THE EFFECTS OF BIOFEEDBACK ON TASK PERFORMANCE

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This experiment attempted to study the effectiveness of biofeedback training on an individual's peak performance while performing a stress-provoking task. In a between subjects design 30 individual college students were divided into 2 groups. One group received auditory biofeedback and relaxation training, and the other group received no training. Both groups met the researcher for 1 hour a week for seven weeks. During each session the participant completed a ten-minute Competition and Coaction (C & C) computer software program (Shea, 1992). The biofeedback equipment recorded the physiological state of each of the participants while he/she performed the C & C task. Both groups' physiological values and C & C scores were compared using the SPSS software. The biofeedback group had statistically lower stress values than the non-biofeedback group (Schwartz, 1995). There was no statistical difference between the 2 groups' C & C scores. The STAI Y-1 and Y-2 anxiety inventories were given to each of the participants at the 1st and 7th session to examine the anxiety differences between the 2 groups. There were no statistical differences between the 2 groups' STAI scores. This study's findings show that individuals can be taught to lower their stress response while performing a computer task.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

According to Suzuki (1956) the notion of physiological self-regulation dates back several centuries and can be found throughout Eastern literature (Sandweiss, 1985). However, the modern medical model describes the process of self-regulation as just entering its fourth decade of existence. During the 1960's the forefather, Elmer Green, began the genesis of the mind-body revolution now commonly referred to as "Biofeedback." Today, there exists a growing database of traditional medical journals attesting to the efficacy of biofeedback when used with a wide variety of medical disorders (Sandweiss, 1985).

Much of the early investigation into biofeedback occurred because of mankind's need to understand the differences between humans and other living creatures or "lower" animals. Early scientists discovered that humans share certain functions with other living organisms, such as heart rate, blood pressure, and breathing. These functions are now known as "vegetative" functions. Other human attributes, such as judgment, intelligence, and imagination were described as "higher mental processes" (Sandweiss, 1985). In the eighteenth century, Bichat separated the bodily functions into two classifications: voluntary and involuntary action. Voluntary actions are those that an individual controls such as moving his fingers and wrist to pick up a pencil. Involuntary actions are related to the autonomic system. This system controls movements and actions that occur automatically within an individual's body. Examples of these actions are breathing, the beating of the heart, and the preparation of the body when defending itself against an acute stress or stressor. The body goes through physiological changes (these are discussed later in the paper) as it prepares itself to either “fight or flee” a stressor. The fight or flight response, as it is commonly referred to, is an innate survival mechanism (Seaward, 1999) designed to recruit power and strength for a short intense period of use such as running away from a lion (Seaward, 1999). However, this mechanism has not kept up with the evolutionary development of the human mind (Simeons, 1961). The autonomic system reacts in the same manner to all stressors, not only tangible ones like a charging lion. In American society today stressors do not come in the form of a lion. They are much subtler. In the twenty-first century stressors take on the form of computers, taxes, and inflation. They can also be positive, such as winning big in the lottery. However, the autonomic system is unable to determine the difference between that of an euphoric emotion and that of a real threat. Problems soon begin to arise when the autonomic system is forced to work for extended periods of time (i.e. being under continuous stress), resulting in medical problems and possibly death.

In 1927, a Russian scientist, Ivan Pavlov, released his work with the autonomic nervous system (vegetative system) in dogs. His “classical conditioning” showed how the brain and body could be conditioned or taught to respond to a stimulus without voluntary control. Ten years later B.F. Skinner published findings on a theory he called operant conditioning. Operant conditioning differed from classical conditioning, which used the association of stimuli by using reinforcement through the association of events in a type of cause/effect relationship. For example, researchers have trained birds to press a red colored lever to receive a piece of bread. The bird was conditioned to press only the red colored level even when given other colored levers as choices. These reinforcing events are learned and either repeated (positive reinforcement) or terminated (negative reinforcement). An example of a positive reinforcement would be a child receiving praise after hitting a home run, and an example of negative reinforcement would be giving a child money for performing poorly on a report card. Another example is in the 1950's Olds and Milner attached an electrical current to a rat's brain, which provided the rat with the sensation of positive reinforcement (Sandweiss, 1985). Their research linked the theories of classical and operant conditioning. Miller and Dworkin (1974) successfully employed reinforcement as a learning method. Their research hypothesized the "idea that humans could obtain voluntary control over autonomic parameters" (Miller & Dworkin, 1974), which later was later used as the bases for the development of biofeedback.

The concept of biofeedback evolved from the marriage of understanding how the body reacts physiologically when under stress and the psycho/behavioral theories that discovered an animal (or human) could be conditioned to change his/her behavior. This relationship becomes more apparent when one examines the two root words that comprise biofeedback. The first "bio" is an abbreviated form of biology referring to the biological aspects of the therapy. The second is "feedback" and it represents the stimulus that fosters the behavioral change within the individual. Biofeedback uses an external sensor (feedback) to provide an organism with an indication of the state of bodily process (biology), usually in an attempt to elicit a change in behavior.

Each year biofeedback researchers and counselors expand the concept of biofeedback in treating individual disorders and problems. One such branch of biofeedback therapy involves the use of biofeedback training in the exercise and sport sciences. More specific is the use of biofeedback in achieving peak performance among athletes. "The differences in performance among athletes of relatively equivalent skills appears to rest on a person's ability to cope with the perceived stress of the competitive situation" (Wenz & Strong, 1980). More specifically, the differences in performance have been attributed to lowered mental elasticity, and capacity for greater concentration (Selder, 1982). High levels of anxiety can be detrimental to motor learning, performance, and participation (Martens, 1977). Furthermore, anxiety is unpleasant and can cause various stress-related disorders (e.g., insomnia, headaches, and lower back pain) when experienced frequently (Stoyva & Budzynski, 1974).

The word "stress" is used in generic terms during the course of this paper. There are countless meanings under the umbrella of the word "stress." In this study, the word "stress" relates to anxiety within an individual. For Sigmund Freud, the word anxiety was "something felt"--a specific unpleasant emotional state or condition of the human organism that included experiential, physiological, and behavioral components (Spielberger, 1983).

Research by Blumenstein, Bar-Eli, and Tenebaum (1995) has demonstrated that the effectiveness of biofeedback techniques can significantly improve performance. Griffiths, Steel, Vaccaro, and Karpman, (1981) tested the effects of biofeedback relaxation training on SCUBA divers prior to an underwater task. The researchers found significant differences between the state of anxiety and performance between the SCUBA divers given the biofeedback intervention and those who were not. Another study by Kirkcaldy and Christen (1981) reported that "a biofeedback training group showed a significant reduction in resting muscle tension and maximal tension induced through exercise, as well as showing almost statistically significant reduction in the recovery tension (between baseline and last session)."

