	0.06	0.06	0.10	0.10	0.10
SC	-0.51	-0.51*	-0.51**	-0.80*	-0.80**	-0.80**
T/S	0.23	0.23	0.23	0.24	0.24	0.24

Note. Biofeedback measurements have been abbreviated as follows: ST = skin temperature, SC = skin conductance, neuro = neurofeedback, combo = combination of HRV training and neurofeedback, T/S = theta/SMR ratio. *p < 0.05. **p < 0.01

In addition, results of the current study indicate little variability in the rating of the treatment satisfaction. A larger sample size may have increased the variability in ratings of treatment satisfaction and participants' perception of biofeedback. With increased variability as a function of sample size, discerning significant relationships may be more probable.

Research question 7: After completing the integrated training protocol, is there a relationship between the clients' ranking of biofeedback measurements and changes in physiological scores taken pre and post training? A Spearman's correlation was conducted between differences and percent of changes in physiological scores and how participants ranked the biofeedback measurements. Two of these relationships were significant. A negative significant relationship exists between an improvement (decrease) in skin conductance as measured by the percent of change between pre and post training,

and how clients ranked skin temperature measurement. As no previous studies exist that rank biofeedback measurements or compares these relationships, a possible explanation for this relationship may be that decreasing physiological arousal through use of skin conductance allowed the participants to achieve a sense of relaxation relating to how skin temperature was ranked.

A significant positive relationship exists between the percent of change in HRV scores as measured before and after engaging in the integrated training protocol and how clients ranked training combining HRV and neurofeedback. A possible explanation for this relationship may be that while participants were experiencing the benefits of HRV training, they appreciated the addition of neurofeedback training screens. Previous research has indicated changing respiration rate impacts the firing of the brain (Sherlin et al., 2012). Perhaps participants in this study enjoyed viewing the full benefits of HRV training as it impacts both the ANS and the CNS (Sherlin et al., 2012).

In this current study, HRV training was administered at two separate times within the integrated training protocol. Initially study participants were educated on and engaged in HRV training prior to any other biofeedback measurement. Also, at the end of the training protocol participants were given the opportunity to engage in a combination of HRV training and neurofeedback. Therefore, participants had multiple opportunities to engage in HRV training. Previous studies indicate there are lasting benefits to HRV training (Wheat & Larkin, 2010). Also, many studies explain the benefits of integrating biofeedback and neurofeedback to target the CAN directly (Danskin & Walters, 1973; Sherlin et al., 2010; Yu et al., 2010; Thompson & Thompson, 2005). While no previous studies have been conducted to rank biofeedback measurements or compare these

relationships, a possible explanation for the relationship between the percent of change in HRV and ranking of the combination of training HRV and neurofeedback may be due to the amount of training received and the benefits the participants experienced. Furthermore, had there been additional study participants there may have been more statistically significant relationships between the changes in physiology and how participants ranked the biofeedback measurements. Weighting the data to increase sample size provides an example of the relationships that may have occurred had there been a total of 20 study participants as shown in Table 11 and 50 study participants as shown in Table 12.

Table 11

Spearman's Correlation: Relationships between Changes & Percent of Change in Physiology and Ranking Biofeedback Measurements n =20

Physiological Measure	HRV Rank	ST Rank	SC Rank	Neuro Rank	Combo Rank
HRV Δ	-0.10	0.01	0.30	-0.57**	0.40
HRV % Δ	-0.23	0.55*	-0.05	-0.57**	.67**
ST Δ	-0.18	0.31	0.17	-0.48*	0.42
ST % Δ	-0.18	0.30	0.17	-0.48*	0.42
SC Δ	0.35	-0.55*	0.29	-0.15	-0.18
SC % Δ	0.47*	-.65**	0.36	-0.13	-0.30
T/S Δ	0.01	-0.13	0.08	0.37	-0.28
T/S % Δ	0.04	-0.18	0.13	0.25	-0.23

Note. Biofeedback measurements have been abbreviated as follows: ST = skin temperature, SC = skin conductance, neuro = neurofeedback, combo = combination of HRV training and neurofeedback, T/S = theta/SMR ratio. *p < .05. ** p < 0.01.

Table 12

Spearman's Correlation: Relationships Between Changes and Percent of Change in Physiology and Ranking Biofeedback Measurements n =50

Physiological Measure	HRV Rank	ST Rank	SC Rank	Neuro Rank	Combo Rank
HRV Δ	-0.10	0.01	0.30*	-0.57**	0.40**
HRV % Δ	-0.23	0.55**	-0.05	-0.57**	.67**
ST Δ	-0.18	0.31*	0.17	-0.48**	0.42**
ST % Δ	-0.18	0.30*	0.17	-0.48**	0.42**
SC Δ	0.35*	-0.55**	0.29*	-0.15	-0.18
SC % Δ	0.47*	-.65**	0.36**	-0.13	-0.30*
T/S Δ	0.01	-0.13	0.08	0.37*	-0.28
T/S % Δ	0.04	-0.18	0.13	0.25	-0.23

Note. Biofeedback measurements have been abbreviated as follows: ST = skin temperature, SC = skin conductance, neuro = neurofeedback, combo = combination of HRV training and neurofeedback, T/S = theta/SMR ratio. *p < .05. **p<0.01.

In addition, a larger sample size may have increased the variability in rankings of the working alliance and participants' perception of biofeedback. With increased variability as a function of sample size, discerning significant relationships may be more probable.

Summary of Results of Research Questions

Both objective and subjective data was gathered during this research study. Objective data consisted of the four different physiological measurements taken before and after engaging in the integrated training protocol. Differences between these scores and the percent of change which occurred were computed. Subjective data included the WAI-SR and the TxSI rated by the participants. Also, participants ranked the biofeedback measurements from most to least helpful. Data was used to explore the participants' experience of engaging in an integrated training protocol.

To answer research question one, a one-way repeated measures MANOVA was conducted to answer research question one. Results indicated changes occurred in all four physiological parameters after engaging in the integrated training protocol. Changes in HRV and skin conductance were statistically significant while changes in skin temperature and Theta/SMR ratios were not statistically significant. Specifically, results indicated changes occurred after engaging in the integrated training protocol. The mean scores were computed to answer research questions two, three, and four. Results from research questions two and three indicate participants rated the working alliance as strong and experienced a high level of treatment satisfaction after engaging in the integrated training protocol. Results from research question four indicate participants found neurofeedback to be the most helpful measurement, followed by a combination of HRV training and neurofeedback, followed by HRV training. Participants ranked both skin temperature and skin conductance training as least helpful.