Biofeedback training has also been used to improve basketball free throw shooting (Kavussanu, Crews, & Gill, 1998). In this study, the researchers showed an improvement in biofeedback groups shooting percentages as compared to that of the non-biofeedback group. Dewitt (1980) used EMG biofeedback training to reduce anxiety and improve game/practice performance among a group of selected football players.

Biofeedback training has also been used with athletes who perform in individual sports such as wind surfing, wrestling, and Israeli judoka (Blumenstein, Bar-Eli, & Tenebaum, 1997). Another study was done using biofeedback training to control the breathing pattern and heart rate of a professional small-bore rifle shooter (Prapavessis, Grove, McNair, & Cable, 1992).

In conclusion, research has shown that biofeedback training can positively influence an individual's ability to control his/her performance anxiety, fine tune performance, increase muscular strength and flexibility, and reduce overall injuries.

Problem of Study

Sandweiss (1985) concluded that there is a relationship between arousal and peak performance. Each individual has a specific arousal level at which he/she performs optimally. Many researchers and professionals refer to this as being "in the zone" (Kriegel and Kriegel, 1984). However, stress and more specifically anxiety can severely affect ones ability to enter into "the zone"(Kriegel & Kriegel, 1984). The physiological effects of anxiety on the body can hinder peak performance further. Heightened stress levels can cause "enhanced performance on simple tasks, but seems to inhibit performance of more complex tasks—this is probably due to difficulties in concentrating and undue effort invested in attempting to cope" (Kirkcaldy, 1984). Also, anxiety has been shown to negatively affect the accuracy and speed on fine muscle movements, such as free throw shooting, while having less of an affect on large muscle movements such as running. Biofeedback training as a stress management tool offers immense opportunities for training athletes to fine-tune their arousal levels to reach their optimum level.

The purpose of this study was to compare participants who receive biofeedback training with another group that receive no biofeedback training and, finally, to compare both groups' accuracy scores on an anxiety producing activity.

Justification of the Study

Previous research on the effects of biofeedback and athletic performance is limited. This is partially because biofeedback is a relatively new science, which limits the number of biofeedback counselors available to do the immense amount of research is needed. In addition, according to the literature, more research is needed to determine the effectiveness of EMG biofeedback training as a reliable tool for improving performance (Blais & Vallerand, 1986).

This study was designed to understand the relationship between biofeedback training and task performance. A standardized task was given to participants in the experimental and control groups seven times. The artificially created task was designed to increase the participant's level of anxiety. Both experimental groups' scores at the first and seventh session on the tasks were compared and analyzed. The EMG biofeedback training was the independent variable. The dependent variables were the EMG, C & C, and STAI scores.

Hypotheses

1. The participants in the biofeedback-training group would have a statistically lower average EMG score compared to that of the control group.
2. The participants in the biofeedback-training group would have higher scores on the performance task than those of the participants in the control group.

Definition of Terms

1. Artifact- incorrect readings taken in by the biofeedback equipment. Causes include faulty electrode wires, incorrect electrode placement, electrode pulling away from the skin, weak electrodes and electrodes touching.
2. Autogenic Training- "refers to the receptivity of the conscious mind to acknowledgment and receipt of specific thoughts or messages" (Seaward, 1999). The autogenic or selective awareness process allows thoughts to flow from the concious to the unconscious mind, allowing the individual to enhance the desired change in the physiological state. In other words, the client's ability to relax is improved.
3. Biofeedback Training- term that refers to "a group of experimental procedures in

which an external sensor is used to provide the organism with an indication of the state of a bodily process, usually in an attempt to effect a change in the measured quantity" (Schwartz & Beatty, 1977). In this study biofeedback training consisted of audio EMG training.

3. Closed Skill- skills performed in a stable, unchanging environment. Examples of closed skills are platform diving, and figure skating. (Rose, 1997).
4. Electrodermal Feedback (EDR)- measures skin conductivity from the fingers and palms (Association for Applied Psychophysical and Biofeedback, 1999)(A.A.P.B). The EDR was measured by dividing the ohm (measurement of electrical resistance) by mho (measurement of electrical conductance). The data was presented in microohms by the computer as a numeric value (A.A.P.B., 1999).
5. Electromyography (EMG)- measures the electrical activity of skeletal muscles monitored with sensors placed on the skin over appropriate muscles. The EMG data was given by scaled outputs that give digital readings in microvolts (A.A.P.B., 1999).
6. Mental Elasticity- refers to the flexibility of an individual's mental capacity. It was used to describe the amount of mental strain an activity, mental or physical produces within an individual. An average from each of the three-biofeedback modalities will provide this data during the course of each session.
7. State-Trait Anxiety Inventory (STAI Y-1, Y-2)- designed by C. D. Spielberger, R. L. Gorsuch and R. E. Lushene as a measurement of trait anxiety and state of anxiety (1986).

8. State of Anxiety- refers to the reaction level or intensity that occurs within an individual during a stressful or threatening situation (Spielberger, 1989).
9. Thermal Feedback (Temperature)- measures the blood flow in the skin, as an individual becomes stressed the blood vessels in the body constricts, causing blood flow to decrease and skin temperature to drop (A.A.P.B., 1999). The temperature data in this experiment was given in degrees of Fahrenheit.
10. Trait anxiety- refers to differences between how individual people relate to a stressor. An individual reacting to a perceived stressful situation as being dangerous or threatening will respond to such a situation with elevations in the intensity of their state anxiety level (Spielberger, 1989).

Limitations and Delimitation

The subjects for this study were selected from university physical education classes. This limits the scope of the results to that of individuals who are capable of attending university level courses as well as being physically able to perform in the study. Individuals who attend physical education classes may be more competitive than other students. They may have been more motivated to better themselves at the task than a participant selected from a physically less demanding course. Furthermore, the age of the subjects was limited to eighteen to thirty years of age. The participant's age may have influenced how well they concentrated on completing the task and outside homework.

There where two participants in the group that received biofeedback training (Group A) that was dropped from the study. The first individual discontinued coming to the experiment after the third session. The second individual had to cancel several sessions and did not have enough time to finish the experiment in the allotted time. The effect that the loss of two Group A participants had on the study's outcome is unknown, but it is necessary to mention it as a possible limitation of the results found in this study. The subjects began the study on different dates. There was up to three weeks between the dates when subjects began the study. This could have affected the internal validity of the study. Also, because there was only one researcher to run the subjects all participants' sessions had to be scheduled during the same week. Subjects had only a limited amount of time slots that were available to meet the researcher, forcing the subjects to meet with the researcher on different days of the week. For example, a participant may have performed better on a Monday than on a Friday or the opposite may have been true, which may be another limitation of the study.

CHAPTER 2

LITERATURE REVIEW

This chapter includes a review of the literature related to physiological changes caused by stress, biofeedback and stress, effects of stress on peak performance, biofeedback and sport, and limitations of stress control and performance.

Physiological Changes Caused by Stress

To be alive is to have some type of stress. The human body is designed to efficiently deal with stress. For example, say that an individual was walking to their car in a parking lot late at night, and he/she began to feel that someone was watching him/her. The person's heart rate would immediately increase, his/her hands would begin to sweat and become cold, and his/her muscles would start to tense for a quick escape. This reaction is commonly referred to as the Fight or Flight response (Charlesworth & Nathan, 1984), and is designed to insure survival. This same reaction occurs within an individual before, during, and a short time after a performance task. A stressful event causes the following physiological changes within the body:

1. Heart vessels dilate (enlarge) and there is increased stroke volume on the heart and increased cardiac output.
2. The spleen constricts to release stored blood so that, with increased cardiac output, more oxygen is available for use within the body.
3. Blood vessels in the skeletal muscles are constricted and, with the increased muscular tension and metabolic rate, the increased oxygen is utilized.
4. Blood pressure increases.
5. The pupils of the eyes dilate.
6. The pilomotor muscles constrict (causing goose bumps and making hair stand on end).
7. Increased output from the sweat glands and the salivary gland produces thick saliva that we recognize as "dry mouth" or "cotton mouth."

Schwartz, 1995

However, the magnitude of the response can have a dramatic effect on an individual's performance of a task. The importance of this section is to understand that every individual's body regardless of color, gender, or race reacts the same way to stress (Seaward, 1999).

Biofeedback and Stress

Biofeedback takes the concept of the Fight or Flight response and applies modern technology to it. "Biofeedback, thus, is nothing more than the use of instrumentation to detect and amplify internal physiological processes in order to make this ordinarily unavailable information available to the individual in a form that is meaningful, rapid, precise, and consistent" (Zaichkowsky & Fuchs, 1988). The biofeedback process involves three methodological elements (Zaichkowsky & Fuchs, 1988). First, the information is obtained through sensing electrodes that pick up the appropriate signals. Second, the biofeedback instrument transduces and amplifies the signals. Third, the signal is transformed into a signal that the client and therapist can use to increase or decrease the biological function. A report written by the Department of Health and Human Resources (1983) stated:

> Biofeedback is a treatment technique in which people are trained to improve their health by using signals from their own bodies. Physical therapists use biofeedback to help stroke victims regain movement in paralyzed muscles. Psychologists use it to help tense and anxious clients learn to relax.

"Responses to the regulation of mental states usually includes galvanic skin response (GSR), frontalis muscle electromyogram (EMG), and most frequently heart rate (HR). For diagnostic purposes, such responses serve as a general index of the emotional state in humans" (Blumenstein, Breslav, Bar-Eli, Tenenbaum, & Weinstein, 1995).

Effects of Stress on Peak Performance

"The differences in performance among athletes of relatively equivalent skills appear to rest on the person's ability to cope with the perceived stress of the competitive situation" (Wenz & Strong, 1980). As mentioned previously "to live is to have stress", however, certain events place additional pressures on an individual to perform at his/her highest potential. This is especially true for athletes whose "concentration and general activity are effected, often resulting in lowered mental elasticity, and incapacity for greater concentration" (Selder, 1982). Griffiths (1981) found significant correlations between anxiety and performance. As stress increases, performance on simple tasks is enhanced, but it seems to inhibit performance on more complex tasks (Kirkcaldy, 1984). The Yerkes-Dodson principle, which is applied to athletic performance, can be used to illustrate the effect arousal or stress has on performance in any given situation not just athletic performance. This principle uses a normal bell shaped curve to illustrate the effects. The middle of the curve is called the optimal stress level. At this point is where the subject performs at his/her highest level. However, performance suffers if the subject becomes too stressed or over aroused, distressed, or he/she becomes under aroused, eustress, (Seaward, 1999). This is important especially for this study because it highlights the need for tools and techniques that can be used by individuals to gain the optimal level of performance without causing unnecessary stress.

Biofeedback and Sport

Biofeedback, relaxation, and other psychological approaches are appropriate ways of overcoming individualized performance stress responses (Wenz & Strong, 1980), "Furthermore, biofeedback has been demonstrated to be more effective than either placebo or control conditions" (Kirkcaldy & Christen, 1981). Biofeedback can be applied to performance in three ways: teaching athletes how to deal with general and specific anxiety, muscle injury recovery, and as a means to provide biomechanical and muscle feedback to allow athletes to improve highly skilled movements and enhance performance (Zaichkowsky & Fuchs, 1988). For the purposes of this study, the researcher concentrated on general and specific anxiety.

Richard Suinn (1980) found that biofeedback can enhance the performance of individuals who experience a level of tension and anxiety that interferes with maximum performance in competitive situations. "The underlying process is to move the athlete from an external locus of control to an internal one" (Suinn, 1980). Peper and his colleagues have used biofeedback with Olympic athletes and other athletic groups as a method to enhance internal control and optimize performance (Norris, 1986). The ability to self-regulate results in a psychophysiological "freeing" effect within an individual. This in turn increases the individual's self-esteem. Wenz and Strong (1980) found similar results with synchronized swimmers. They reported that as the swimmers' ability to self-regulate improved, they became more self-confident and improved their performances. Feltz (1988) found that when athletes where successful in coping with increasingly problematic situations their self-confidence and self-efficacy increased.

Self-efficacy within an individual is related to the belief that he or she can be successful in executing a behavior required to produce a desired outcome (Fitzsimmons, Landers, Thomas, & van der Mars, 1991). "Self-efficacy expectancies can influence choice of activities, amount of effort expended, degree of persistence in completing a task, kinds of thought patterns and emotional reactions in anxiety-provoking situations" (Bandura, 1986). An athlete's ability to control the influence of self-efficacy can have an enormous effect on not only performance during the event, but it also effects practice, intensity level, focus, etc. A review of the current literature suggests that biofeedback training can improve an individual's self-efficacy level on performance-based tasks (Fitzsimmons, Landers, Thomas, & van der Mars, 1991).