A Pearson's correlation was conducted to answer research questions five and six. Results from research question five indicate no significant relationship exists between

changes in physiological states measured before and after engaging in the integrated training protocol and the WAI-SR. Results from research question six indicate only one relationship existed between changes in physiological states measured before and after engaging in the integrated training protocol and the TxSI. A negative relationship existed between the improvement (decrease) in skin conductance and a high level of treatment satisfaction. A Spearman's correlation was conducted to answer research question seven. Results of research question seven indicated two relationships existed between changes in physiological states measured before and after engaging in the integrated training protocol and how participants ranked the biofeedback measurements. A negative significant relationship exists between an improvement (decrease) in skin conductance as measured by the percent of change between pre and post training, and how clients ranked skin temperature measurement. A significant positive relationship exists between the percent of change in HRV scores as measured before and after engaging in the integrated training protocol and how clients ranked training combining HRV and neurofeedback.

Study Limitations

The current study utilized a descriptive field study design with an emphasis on process evaluation to assess the clients' perspective of implementing the integrated training protocol into counseling. A descriptive research design may be utilized to increase knowledge and understanding about behaviors and thought processes which occur within natural environments (Trochim, 2006). The purpose of this current field experiment, which was conducted in the naturalistic environment of an outpatient clinic, was to explore the implementation of an integrated training protocol in relation to the counseling experience as defined by process variables including the working alliance and

treatment satisfaction. Limitations of the study involve issues concerning the research design.

Internal Validity

Internal validity is the extent to which a causal conclusion based on a study is defensible (Trochim, 2006). Results obtained and the relationships between the independent and dependent variables are not completely free from potential errors. By utilizing a descriptive field study design, the researcher must consider the following threats to internal validity.

A Convenience Sample. Because there was no control group, the descriptive field study design allowed for participant selection in this study to utilize a convenience sampling from the archival data obtained. Therefore, the study sample size was relatively small (n = 10) and lacked randomization. With a small sample size, the researcher is less confident in the differences which occurred and is cautious when making conclusions regarding the data.

Experimenter Bias. All assessments in this study were administered by the counselor who was conducting the research. Therefore, a therapeutic relationship was already established which may be problematic for research purposes. Participants may have responded to please the counselor or altered their responses to meet the expectation of the counselor instead of completing the assessments free of preconceived judgments (Moore et al., 2009). The researcher must be cautious of this when interpreting the results.

History. The descriptive field study design allowed for the research to be conducted in the natural setting of a counseling clinic. As a result, the researcher was

unable to prevent or control for events (family crises, relationship statuses, career changes, involvement in other therapeutic interventions) occurring outside of the study. Such events may influence the clients' responses on the assessments given. The researcher is aware of history threats that may have influenced the change that occurred within the study and must be cautious of this when interpreting the results.

Instrumentation. No previous research has reported the limitations of the subjective assessments utilized in this study. However, both the WAI-SR and the TxSI are both self-report measurements. While self-report assessments provide information that may not always be accessible through observations, there are disadvantages associated with validity when collecting this data. Data reported is personal, according to the individual's perception, and may be biased (Baker, Pistrang, & Elliot, 2002). The disadvantages of these subjective scales must be considered when interpreting the results.

The research design utilized in this study allowed for this study to take place in a natural setting. Despite these threats, conducting this study was justified based on the purpose and the goals of the study.

External Validity

External validity is the extent to which the results of this study may be generalizable to other populations (Trochim, 2006). The current study utilized a descriptive field study design with convenience sampling of participants obtained from archival data. As a result, the sample size was relatively small (n = 10). Therefore, generalizing the findings must be approached with caution. All participants reported they experienced anxiety and expressed an interest to learn self-help skills to better control symptomology of their stress response. The physiological basis of mental health

conditions is stress related in nature (American Institute of Stress, 2013; APA, 2013). Utilizing a training approach, biofeedback techniques have been deemed an efficacious form of treatment for stress-related conditions and are applicable for most populations (Moss & Gunkelman, 2002). Therefore, it would make sense to generalize these findings to a larger population consisting of individuals seeking counseling during times of distress; however, this must be done with caution. While this small sample may be representative of the general population, the researcher is aware of the specific demographics of the participants in the sample which may be limiting to other populations. All participants in this study sample expressed a desire to learn tools to better manage symptomology of anxiety the experienced. Therefore, they were motivated to engage in the training protocol which may explain the high level of attendance. In addition, all participants were able to meet the financial obligations based on the sliding scale fees in which the clinic operated. Also, the protocol followed in this study was implemented with flexibility which limits replication in future studies. A descriptive protocol has been provided for future research (Appendix B). Larger scale studies are needed to reduce threats of external validity and increase generalizability.

Conclusion Validity

Conclusion validity is helpful when considering conclusions about relationships within the data are reasonable, not causal. Valid conclusions about the data may be constructed as a detailed description of the protocol was provided. With only one counselor implementing the protocol, all study participants were educated on physiological states in relation to their current condition and coached to control these physiological responses in a similar manner. Benefits of this research design allowed for flexibility in the

implementation of the integrated training protocol. While this may affect future replication of the study, a descriptive field experiment enabled the counselor to conduct research in a natural setting adhering to the principles of counseling by permitting psychotherapy to take place based on the needs of the consumer. The number of sessions and the time spent on each biofeedback training measurement varied among participants. Also, participants moved through the protocol according to their needs. The research design in this current study allowed for flexible implementation of the protocol outweighing the threats to conclusion validity.

Implications for Future Research and Counseling Practice

The purpose of this study was to conduct a process evaluation of the use of a training protocol integrating biofeedback and neurofeedback applications to alleviate symptomology of mental health conditions. The results of this study reveal elements of a prospective model for implementing biofeedback into future research and counseling practice.

Future Research.

The results of this study reveal elements of a prospective model for future research implementing biofeedback into counseling. A primary disadvantage of this research design was the lack of a control group in which to compare the results. While the results from this current study are both intriguing and encouraging, controlled studies are required to determine causal relationships.

Larger scale investigations may be useful to determine if participation in the integrated training protocol affects the therapeutic relationship and level of treatment satisfaction above and beyond the descriptive nature of the current study. While the results