Summary

"Recently, the interest of Biofeedback researchers in sport has shifted toward the identification of psychological conditions associated with better performance, particularly in closed skilled tasks. This experiment was designed to test the effects of biofeedback training on a closed skilled task, which is defined as a skill performed in a stable, unchanging environment" (Schwartz & Beatty, 1997).

CHAPTER 3

METHODOLOGY

A 2 X 2 experimental design was used to investigate the following relationships: 1) The average number of correct responses on the Competition and Coaction task between both groups 2) The differences between average EMG score of both experimental groups. This chapter is a description of the sample and setting, instrumentation, data collecting, protection of human subjects, and data analysis procedures used in this study.

Sample and Setting

The target population for this study consisted of University of North Texas (U.N.T.) students. Participants were selected from U.N.T. physical education courses. The participants selected represented a convenience sample from the college general population and were between the ages of eighteen and thirty.

The sample consisted of thirty volunteer students. The thirty participant names were selected randomly from a list of volunteers and placed in one of two experimental groups. The thirty total students were chosen based upon the average number of participants used in other similar studies. The researcher theorized that the attrition of approximately two to three total participants would occur due to lack of interest, time, disbelief in biofeedback training process, or schedule conflicts.

Each participant attended seven sessions regardless of group assignment. Seven sessions were chosen based upon consensus of previously done biofeedback studies that dealt with performance enhancement (Blumenstein, Breslav, Bar-Eli, Tenenbaum, &

Weinstein, 1995; Zaichkowsky & Fuchs, 1988; Costa, Bonaccorsi, & Scrimali, 1984). Group A sessions lasted approximately one hour where as Group B sessions lasted approximately thirty minutes. The Group A sessions needed more time for each session to go over homework, answer questions, and for teaching the relaxation technique. The biofeedback training was performed at the Biofeedback Lab on the U.N.T. campus. The same room was used with both groups' participants.

Instrumentation

Data was collected in five methods. The Pro-Comp biofeedback microcomputer was used to obtain data on the participant's Electromyography (EMG) level, finger temperature, and Electrodermal (EDR) readings. The data from the Pro-Comp was recorded digitally on the computer hard drive. The fourth collection instrument is the State-Trait Anxiety Inventory (STAI Form Y-1, Y-2), which is a paper and pencil test (Spielberger, 1983). The Y-1 form provided a measurement of how the participant feels "right now" while the Y-2 form provided a score on how the participant "generally feels" (Spielberger, 1983). Each form consists of twenty questions. The scores on each form can range from twenty to eighty. A score of twenty is related to low anxiety and a score of eighty is related to high anxiety. Speilberger (1983) provides support for the accuracy of these numbers as a measurement of an individual's anxiety level. These instruments are important because they provide a method to measure the physiological and behavioral manifestations of arousal, which previous experiments have found to directly affect athletic performance (Griffiths, Steel, Vaccaro, & Karpman, 1981). The researcher used these tests to provide pre and post intervention data, which was then analyzed. The tests were only administered at the first session and last session to reduce the testing threat to internal validity. The researcher is expecting that the results from the STAI will provide additional support for the acceptance of the hypothesis. It was hypothesized that the biofeedback group would reduce their overall anxiety level when compared to that of the other group. The Competition and Coaction software provided the fifth method of collection. It recorded the total number of correct responses within the ten-minute testing period (Shea, 1992). Previous studies have suggested the importance of having a system of recording the accuracy during the intervention period as another method of determining the effectiveness of the program (Kavussanu, Crews, and Gill, 1998).

The performance intervention that all of the subjects were tested with is a computer game called Competition and Coaction, which is one of several programs found on the Lab Activity Software designed by Dr. Charlie Shea (Prentice-Hall, 1992). The Competition and Coaction program consists of four two-inch circles that line up in a horizontal row across the computer screen. The colored circles read left to right purple, green, blue, and red. The sequence is always the same. The computer randomly illuminates the colored circles in a specified sequence. The responses are given by using the D, F, J, and K keys on the computer keyboard. The letter D correlates to the color purple, F correlates to green, J to blue, and K to the red circle on the screen.

The game begins with one color circle illuminating. The participant presses the key on the computer keyboard that relates to that circle. Next, two light circles are illuminated with one circle lighting up just before the other. The cycle continues with the addition of a third light circle to the sequence. The color sequence remains the same with the new circles added to the end of the existing sequence. A correct response occurs when the participant presses the correct circle key in the proper sequence. If the participant enters the sequence correctly, another circle is added to the original sequence, and the participant is required to enter that sequence correctly. If the participant enters the wrong sequence, the program informs them and then asks he/she to enter the sequence again. This cycle continues until either the subject enters the sequence correctly or time runs out. The program runs for ten minutes. The computer tabulates the cumulative number of correct answers, number of incorrect answers, current sequence length, percent correct, and the time remaining during the course of the test session. At the end of the test session, the computer also provides a percentage of correct responses.

Data Collection

The Pro-Comp instrument was used to provide the biofeedback data. During each biofeedback training session, the Pro-Comp recorded data on EMG, pinkie finger temperature, and EDR. The EMG data was collected from three electrodes attached to the client's frontalis muscle. It was assumed that there would be a small amount of artifact associated with the client's eye movements during the performance task. The researcher believed it would cause the EMG scores to be slightly higher across both groups, but that it would be relative between both groups and not act as an extraneous variable. In most cases, EMG feedback can be generalized to the state of anxiety within an individual (Schwartz, 1995). The researcher chose to use EMG as the comparison modality based on that information. Hand temperature data was collected from an electrode attached to the client's right pinkie finger. The right pinkie finger was chosen because it ensured that all of the participant's data would be collected from the same finger. The participants' temperatures were expected to be lower during the task than during the two baselines. This is due to the participant's increased arousal during task participation (increase in tension). The EDR data was being collected from two electrodes attached to the arch of the client's right foot. The foot was chosen because movement in the hand would have produced artifact in the EDR's data. However, the EDR values were not at the normal levels because the hand contains more sweat glands than the foot does. The researcher assumed that the lower temperature and EDR values would be relatively the same across both groups and would not an extraneous variable. At the completion of each session, the Pro-Comp software averaged the session's data for each of the three modalities. The last minute of the first baseline was averaged and recorded. The first and last minute of the second baseline was also averaged and recorded. All ten minutes of the task data was averaged and recorded. This data was used to analyze the results from all three sources. It is analyzed graphically, as well as, statistically at the end of the study. The literature has suggested that previous studies have lacked validity due to limited data collection, many studies only used one of the modalities, and so the researcher felt that it was imperative for this study to contain all three modalities. Only the EMG modality was used to provide simultaneous "feedback" to each individual participant in the A Group during the course of the entire session. This is based upon suggestions in the current literature (Kavussanu, Crews, & Gill, 1998; Zaichkowsky & Fuchs, 1988; French, 1980). This feedback was provided by a beep produced by the computer through audio speakers attached to the lap top computer. The participant used the tone of the beep to identify his/her current muscle tension (stress level) and used the biofeedback training tools (diaphragmatic breathing) to make adjustments as necessary. Group B received no audio beeps.

Group A also received a weekly homework assignment. They were asked to practice raising their finger temperature with a small thermometer attached to the index finger, to listen to an audio relaxation tape, or practice one of the breathing techniques taught to them by the researcher. The participant was given a homework log (Appendix 4) where he/she was asked to write down the time and date he/she practiced, as well as, any comments or concerns that arose during the completion of the assignment. During each session, the researcher collected the homework assignment and gave each client a new sheet for the following week. The participant was instructed to practice at least one of the homework tasks mentioned above at least five times a week. The client was given the option of alternating between the two homework assignments during the course of the week. Group B received no homework assignment. The research found that the participants' practice schedules ranged from at least once to seven days a week. The researcher prepared an audiotape for the participants in the A Group. The tape consisted of one side of Warm and Heavy (Holepersons & Associates, 1988) and the other side consisted of Stress Release (Holepersons & Associates, 1983). The Warm and Heavy side allowed the participant to practice warming his/her hands. The Stress Release side involved using a progressive relaxation as a method to reduce stress. In addition, the participants were taught four different breathing techniques which they were expected to practice between each session. These four breathing techniques were taught by the Take a Deep Breath (Holepersons & Associates, 1993) audiotape.

The STAI test was issued to the participants during the first and last sessions. The primary goal of the test was to provide the researcher with a method to test the participant's perception of stress at the baseline and completion of the study. The STAI Form Y-1 (appendix 1) and Y-2 (appendix 2) tests were administered to the participants. This test is designed to assess how people generally feel (Spielberger, 1983). The STAI is a self-administered Scan Tron test, and it takes approximately six minutes to complete (Speilberger, 1983). It consists of twenty questions and the participants had as much time as necessary to complete the test. Spielberger (1983) reports that the STAI has been used in over 3,300 studies in fields such as medicine, dentistry, education, psychology, and other social sciences as an anxiety inventory.

It is difficult to describe a standard set of events that occurred during each biofeedback session. This can be attributed to the counselor's need for flexibility when dealing with human subjects who learn and understand at different levels and speeds. The training and treatment of a patient was changed and modified in a way that best suited the client. However, this study followed a generic format for Group A and Group B participants. The following is a description of the format used with each of the Group A (biofeedback) clients. During session one, the client was given a general overview of what biofeedback is and how it works. He/she was also given instructions on how to understand and interrupt the audio feedback. The researcher connected him/her to the Pro-comp and performed a baseline measurement, the performance task, and the post baseline measurement. The researcher filled out a session form at the completion of each session (Appendix 3). The session form recorded general information about caffeine intake, baseline and task modalities, and C & C scores. No audio feedback was given to any of the participants (Groups A and B) during the first session. The researcher then went over the details of the homework assignment and then ended the session (Appendix 4). At the beginning of the second session, the researcher reviewed the client's homework assignment from the previous week. This also occurred at the beginning of each of the remaining five sessions. The second and third sessions involved listening to the progressive relaxation side of the Sensational Relaxation tape. The same side of the tape was used for both sessions. During the fourth, fifth, sixth, and seventh sessions the researcher trained the clients four different diaphragmatic breathing techniques. Breathing exercises focused on the use of diaphragmatic breathing, which has been found to be effective in producing a relaxed state within humans (Bentov, 1988). During the pilot study the researcher found that it was less distracting for the participants to concentrate on using diaphragmatic breathing to reduce anxiety while performing the task. Group participants' training also involved using autogenic phrases as a relaxation technique. The "Warm and Heavy" side of the clients' relaxation homework tape was used to provide the autogenic phrases. Listening to the Warm and Heavy side of the tape was performed as a homework assignment by the participants, and was not used during the session.

After the relaxation intervention was taught, a five-minute baseline was collected. The participant was then given the performance intervention (Competition and Coaction) that lasted ten minutes. During the performance intervention, participants in Group A received audio signals (beeps) from the biofeedback equipment about their current EMG levels. When the intervention was done, a five-minute post-test baseline was taken to allow the participant to return to his/her baseline level. There was no auditory feedback given during the beginning and ending baselines. The second group (Group B) followed the same protocol as Group A, but the participants were not exposed to any EMG audio signal beeps during the course of the session. The Pro-comp biofeedback computer collected data on all three modalities.

Protection of Human Subjects

Approval to conduct this study was granted by the Institutional Review Board at the University of North Texas (U.N.T.). The Biofeedback Clinic and Dr. Cynthia Chandler, coordinator of the U.N.T. Biofeedback Clinic, gave the researcher permission to use their facilities and other related resources. Each participant's information will remain confidential. The subjects' names and information was kept in a locked cabinet in the Biofeedback Clinic. The data and all other information from this study will remain in a secure location for three years and after such time will be destroyed. All findings were reported without names or personal identification. The potential risks to the participants included possible skin rash, and temporary physical and psychological discomfort. A more detailed account of human subject protection is available in Appendix 5.

Data Analysis

The data was analyzed using the Statistical Package of the Social Sciences (SPSS). The level of significance was $p < 0.05$ for all of the tests. An analysis of variance

(ANOVA) with repeated measures was used. The ANOVA was a 2 X 2 design.   The EMG, Task, and STAI scores at session one and session 7 were compared between both groups.

CHAPTER 4

RESULTS

This chapter contains the interpretation of the statistical findings of this research study. Data analysis, results, and interpretations of the findings are included as well as a section on the limitations of the data.