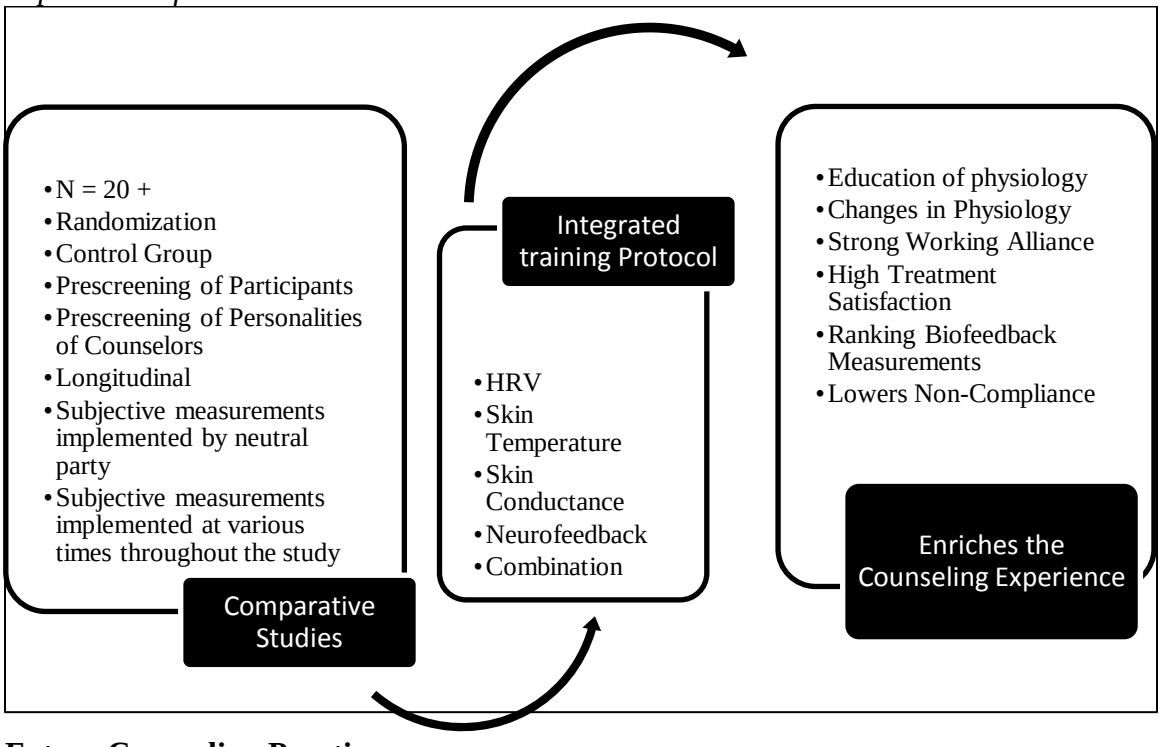
of this study indicated positive outcomes, larger scale studies which include a control group may help future researchers to determine if the changes in physiology along with how participants rated both the working alliance and treatment satisfaction are a result of implementing biofeedback, or how the counselor in this particular study utilized the biofeedback output. Comparative groups may also help to rule out placebo effects in terms of subjective scales. In addition, future studies may be needed to compare the effectiveness of the integrated training protocol as a means to increase the working alliance and improve treatment satisfaction. Studies like these with more empirical control would help determine if and how integrating biofeedback enhances counseling. For example, one enhancement may be increasing session attendance. If clients feel a stronger working alliance and are more satisfied with counseling that implements biofeedback applications, they may be more likely to attend and complete the counseling process. Indeed, previous research has determined implementing biofeedback applications into counseling assists counselors in attending to the immediate concerns of the client thus requiring fewer sessions to obtain relief and meet personal goals (Henschem, 1976; Larson et al., 2010). Also, research has indicated biofeedback training to have lasting effects (Barowsky, Moskowitz, & Zweig, 1990; Cannici, Malcolm, & Peek, 1983; Carmichael, 2009; Crockett & Bilsker, 1984; Henschem, 1976; McGrady & Linden, 2003; Schwartz & Sedlacek, 2003; Wheat & Larkin, 2010). Not only will future research determine the prospective enhancement to counseling provided by implementing biofeedback, future research may also consider the relative impact of the counselor. In other words, future research is needed to determine if the impact of biofeedback is powerful enough to preclude the presence of the counselor, or is the counselor relationship indispensable. Additionally, future research may look at the

impact of different counselors and their respective styles as the current study only had one counselor. Future research may also be conducted to determine if the biofeedback applications were helpful to demystify the process of counseling, or did training of the physiological states utilizing the biofeedback measurements truly impact treatment satisfaction. While results of this current study revealed physiological changes occurred after engaging in a range of training sessions (between 7 and 15 among the participants), longitudinal studies are encouraged to determine long term effects of participation in the integrated training protocol, particularly those which examine the relative impact of the counseling relationship.

Given the nature of participant selection, this current study sample included a small number of participants. With a larger number of study participants, researchers may conclude statistically significant differences that may be generalized to the given population. With a larger sample size that had variability within the study sample, researchers may be able to determine if this integrated training protocol is applicable to populations that differed in demographics comparative to this current study sample. In addition, with a larger sample size, researchers may determine if stronger relationships exist between the objective and subjective data gathered. Future research may consider conducting a correlation between the working alliance and treatment satisfaction after engaging in the integrated training protocol if a relationship between these two variables exists. A prospective model was constructed to explore future research to determine the effectiveness of implementing an integrated training protocol into counseling as a means to enrich the counseling experience with an emphasis on the working alliance and treatment satisfaction as shown in Figure 6.

Figure 6

Implications for Future Research



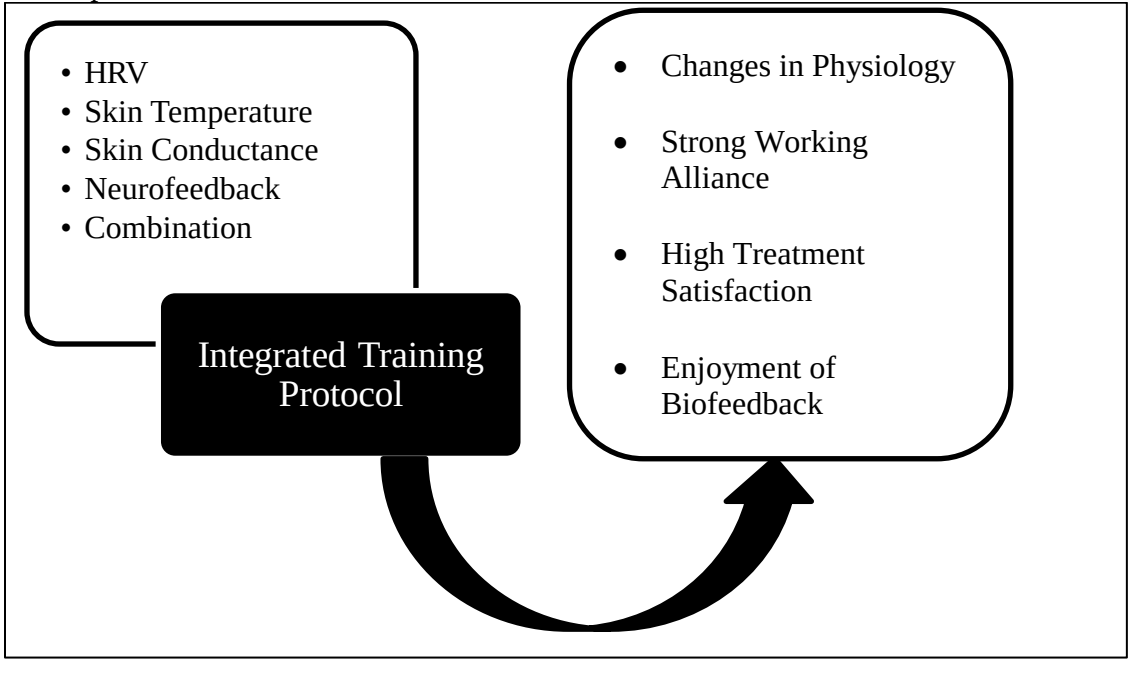
Future Counseling Practice.

Results from this study indicate implementing an integrated training protocol into counseling helps improve physiological states associated with mental health conditions. In addition, counselors may find that through the implementation of biofeedback, clients may experience a strong working alliance and may be highly satisfied with the treatment provided, particularly when utilizing neurofeedback, HRV, and a combination of training these two measurements simultaneously. While the researcher is unable to determine causal relationships, it is reasonable to conclude implementing biofeedback and counseling does lead to positive outcomes as revealed in the results of this study. Therefore, the results of this study warrant the implication for future counseling practice. An additional variable to include in future practice may be to record and display the

counselor's physiology during the session as well as the client's to determine how both parties are reacting throughout the session. This information may help practitioners to decipher how their attitude and how they attend the session may impact the client's progress in counseling. With continued practice, perhaps counselors may be able to one day define implementing biofeedback and counseling as best practice. A prospective model has been constructed implementing an integrated training protocol into counseling as shown in Figure 7.

Figure 7

A Prospective Model



Conclusion

The purpose of this study was to evaluate clients' experience of engaging in an integrating training protocol used as a means to enrich the counseling experience. Valuable information was gathered from this research study. Desired changes in physiological states occurred when measured before and after engaging in the integrated training protocol.

Participants rated a strong working alliance and a high level of treatment satisfaction after engaging in the integrated training protocol. Participants also rated the biofeedback measurements from most to least helpful as follows: 1) neurofeedback, 2) combination of HRV training and neurofeedback, 3) HRV, and 4) skin temperature and skin conductance. In addition, correlational analyses revealed relationships existed between the objective and subjective data. This chapter provided possible explanations for the results of the study.

Both objective and subjective data was obtained to evaluate the integrated training protocol and explore the research questions. Results of this study indicate clients had a positive experience engaging in the process of the integrated training protocol. The data obtained in this study was used to construct a prospective model for the implementation of an integrated training protocol into counseling. The model proposes biofeedback applications may be used as a means to enrich the counseling experience defined through the working alliance and treatment satisfaction. If clients feel a stronger working alliance and are more satisfied with counseling that implements biofeedback applications, they may be more likely to attend and complete the counseling process. Future research is needed to determine causal relationships between the integrated training protocol and the working alliance and treatment satisfaction.

This chapter began with a summary of the current study, including the purpose, variables, sample, and data collection procedures which were utilized in this study. An interpretation of the study results was provided along with possible explanations for these results. The limitations of the study were presented, followed by implications for future research and practice.

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APPENDIX A: NAVIGATE CONSENT FORM

Study ID:UMCIRB 12-000419 Date Approved: 7/9/2012 Expiration Date: 7/8/2013

East Carolina University

Informed Consent to Participate in Research

Information to consider before taking part in research that has no more than minimal risk.

Title of Research Study: Effects of Counseling Interventions with Clients Receiving Counseling at the Navigate Clinic
Principal Investigator: Stephen Leierer, PhD
Institution/Department or Division: Department of Addictions and Rehabilitation Studies
Address: 4410 Health Sciences Building, Mail Stop 677, East Carolina University, Greenville, NC 27858
Telephone #: (252) 744-0328

Researchers at East Carolina University (ECU) and the Navigate Counseling Clinic in the Department of Addictions and Rehabilitation Studies study problems in society, health problems, environmental problems, behavior problems and the human condition. Our goal is to try to find ways to improve the lives of you and others. To do this, we need the help of volunteers who are willing to take part in research.

Why is this research being done?
The purpose of this research is to evaluate the effectiveness of counseling services as provided by the Navigate Counseling Clinic. The decision to take part in this research is yours to make. By doing this research, we hope to learn more about counseling outcomes and processes including client attendance, therapeutic homework completion, and client satisfaction with counseling services.

Why am I being invited to take part in this research?
You are being invited to take part in this research because you have chosen to receive counseling related services at the Navigate Counseling Clinic. If you volunteer to take part in this research, you will be one of an estimated 200 people to do so from the Navigate Counseling Clinic.

Are there reasons I should not take part in this research?
I understand I should not volunteer for this study if I am under 18 years of age, am seeking couples counseling, medically unstable, or am actively experiencing psychotic symptoms (e.g. delusions, hallucinations).

What other choices do I have if I do not take part in this research?
You can choose not to participate. If you choose not to participate, you can continue to receive services from the Navigate Counseling Clinic.

Where is the research going to take place and how long will it last?
The research procedures will be conducted at the Navigate Counseling Clinic on the 4th floor of the Allied Health Building. You will need to come to Room 4410 at your scheduled counseling appointment during the study. An estimated two hours of services is expected beyond normally scheduled counseling. Counseling will begin and end based on individual client needs. The total amount of time you will be asked to volunteer for this study is approximately two hours for research and evaluation activities beyond normally conducted counseling.

What will I be asked to do?
You are being asked to do the following:

- Complete the GAIN assessment during intake to the counseling clinic. The GAIN is a verbally administered assessment containing questions on one's history pertinent to counseling including school, career, life stressors, crime/violence, substance use, life satisfaction, physical and mental health, and risky behavior.
- Complete the GAIN assessment following discharge.
- Participate in counseling sessions in which the counselor is video recorded. As a client, only voice will be recorded.
- A client may opt out of participation in research (video recording) while still receiving counseling services. All clients regardless of research participation will be administered the GAIN as part of an intake assessment.
- Video recordings will be collected and stored via a fully HIPAA compliant, encrypted, and password protected video recording system.
- GAIN Data Management Services (Chestnut Health Systems, 448 Wylie Drive, Normal, IL) will have access to your de-identified data.

What possible harms or discomforts might I experience if I take part in the research?
It has been determined that the risks associated with this research are no more than what you would experience in everyday life.

What are the possible benefits I may experience from taking part in this research?
We do not know if you will get any benefits by taking part in this study. This research might help us learn more about how counseling services work to benefit clients. There may be no personal benefit from your participation beyond that normally received from counseling related services, but the information gained by doing this research may help others in the future.

Will I be paid for taking part in this research?
We will not be able to pay you for the time you volunteer while being in this study.

What will it cost me to take part in this research?
You will be asked to pay for counseling services based on a sliding scale fee. Should you be unemployed or unable to pay, you will not be turned away for services.

Who will know that I took part in this research and learn personal information about me?
To do this research, ECU and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. With your permission, these people may use your private information to do this research:

- Any agency of the federal, state, or local government that regulates human research. This includes the Department of Health and Human Services (DHHS), the North Carolina Department of Health, and the Office for Human Research Protections.
- The University & Medical Center Institutional Review Board (UMCIRB) and its staff, who have responsibility for overseeing your welfare during this research, and other ECU staff who oversee this research.