There were two groups in this experiment. Thirty volunteers were selected from U.N.T. physical education courses and were randomly assigned to one of two groups. The first group (Group A) received the independent variable, which was biofeedback training and the second group (Group B) received no biofeedback training. Each participant met with the researcher at least once a week for seven consecutive weeks. During each session four sources of data were collected (EMG, EDR, Temp., and Task Score). A STAI score was recorded at the first and last session. The statistical analysis of this data is explained in more detail below.

Data Analysis

The data analysis of this study was done using the Statistical Package for the Social Sciences (SPSS) 2000 software program. The General Linear Model with Repeated Measures was used to compare the Between-Subjects data. A T-test was run to ensure the reliability of the General Linear Model's results, but was not used in the comparative data analysis.

The first hypothesis stated: The participants in the biofeedback training group would have statistically lower average EMG score when compared to that of the control group. The analysis showed that with an alpha level of .05, the effect of biofeedback training was statistically significant, $F(1,25) = 7.781$, $p < .05$, which shows that Group A (biofeedback group) was able to reduce their task EMG levels between the first and seventh session. The descriptive statistics can be found in Table 1.

TABLE 1	GROUP	MEAN	STD. D.	N
TASK 1 EMG	A	11.3115	6.0238	13
	B	9.3080	9.8703	15
TASK 2 EMG	A	1.2115	0.7643	13
	B	7.9233	7.0042	15

A second data analysis was run on the first, fourth, and seventh Task EMG for both groups. This analysis also showed a significant difference between the two groups with $F(1,25)= 6.033$, $p. < .05$, which provided further support for the acceptance of the first hypothesis.

The second hypothesis stated: The participants in the biofeedback training group will have higher scores on the Competition and Coaction performance task than that of the participants in the control group. The Competition and Coaction task required participants to enter a sequence of colored dots with a new color dot being added with each correct sequence entered over a ten-minute time limit. The data analysis showed that there was not a significant relationship when the two groups were compared for Between-Subject significance with $F(1,26) = .011$, $p > .05$, which does not show a relationship between reductions in anxiety and improved performance. The descriptive analysis of the second hypothesis is contained in Table 2.

TABLE 2	GROUP	MEAN	STD. D.	N
NUMBER CORRECT 1	A B	419.9231 398.4000	67.3875 75.2026	15 15
NUMBER CORRECT 2	A B	468.2308 494.4000	90.4582 73.6838	13 15

A T-test was also run on the task data scores between both groups. This test also produced similar results as the Between-Subjects test with no significant findings.

Despite the lack of a significant difference between the two groups, it is important to examine their means. The difference between Group A's averages for the first and seventh session was a 49-keystroke improvement. The Group B's difference was a 96-keystroke difference. There was not a significant difference, but the Group B did improve more than the Group A and was the opposite result from what the researcher had hypothesized. This phenomenon is highlighted later in the discussion section.

The researcher also tested both groups' anxiety level at the first and seventh session using the STAI (Spielberger, 1983). The researcher believed that the Group A participants would have lower anxiety scores at the seventh session than the scores collected at the first session. The STAI is composed of two forms. STAI Form Y-1 tests how an individual feels his/her anxiety level is at that "present moment," and STAI Form Y-2 tests the individual's "general anxiety level." The scores on each form can range from 20-80. The lowest amount of anxiety measured by this instrument is a score of 20, and the highest amount of anxiety is represented by a score of 80. An analysis of the STAI Form Y-1 was not statistically significant with an alpha of .05, $F(1,27) = 3.046$, $p > .05$, which showed that the Group A perception on how they perceived their anxiety "at that moment" was less than the first time they took the test (descriptive statistics Table 3).

TABLE 3	GROUP	MEAN	STD. D.	N
A Y-1	A	30.9333	10.1733	15
	B	36.7333	9.4526	15
B Y-1	A	34.2667	6.8709	15
	B	39.6667	8.9815	15

The statistical analysis of STAI Y-2 was not statistically significant with an alpha of .05, $F(1,25) = 3.0235$, $p > .05$, which showed that there was no significant difference between how the participants of either group perceived their general anxiety level when the first and seventh sessions results were compared. The results are found in Table 4.

TABLE 4	GROUP	MEAN	STD. D.	N
A Y-2	A	25.69	5.4679	13
	B	32.67	6.8730	15
B Y-2	A	31.69	8.4398	13
	B	36.60	8.9347	15

A statistical analysis of all four STAI tests revealed a significant difference between the two groups. The alpha was .05, $F(1,25) = 4.511$, $p < .05$. The author believes that there was a difference between the two groups self reported anxiety levels and that this analysis provides support for that conclusion. The descriptive statistics can be found in Table 5.

TABLE 5	GROUP	MEAN	STD. D.	N
A Y-1	A	30.7692	10.8563	13
	B	36.7333	9.4526	15
AY-2	A	25.6923	5.4679	13
	B	32.6667	6.8730	15
B Y-1	A	33.6154	6.8257	13
	B	39.6667	8.9815	15
B Y-2	A	31.6923	8.4398	13
	B	36.6000	8.9347	15

There was no statistical significance found between the two groups' temperature and EDR values. The mean temperature for Group A session one was 84.59 degrees Fahrenheit (d. F.), and on the seventh session was 88.71 d. F. There is a difference of four degrees. The mean temperature for Group B session one was 84.12 d.F., and the seventh session was 86.69 d.F. This was only two degrees difference. Group A's first session mean for EDR was 10.75 micro-ohms, and for the seventh session was 6.65 micro-ohms. The difference was approximately 4 micro-ohms. Group B's EDR mean for session one was 9.02, and for the seventh session 8.82 micro-ohms. The difference was only 0.20 micro-ohms. This data is discussed in more detail later in the paper.

CHAPTER 5

DISCUSSION

Chapter V includes a summary of the research project, educational implications, suggestions for further research, and a conclusion.

Summary of Research

The data collected showed a statistically significant relationship between biofeedback training and EMG task scores and EMG task scores. The participants who received biofeedback training (Group A) were able to lower their average EMG scores during task participation compared to the scores of the non-biofeedback group (Group B). In addition, the EMG data collected during each session's beginning and end baselines showed that there was a difference between the two study groups. According to the descriptive statistics the Group A participants were able to relax more quickly after the task than the Group B participants. This provides evidence of the Group A participants' ability to self-regulate when the audio feedback was removed.