How will you keep the information you collect about me secure? How long will you keep it?
Recordings will be kept until the study is closed at which point all recordings will be completely erased from the video recording system. Video recordings will be used only for research and clinical supervision purposes. Client paperwork and records will be stored in a locked filing cabinet with access given only to clinic staff. GAIN data will be stored in encrypted HIPAA compliant form.

***Title of Study**: Effects of Counseling Interventions with Clients Receiving Counseling at the Navigate Clinic*

What if I decide I do not want to continue in this research?
If you decide you no longer want to be in this research after it has already started, you may stop at any time. You will not be penalized or criticized for stopping. You will not lose any benefits that you should normally receive.

Who should I contact if I have questions?
The people conducting this study will be available to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator, Stephen Leierer, PhD, at (252) 744-6298, Monday-Thursday, 7am-9am.

If you have questions about your rights as someone taking part in research, you may call the Office for Human Research Integrity (OHRI) at phone number 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of the OHRI, at 252-744-1971

I have decided I want to take part in this research. What should I do now?
The person obtaining informed consent will ask you to read the following and if you agree, you should sign this form:

- I have read (or had read to me) all of the above information.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I know that I can stop taking part in this study at any time.
- By signing this informed consent form, I am not giving up any of my rights.
- I have been given a copy of this consent document, and it is mine to keep.

_____ _____ _____
Participant's Name (PRINT) **Signature** **Date**

Person Obtaining Informed Consent: I have conducted the initial informed consent process. I have orally reviewed the contents of the consent document with the person who has signed above, and answered all of the person's questions about the research.

_____ _____ _____
Person Obtaining Consent (PRINT) **Signature** **Date**

_____ _____ _____
Principal Investigator (PRINT) **Signature** **Date**
(If other than person obtaining informed consent)

APPENDIX B: EXPLAINING THE PROTOCOL

An Introduction to Biofeedback: Explanations and Recording Procedures

During the first session, the following steps were taken to introduce the client to the training protocol integrating biofeedback and neurofeedback. Clients met with the counselor implementing the integrated training protocol and engaged in the following:

1. Clients identified personal goals and expectations for training.
2. Both the counselor and the client clarified their roles and expectations of themselves and for each other.
3. Clients were educated about the following:
    a. Biological reactions of the central nervous system and autonomic nervous system that occur during a stress response
    b. Biofeedback and neurofeedback principles and procedures in relation to these biological reactions during a stress response
4. The counselor clarified any misconceptions about biofeedback training and addressed any of the client's concerns.
5. Physiological baseline measurements were obtained in the following manner:
    a. The counselor would explain how the sensor would need to be attached to the client in order to gather the biofeedback data
    b. After receiving verbal consent from the client to participate in biofeedback training and allow the counselor to attach the sensors, the counselor would attach the biofeedback sensors to the client and simultaneously explain the principles for utilizing these modalities to measure physiological responses to stress as follows.

Heart Rate Variability

HRV data was obtained through use of a photo-plethysmograph attached to the clients' ear. The data was calculated utilizing Biocom Technology's Heart Tracker 3.0 professional addition program and displayed on the computer screen.

The counselor explained the role of the vagus nerve and reviewed the branches of the ANS. In addition, the counselor explained that when in a fight or flight stance, the vagal brake is removed allowing heart rate to increase. As a result, blood vessels quickly constrict and dilate, pumping blood throughout the body. HRV biofeedback measurements display the functioning of the ANS in real time quantified in terms of both a time and frequency domain.

In the time domain, information displayed quantifies heart beats per minute and variation in heart rate. When in a fight or flight state, fast, shallow breaths will increase the heart rate and decrease the variation. Often clients may report feeling their heart racing and describe the sensation as if their heart will beat right out of their chest. Plotted on a time domain consisting of time on the x-axis and heart rate on the y-axis, the heart rate of a client in a state of over-arousal will look scattered and chaotic. When functioning with the ANS in a balanced state, heart rate should automatically increase during inhalation and decrease during exhalation. In addition, there should be variation or fluctuation among heart rate, at a coherent degree.

The frequency domain quantifies the variation, or fluctuation of the heart rate that occurs during each heartbeat with calculations including

1. Very low frequency (VLF) represents very little change or variation in heart rate between each heartbeat, indicative of sympathetic nervous system activation or a state of fight or flight.
2. High frequency (HF) represents much variation in of heart rate between each heartbeat, indicative of parasympathetic nervous system activation, known as the braking response that enables the body to return to a state of homeostasis.
3. Low frequency (LF) is a combination of both very low frequency and high frequency calculations and is indicative of a balance in the autonomic nervous system.

The goal of heart rate variability training is to increase LF and achieve a balance between the sympathetic and parasympathetic branches of the ANS, thus creating a tone within the vagus nerve. This change is accomplished by regulating respiration rate, breathing in a controlled but relaxed manner at six breaths per minute. Ultimately breathing and heart rate begin to synch and the individual achieves a balance in the autonomic nervous system.

Skin Conductance

Skin conductance sensors were attached, using Velcro straps, onto two of the client's fingertips of their non-dominant hand. The non-dominant hand is preferred as it is typically less calloused. Callouses may interfere with the electrical signal. This biofeedback data was captured using the Thought Technology recording device and displayed on a computer screen.

The counselor explained when in a state of sympathetic arousal, or during a fight or flight response, sweat glands open to enable the release of toxins and help the body

work more efficiently and escape danger. Sweating also helps cool the body as core temperature rises during times of fight or flight. Often times, individuals' perceptions of a stressor are more detrimental to their being than the stressor itself. Reacting with a heightened stress response at times when in reality this response is not needed due to the stressor has physical and psychological implications for the individual.

Thought life. Thoughts are constructed of both chemical and electrical processes. Every given thought leads to a feeling which shapes an attitude and causes a behavior. Therefore, any thought process, be that positive or negative, will have corresponding chemical and electrical activity. As an individual thinks a certain way, certain processes send signals throughout the body so the individual may respond a certain way. For example, a cognitive threat of danger leads to physiological arousal which is measurable through skin conductance. As the body prepares for danger, sweat glands open allowing the individual to produce more sweat. The process however, is bi-directional, meaning that signals do not only begin from the brain and are relayed through the body, but when absorbed from the senses will relay signals to the brain.

The body keeps the score. Not all states of fight or flight begin in the brain with a thought. The body gathers information through sensory neurons and is also aware of danger, sometimes even before the individual may be conscious of its presence. Senses of smell and touch automatically trigger an emotional response that the brain does not fully process to make sense of before signaling for danger. An over-active ANS signals the brain of danger and reinforces faulty thought patterns, which in turn release corresponding chemicals throughout the body to help enable the fight-or-flight response.

Changing faulty patterns of functioning. Biofeedback measuring skin conductance shows an increase or decrease in sweat gland activity which is indicative of a stress response. Therefore, as the number on the skin conductivity measure increases, the more sweat glands are opened, to produce sweat. When an individual continuously experiences a heightened level of stress response that exceeds the amount needed for the stressor itself, the body adapts to functioning in this manner and the brain perceives this state as normal. Using skin conductance measurements helps the individual become aware of these physiological responses to stress. Moreover, when skin conductance measurements are used in conjunction with therapy, clients become more aware of how certain thought processes may influence physiological responses. This biofeedback modality is used to help individual learn to differentiate their levels of stress in various situations. Separating the emotional aspect from the situation allows individuals to process the situation differently, reconstruct faulty thought patterns, and gain a more realistic perspective of the situation.

Skin Temperature

Skin temperature is measured by attaching the skin temperature probe to the client's fifth finger using paper tape that was strategically placed to prevent trapping heat by the tape. The counselor also was cautious to only wrap tape around ¾ of the client's finger, allowing for proper blood circulation to occur. This biofeedback data was captured using the Thought Technology recording device and displayed on a computer screen.

The counselor explained, when in a state of flight or flight, blood vessels constrict in the peripherals (hands and feet), which allows the blood to pool in the core and protect

vital organs. This process leaves the hands and feet to feel cold. Skin temperature biofeedback training is typically used in conjunction with autogenic training, incorporating mediation and relaxation techniques to teach individuals to increase dilation in the blood vessels in their peripherals and warm up their hands and feet. *"I feel quite quiet, my hands (or feet) are warm and heavy,"* was the phrase suggested by the counselor for the client to repeat in this phase of the training.

Baseline Measurements

After the counselor attached the HRV, skin conductance, and skin temperature sensors and explained the stress response according to these biofeedback modalities, she captured the client's physiological data while conducting a ten minute cognitive stress test following these procedures;

1. 2 minutes of silence to obtain baseline measurements
2. 2 minutes of engaging in a math task of subtracting by 7's from 100
3. 2 minutes to rest
4. 2 minutes of speaking of something stressful
5. 2 minutes to rest

Neurological baseline measurements were conducted in the same manner and were obtained utilizing a recording device manufactured by Thought Technology®. Through use of an electroencephalograph, brainwave data is quantified and displayed on the computer screen. The current study focuses on brainwaves including 1) theta, 2) SMR, and 3) high beta.

Neurofeedback

Clients were shown the EEG sensors that would be used to measure neurological data and train neurological responses. Clients were also shown the cleaning abrasive and conductance paste that is needed for neurofeedback. The counselor also asked if clients had any adverse reactions to rubbing alcohol. The counselor located the specified site of Cz according to the standard ten-twenty placement map (see Figure 1). While there is no central lobe, C refers to central location of the brain and z refers to 0 on a midline). The counselor cleaned the site with Nuprep®, a slight abrasive, to rid the site of natural oils. She then removed the cleaner with rubbing alcohol swabs. Both ear lobes were also cleaned utilizing alcohol swabs. After the site had dried, the counselor attached the active sensor on the client's scalp with Ten-20® conductance paste. Ten-20 paste was also applied on the ground which was then placed on the left ear and on the reference lead which was placed on the right ear. The EEG data was captured using the Thought Technology® recording device and displayed on a computer screen. The counselor determined if the electrical signal was acceptable by checking the impedance readings by switching the biofeedback device into the impedance mode. If the signal was impeded, the counselor readjusted the sensors or detached and replaced them if needed. The counselor also visibly inspected the EEG signal to determine if it was free of artifact by having the client clench their jaws and squint their eyes.

Clients were instructed to sit still and quietly for five minutes while neurological baseline data was recorded. The counselor explained Thought Technology® EEG screen. In addition, she described all brainwaves and functionality according to the neuropsychological arousal model (Evans & Abarbanel, 1999), which states that when functioning, brainwave frequencies change globally in a stereotypical pattern.

During the introduction to neurofeedback training, the counselor explains several brainwaves and functionality to clients. The counselor provided the following descriptions for the clients:

a. *Delta brainwaves* are the slowest firing waves produced at 0-4 hertz, or cycles per minute. Most delta waves should be kept to a minimum in the frontal regions of the brain during wakeful periods, and produced heavily in the back of the brain during sleep rhythms.
b. *Theta brainwaves* are is slightly faster than the delta wave, produced at 4-8 hertz. Theta waves are more prevalent when a person is in a groggy or foggy state and should be kept at a minimum in the frontal region of the brain when engaging in tasks. Conversely, when a person is in a creative state or reminiscing, theta waves increase; however, too much theta in the frontal region of the brain may cause the individual to experience feelings of sadness. It also interferes with the individual's ability to quickly perform in-depth cognitive problems.
c. *Alpha* is separated into two dimensions; low and high. Low alpha is produced between 8-10 hertz and when experienced in abundance in the mid to frontal regions of the brain may cause the individual to feel unmotivated and somewhat depressed. High alpha, produced at 10-12 hertz may cause the individual to feel a sense of calm awareness, where the individual may be motionless but very much in touch with their own sensations and observant of their surroundings. High alpha is often produced during a meditative state.
d. *Sensory Motor Rhythm (SMR)* is produced at 12-15 hertz when measured along the sensory motor cortex, running directly on top of the head from ear to ear (Neuhmann,

Strehl, & Birbaumer, 2003). Producing the appropriate amount of SMR may equate to feeling calm but focused, in order for individuals to learn and concentrate without intensity. Training to increase SMR activity through neurofeedback may improve the individual's ability to attend to tasks, sustaining attention for longer durations of time in both healthy subjects and those diagnosed with learning disabilities and attention deficit disorders.

e. *Beta brainwaves are* produced between 13-30 hertz and categorized, divided into low and high sections. Anything below 18 hertz is considered low beta. Individuals may engage in neurofeedback to increase the amount of low beta produced in the frontal regions of the brain to improve focus and enhancing the ability to attend to tasks. High beta is often associated with anxiety, obsessive compulsivity, impulsivity, and pain. High beta produced in abundance in the back areas of the brain interfere with healthy sleep patterns.

While all brainwaves coexist in all regions of the brain, some brainwaves will be more dominant than others depending on functionality. Therefore, certain brainwaves should increase while others decrease according to the function, emotion, and behavior presented. However, it is possible for brainwaves to get out of arrhythmic sync and misfire due to a number of both organic and inorganic reasons including repetitive thought patterns or dysfunctional behaviors, brain injuries, chronic stress, and/or trauma. Over time, a maladapted pattern of functioning is created and becomes the individuals new normal. Because individuals are not able to see how their brainwaves fire at certain times without technology, it may be difficult to be aware of these maladapted brainwave patterns and further take, or know how to take, the necessary steps to establish healthy

brainwave patterns. Neurofeedback training is a therapeutic tool to help individuals become aware of misfiring in the brain and to gain skills necessary to reestablish healthy brainwave patterns.