The work place today is becoming increasingly reliant on computers and electronic devices to perform a job. The term used to describe the stress related to technology and electronic equipment is techno-stress. This study's findings are important because it provides evidence that an individual can be taught through the use of biofeedback to control his/her EMG tension while performing a computer-based task. Employers could train employees with similar techniques to the ones used by coaches to improve their athletes. Techniques such as progressive relaxation, diaphragmatic breathing, and biofeedback could be taught to an employee to decrease the effects of techno-stress while lowering his/her overall anxiety. The results can also be applied to the study of ergonomics, which deals with chronic pain and arthritis associated with repeating finger and arm movements. The pain associated with ergonomics is related to excessive muscle tension in movement areas and is most often referred to as Carpal Tunnel Syndrome. Many of the problems with ergonomics are related to working on a computer for extended periods of time. This study has shown that EMG training can be used to reduce muscle tension while performing a movement task on a computer keyboard. The researcher believes that much more research is needed to study the effects EMG training can have on reduction of Carpal Tunnel Syndrome.

The data analysis of the temperature and EDR mean score for the first and seventh sessions were not statistically significant. However, the results did in fact have clinical significance (Schwartz, 1995). The Group A participants raised their mean temperature from 84 d.F., which is considered "tense," at session one to 88 d.F., which is considered "involved," at session seven. A four-degree body temp. improvement is very clinically significant because the body will only raise in temp. when an individual relaxes and removes muscle tension. Also, the Group A participants were able to lower their EDR scores from 10.05 in the first session to 6.65 in the seventh. Again, providing support for the clinical significance of the experiments findings despite the lack of statistically significance. The normal scale for a biofeedback client's EDR values are between two to ten micro volts (Schwartz, 1995). In this study the participants were able to bring their mean score down four micro volts on an eight micro volt scale which is very clinically significant. In both situations Group A participants demonstrated the ability to remain in a more physiologically relaxed state during the task than Group B.

Dr. Cynthia Chandler has said, in her biofeedback-training course at U.N.T., that it is not uncommon for a biofeedback client to take ten sessions before he/she becomes proficient using the biofeedback techniques successfully. The subjects in this study only attended seven sessions, and three additional sessions could have made a significant difference in the temperature and EDR results. However, this observation is limited for two reasons. First, it is an observation and not an established fact. Secondly, it applies to individuals who are using biofeedback to treat a preexisting stress related condition and the participants were not selected from such a group. The author believes that combining the EMG data along with the temperature and EDR data results provides support for the Group A participant's ability to generalize the relaxation training to not just muscle tension but to temperature (blood flow constriction) and EDR (sweat production).

The literature review cited several examples of studies where biofeedback had been used to successfully control stress and anxiety in individual sports. Kavussanu, Crews, and Gill (1998) used biofeedback training to improve basketball free throw shooting. Blumenstein, Bar-Eli, and Tenebaum (1997) found biofeedback could be used with individual sports such as wind surfing, wrestling, and Israeli judoka. Both of these studies' findings help to support the acceptance of this study's first hypothesis.

However, despite Group A's participants' ability to reduce their stress during the tasks there was not statistical significant to support the hypothesis that the biofeedback group (Group A) would be able to perform better (more correct responses) than the non-biofeedback group. In fact, the Group B scores were higher than that of the Group A's scores. The researcher believes that the task was responsible for causing this phenomenon. First, the task involved the use of the participants' memory to input the correct color sequence. The mean for both groups total task sequence length at the seventh task was 24.3. According to Schmidt & Lee (1999), short-term memory has a capacity of approximately 7 (plus or minus 2) items. The mean for the total task sequence length (number of correct responses in a row) for this experiment was 24.3 keystrokes. Also, Schmidt and Lee (1999) stated that "short term memory is related to consciousness; those things in short-term memory are essentially things of which we are consciously aware." Which suggests that an individual must be conscious of an object in order place it into short-term memory. While performing the task, the Group A participants were distracted from his/her focus of memorizing the color sequence by auditory beeps, the researcher's verbal coaching, and the participant's attempts to remember to correctly use the relaxation techniques. The researcher attempted to minimize these distractions during the task by lowering the sound level of the auditory beeps, and minimizing verbal coaching. However, it is apparent when one looks at the scores from both groups that there was interference with the Group A's ability to concentrate on inputting the correct sequence. Willard, Johnson, and Rosenfeld (1994) had a similar finding with auditory tones and biofeedback. They found that performance decreased with increased sensory stimulus due to "sensory overload." Other studies (Landers, Min-Qi, & Courtet, 1985; Lysklett, Whiting, & Hoff, 1998; Masters & Polman, 1995) found that the addition of a secondary task (biofeedback) did not hinder nor improve a participant's performance. All three studies had results similar to this study. Masters & Polman did find that after the secondary task was removed the experimental groups scores improved dramatically. The researcher observed that as the task sequence increased the Group A participants demonstrated more physical signs of frustration (sighing, clinching jaw, verbalizing words of disappointment) than was observed by Group B participants. These signs occurred during and after their session. The researcher questioned several of the subjects to determine if their performance was being affected by the distractions mentioned early. Each of the questioned participants answered "yes" that their performance was being affected, which lead the researcher to believe that the improvement shown by Group B was related to the lack of distractions and total concentration on the task completion. It is important to reiterate that if the participants in Group A had been given ten sessions they may have become more proficient at self-regulating and needed less auditory feedback to remain relaxed. This would have lowered the participant's sensory load and would have allowed them to devote more to concentrating on the task.

In this study the participants were required to learn too much and too quickly, and the following are the researcher's suggestions to eliminate the problems found in this study. First, the biofeedback group should receive nothing but biofeedback training (also progressive relaxation and diaphragmatic breathing) for the first five sessions. This would be done to allow the participant to understand how biofeedback works without the distraction of the task. Secondly, the participants in biofeedback group should not receive any feedback while performing the task. The task would be introduced at session six and would end at session ten. The biofeedback training would be given at the beginning of each session prior to the task and the first baseline, and after the completion of the task and the second baseline. This would occur at the sixth through the tenth session. This would eliminate the audio feedback as a possible extraneous variable.

Speilberger (1983) reported the mean score for the component Y-1 was approximately a score of 37(S.D. 10.02) and Form Y-2 was 39 (S.D.10.00). The STAI results for both groups at session one and session seven in this study were very similar to the norms presented by Speilberger (1983) meaning that the participants in this study were near the normal college student anxiety level at the time of data collection.