Physiological and neurological baseline data were saved in an excel document. Clients were then scheduled to begin biofeedback training following the Maes (2012) protocol in conjunction with counseling at their next session.

Training Sessions:

While no two training sessions are the same, the following paragraphs describe a flexible protocol used with the clients in this study. There are three phases in the training protocol including 1) biofeedback training, 2) neurofeedback training and 3) combined biofeedback training with neurofeedback. Clients are often aware of experiencing the physical sensations associated with stress. For example, clients reported experiencing cold, clammy hands and a racing heart during times of anxiety. Biofeedback modalities are capable of measuring these responses. When clients were able to show they were able to control and manipulate their physiology utilizing a certain biofeedback modality, the next biofeedback modality was introduced. Often clients are unaware of experiencing electrical activity in their brain. Therefore, biofeedback modalities are more tangible than neurofeedback. Once clients have gained control of these physiological responses, neurofeedback was introduced to help clients train the electrical activity, or firing rate, of their brain. After engaging in neurofeedback, clients were instructed to utilize skills achieved from previous training sessions and engage in biofeedback training with neurofeedback simultaneously.

The amount of time spent on each modality varied according to the client's ability to self-regulate and gain control over their physiological response to stress captured by the biofeedback modalities. Typically participants had between two and four sessions training each biofeedback measurement. Based on the client's needs and performance in previous sessions, the training protocol was adapted to help facilitate the client's progression to his/her goal. All clients were educated on each biofeedback measurement and received similar coaching from the counselor during each session.

Beginning at each session, clients were asked to report current symptoms or any difficulties they may have experienced since the previous meeting. Sensors were attached following the same procedures as when physiological baselines were obtained. Most sessions would involve the following flow; 1) training, 2) a dialogue between the counselorand client regarding the training results, 3) recalling a stressor, 4) a dialogue reviewing the physiological results captured while recalling the stressor, 5) training and, 6) a dialogue reviewing the training results. Clients were then given the opportunity to identify their own personal homework according to what they thought they would be appropriate to work on, or practice, in between sessions. At the following session clients would report back on successes, difficulties, and stressors since the previous training session.

Biofeedback Training

Clients engaged in HRV and respiration training first, followed by skin temperature and skin conductance training. Biofeedback training was conducted according to the following procedures.

HRV. Clients were taught principles of HRV training first. Regulating one's breathing pace is a more concrete concept to understand in comparison to other biofeedback modalities. In addition, learning this skill prior to training other biofeedback modalities may enhance the training of the other modalities. After the HRV sensor was attached, clients were instructed to engage in diaphragmatic breathing and follow a breath pacer presented on the computer screen to pace their breathing at 6 breaths a minute and achieve a balance in their autonomic nervous system. The biofeedback equipment provided a visual representation of these internal changes. Training followed the flow previously discussed.

Skin conductance. After the skin conductance sensor was attached as previously discussed, clients were introduced to Thought Technology's skin conductance training screen. Clients' physiological data was displayed in the form of visual and audio information. Visually, the skin conductance score was represented with a graph and digital data was provided. The physiological data was also displayed in the form an animated roller coaster ride. When skin conductivity would decrease, the roller coaster would move along the track and a song would play. Clients were instructed to decrease skin conductivity by utilizing mindfulness drills that instruct clients to focus on the present sensations they experience, becoming aware of and reconstruct irrational thoughts, and emotionally detaching from self-judgment of their progress presented with the animation. When clients were successful with this, the roller coaster would move around the track and a song would play providing auditory feedback. When skin conductivity would increase, both the roller coaster ride would stop moving and the song

would stop playing. The goal for the training screen was to continue to make the roller coaster move and the song to play by controlling skin conductivity.

Skin temperature. After participants were acclimated to the temperature of the room and the skin temperature sensor was attached as previously discussed, clients were introduced to Thought Technology's skin temperature training screen. Clients' physiological data was displayed in the form of visual and audio information. Visually, the skin temperature was represented with a graph and digital data was provided. The physiological data was also displayed in the form of an animated sun rise. Clients were instructed to increase their skin temperature in their hands through autogenic techniques involving visualization and meditation exercises. Therefore, when skin temperature would increase, the animated sun on the computer screen would rise in the sky and a song would play. If skin temperature would decrease, the opposite would occur. The goal for the training screen was to raise the sun and have the song play by increasing skin temperature. A relaxation response was induced by increasing hand temperature to 92-95.

Neurofeedback

Incorporating principles of operant conditioning, neurofeedback presents EEG signals in the form of a computer game, animation, or audible tone. In this study, clients were instructed to increase SMR brain waves and decrease theta and high beta brain waves, and were rewarded for manipulation of these brainwaves by controlling animations that were connected to the neurological data and displayed on the computer screen (Hammond, 2007; Johnson et al., 2010). Training screens in this study consisted of 3 bar graphs, one representing each brainwave; theta, SMR, and high beta. Using the Thought Technology ® software program, the neurological data produced by the client

was converted into an animated boat race which was displayed on the computer screen. When a brainwave would increase, the corresponding boat would move. Clients were instructed to increase SMR brainwaves while decreasing theta and high beta brainwaves by being aware of their thoughts and utilizing mindfulness drills to function with realistic and present-focused cognitions. In addition, clients were instructed to engage in paced breathing, slowing breath rate down to six breaths a minute as research has indicated this to have positive effects on brainwave functioning. Another training screen consisted of a ball positioned on top of sloping pegs. The goal for this training screen was to keep the ball at the top of the pegs by increasing SMR and decreasing theta and high beta brainwaves. Clients were able to control the electrical activity of their brain by manipulating the animations.

Combining HRV Training with Neurofeedback

Once clients trained with both biofeedback and neurofeedback modalities, the counselor would introduce combining both HRV training and neurofeedback to train these components simultaneously. The counselor would start both the HRV training screen and neurofeedback simultaneously, and displayed these screens side by side on the computer. The client was instructed to engage in paced breathing at 6 breaths a minute while manipulating a neurofeedback screen to increase SMR brainwave activity and decrease theta and high beta brainwave activity, to ultimately achieve a balance in their central autonomic network.