There was also another trend with the STAI anxiety tests. The data shows that the Group A participants did not improve their state of anxiety, where as, the researcher believed the opposite would occur. Most of the Group A participants reported throughout the training sessions that they were not aware of how much anxiety and stress they were under until they began this study. As the study proceeded Group A participants reported that they were much more aware of when they were under stress and expressed that they were able to control it to some degree. However, the Group A's STAI scores were not significantly different from that of the Group B scores which was the opposite of what the researcher expected. The researcher believes this occurred because Group A participants were much more aware of their level of anxiety at the time of the second test. Group A answered the questions based on their ability to more accurately appraise their anxiety level than that of the Group B.

The researcher attempted to keep the experimental basis to a minimum by meeting both groups with enthusiasm so that neither group's performance was influenced by the experimenter's mood. The Group A individuals did receive praise that the Group B participants did not. Biofeedback training is designed with praise as a crucial part of the learning process (Schwartz, 1995). In order to follow the biofeedback training protocol it was necessary to use praise. Praise was given to the biofeedback group for EMG reduction during the baselines and task performance. Praise was also given for lower EDR, higher temp., and good performance or improved performance on the task.

During the course of the study there was an attrition of two participants from Group A. It is difficult to determine the effect this had on the overall results of the study. The researcher suggests that future research should attempt to eliminate this problem by providing incentives that are more desirable.

Suggestions for Future Research

The literature suggests that biofeedback can be used to promote success in stressful situations. The author would have to agree based on experiences with this particular study. The participants in Group A were able to significantly lower their task EMG levels when compared to that of Group B. However, it is the author's opinion that the task or sport that the biofeedback training is being used with needs to be investigated very closely. Take this study for example. The task involved memorization of a sequence while more components were added to the sequence. The participant was forced to remember the order and remember to stay calm by using the biofeedback techniques. The author believes that Group A participants could have performed better if they had been given more time to practice and improve their relaxation skills so that they became automatic. Avni & Lidor (1997) found that skilled gymnasts could more efficiently cope with external distracters when performing a secondary task. Based on this the author suggests that future research involving the use of biofeedback training use a highly intensified program that ensures the participant's response to a stressor becomes automatic, allowing the participant to devote more attention to the task or skill.

The entire literature review dealt with the use of biofeedback as a means to control anxiety and stress. The author believes very strongly that more work with paper pencil tests, computer-based skills, and communication should be examined. Sports and athletic competitions only represent a small portion of events that each individual could be involved in during his/her lifetime. Computers are increasingly becoming involved in the work force.

The author mentioned early in this paper that the use of biofeedback and sport was just one of the many branches that have sprouted from the biofeedback movement. The use of biofeedback and stress management to improve an individual's production on closed skills such as computer skills is the next logical step in the biofeedback evolution.

According to the literature, biofeedback can produce highly desirable responses from an athlete or test subject (Dewitt, 1980; Prapavessis, Grove, McNair, & Cable, 1992). The author believes that these techniques should not be limited to just this small portion of life. The ability to understand one's internal reaction to stress and anxiety is a skill that everyone could benefit from today. The programs would not need to be as intense as those performed with top athletes or in a laboratory setting, but the key ideas and philosophies can be passed along in simple skills and techniques. The author believes that biofeedback or relaxation training could have a positive effect if taught to children and teens. They could apply the relaxation techniques to learning and athletics. The author also believes that if these skills are learned early that there is a possibility that they will become more automatic and will be used throughout the individual's life.

The author believes that this study was done very soundly, and that if he were to duplicate this study he would only implement small changes. The most crucial change would involve finding a task that does not require the use of memorization as a key element. Another change would be to extend the number of sessions from seven to ten. It may also be beneficial to use subjects that have pre-existing stress and anxiety issues. The author believes that the techniques taught to the participants were acceptable and fostered the participants' learning of the biofeedback training. The author also believes that if these changes were made the experiment would prove both of the previously stated hypothesizes.

Conclusion

There are only two conclusions possible from this study. First, that biofeedback training can be taught to an individual and applied to computer based programs in much the same way a coach teaches an athlete a new skill. Secondly, memorization skills as a performance measure must be analyzed to determine if it will interfere with the study's desired outcome.

APPENDIX

PROTECTION OF HUMAN SUBJECTS

1. The potential subjects will be drawn from University of North Texas Spring 2000 physical education courses (Dr. James Morrow, II the head of the Department of Kinesiology, Health Promotion, and Recreation has given permission to use this population). This population of possible subjects will be selected on the basis of conveyance. There will be 30 subjects in total acquired for the study. The subjects ages, gender, and ethic background is insignificant for the purposes of this study. Potential subjects under seventeen years of age will not be involved in the study.

2. The following represents the study's two major hypothesis:

A. The participants in the biofeedback training group will have a lower average physiological stress score when compared to that of the two other control groups.

B. The participants in the biofeedback training group will have higher accuracy scores on the intervention than that of the participants in the other two control groups.

The thirty subjects will be randomly divided into three groups. Group A will receive biofeedback training. Group B will receive only audio signals from biofeedback equipment with no explanation. Group C will receive no audio signals or feedback. Each subject will attend seven sessions.

During each session participants from all three groups will perform a computer performance test designed by Dr. Charlie Shea (Prentice-Hall, 1992). This program is called Competition and Coaction. The computer program consists of four different light circles, which light up in a random order. The participant must remember the pattern and then recall it in the same order. The light pattern order remains the same during the exercise. When the participant enters the correct pattern a new light is added to the old pattern. This possess continues for ten minutes. Each participant will be connected to a biofeedback machine that will record EMG, EDR, Temperature, and EEG readings.

Each participant will take the State-Trait Anxiety Inventory (STAI) form Y-2 on the first and the last session. This test provides a measure of the physiological and behavioral manifestations of arousal.

3. The subjects will be solicited from University of North Texas physical education classes. These students will be volunteers. The only requirements to take part in the study will be that the volunteer be seventeen years or older and will sign the informed consent form. Each participant will be given the complete back ground on the nature of the experiment and all of their questions will be answered. No information will be denied to the participants.

4. The researcher and University of North Texas Biofeedback Lab will ensure the participant's confidentiality. The subject's personal information will be kept in a locked cabinet in the U.N.T. Biofeedback Lab. Each participant will be coded with a two digit number as an extra step to ensure privacy.

5. The subjects in the Group A will receive the greatest benefit from this study. These individuals will be given the training that will help them to better control and deal with stress in their personal lives. The two control groups will not gain many benefits from this experiment, because they will not receive any biofeedback training.

6. The possible risks to the participants are very minimal. Risks include possible skin rash from electrodes and slight mental discomfort during the testing intervention.

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