Summary of Training

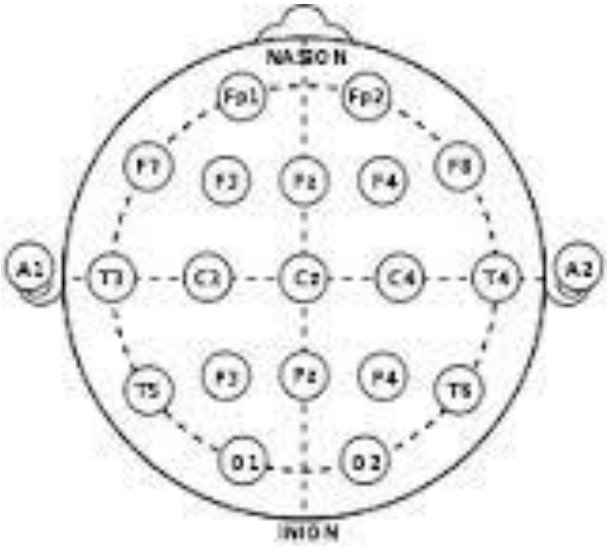
All training sessions were 50 minutes in length. Physiological and/or neurological data were collected during each session. The frequency of sessions ranged among clients

from seven to fifteen, depending on how quickly physiological and neurological control was gained. After completion of the training protocol, clients engaged in physiological and neurological assessments for the second time. The counselor then took the mean score of the biofeedback assessments and neurofeedback ratios obtained before and after engaging in the training protocol, and the mean score of each training session and graphically presented this data to the client.

Post Training

At the end of the training program, clients engaged in a series of self-administered tests that were given in random order. The series included 1) the Working Alliance Inventory to rate their perception of the client/counselor relationship, 2) the Treatment Satisfaction Index to rate their experience of the training program, and 3) ranking of the biofeedback modalities, ordering them from what they found most helpful to least helpful for their personal situation.

Figure 1: Locations of the standard 19 electrode placements, according to the International 10-20 System



APPENDIX C: WORKING ALLIANCE INVENTORY – CLIENT FORM

Working Alliance Inventory-Client
Short Form (Client)

Client Case# _____ **Counselor ID#** _____ **Date** _____

Measurement Point (circle one): **1st Week** **3rd Week**

Instructions:
On the following page there are sentences that describe some of the different ways you might think or feel abo your counselor.

As you read the sentences mentally insert the name of your counselor in place of _____in the text.

Below each statement there is a seven point scale:

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

If the statement describes the way you *always* feel (or think) circle the number 7; if it never applies to you, circle the number 1. Use the numbers in between to describe the variations between these extremes.

Work quickly, your first impressions are the ones we would like to see.

PLEASE DON'T FORGET TO RESPOND TO EVERY ITEM.

Thank You!

1. _____ and I agree about the things I will need to do in counseling to help improve my situation.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

2. What I am doing in counseling gives me new ways of looking at my problem.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

3. I believe _____ likes me.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

4. _____ does not understand what I am trying to accomplish in counseling.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

5. I am confident in _____ 's ability to help me.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

6. _____ and I are working towards mutually agreed upon goals.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

7. I feel that _____ appreciates me.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

8. We agree on what is important for me to work on.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

9. _____ and I trust one another.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

10. _____ and I have different ideas on what my problems are.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

11. We have established a good understanding of the kind of changes that would be good for me.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

12. I believe the way we are working with my problem is correct.

1	2	3	4	5	6	7
Never	Rarely	Occasionally	Sometimes	Often	Very Often	Always

APPENDIX D: TREATMENT SATISFACTION INDEX

Treatment Satisfaction Index

The next questions are about how you feel about the therapist in the program you recently attended. Your answers are private. After each statement, please respond with strongly disagree, disagree, feel mixed, agree, or strongly agree.

	Strongly Disagree	Disagree	Feel Mixed	Agree	Strongly Agree
You are satisfied that the presenting therapist in this program...	1	2	3	4	5
Did a good job	1	2	3	4	5
Was fair with clients	1	2	3	4	5
Had the time to see me	1	2	3	4	5
Had respect for me	1	2	3	4	5
Explained the procedures clearly	1	2	3	4	5
Agreed on what your problems were	1	2	3	4	5
Explained what the biofeedback training was supposed to accomplish	1	2	3	4	5
Provided you with foundational education of the fight/flight response	1	2	3	4	5
Helped you make sense of your presenting problem via biofeedback techniques	1	2	3	4	5
Asked you for your opinion and how to solve them	1	2	3	4	5
Agreed on what you were to do about your presenting problem ( )	1	2	3	4	5
Helped you do something about your presenting problem ( )	1	2	3	4	5
Agreed on what to do about your other problems	1	2	3	4	5
Helped you do something about your other problems ( )	1	2	3	4	5
Was sensitive to your cultural background	1	2	3	4	5
Gave you enough help for now	1	2	3	4	5

This survey has been adapted from the GAIN.

APPENDIX E: PARTICIPANTS' DATA: DEMOGRAPHICS, OBJECTIVE, SUBJECTIVE

The following section provides a table of the data collected for this study including the participants' demographics and the objective and subjective data that was collected during this study. The objective data includes pre and post training scores for the following four physiological measurements: 1) HRV, 2) skin temperature, 3) skin conductance, and 4) Theta/SMR ratios). The subjective data includes the WAI, TxSI, and how individuals ranked the biofeedback measurements from most to least helpful.

Participants Demographics, Objective Data, and Subjective Data

Ct.	Age	Gen	Eth	HRV Pre	HRV Post	ST Pre	ST Post	SC Pre	SC Post	T/S Pre	T/S Post	WAI-SR	TxSI	R1	R2	R3	R4	R5
1	34	M	Bel	17	1168	93.36	94.55	2.50	0.59	0.57	0.52	82	80	N	HRV	C	ST	SC
2	48	F	Cau	45	71	95.83	92.14	1.62	1.14	0.57	0.72	84	80	N	HRV	C	ST	SC
3	64	F	Cau	09	39	76.24	77.85	3.41	2.09	0.44	0.54	84	80	N	C	HRV	ST	SC
4	61	F	Cau	29	128	90.47	94.50	0.76	1.31	0.46	0.51	77	75	HRV	N	C	SC	ST
5	45	F	AA	11	806	92.23	95.09	0.63	0.22	0.47	0.511	84	80	C	N	ST	HRV	SC
6	81	F	Cau	130	3053	90.24	92.97	0.53	0.62	0.49	0.63	80	77	HRV	C	N	SC	ST
7	68	F	Cau	127	250	85.70	89.98	7.15	3.17	0.44	1.36	84	80	N	HRV	C	ST	SC
8	66	F	Cau	539	730	94.91	92.88	1.73	1.89	0.39	0.60	84	79	N	SC	C	HRV	ST
9	32	F	Cau	59	1063	83.73	86.96	3.32	1.01	0.39	0.41	78	78	C	SC	N	ST	HRV

10	60	M	Cau	02	212	71.73	92.44	4.63	2.99	0.41	0.58	83	80	C	N	ST	SC	HRV

Note. Abbreviations are as follows: Ct. = client, Gen = gender, M = male, F = female, Eth = ethnicity, Bel = Belizean, Cau = Caucasian, AA = African American, ST = skin temperature, SC = skin conductance, N = neurofeedback, C = combo, R1 – R5 = Most to least helpful biofeedback measurement.