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Biofeedback assisted relaxation training program to decrease test anxiety in nursing students

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BIOFEEDBACK ASSISTED RELAXATION TRAINING PROGRAM TO DECREASE

TEST ANXIETY IN NURSING STUDENTS

by

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ABSTRACT

Biofeedback Assisted Relaxation Training Program to Decrease Test Anxiety in Nursing Students

by

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Nursing programs have been cited as being among the most stressful undergraduate programs. Students' knowledge and skills are consistently tested and monitored, and students may fail a course or be dropped from their nursing program if scores are not above a certain standard. Anxiety reactions are common to situations perceived as threatening; however, excessive anxiety may paralyze an individual and interfere with effective learning, functioning, and testing. Numerous studies have found increased anxiety causes physiological changes including increased respirations and heart rate, and decreased peripheral skin temperature.

The purpose of this study was two fold. First test anxiety was measured across the four semesters of a nursing program to determine if test anxiety differed by semester. Second, a biofeedback assisted relaxation training program was tested as a means to reduce test anxiety in undergraduate nursing students who self reported test anxiety. Anxiety was measured subjectively using Spielberger's Test Anxiety Inventory (TAI) and objectively by monitoring peripheral skin temperature, pulse rates, and respiration rates during the biofeedback assisted relaxation training program.

There were no statistically significant differences in test anxiety across the four semesters. However, third semester nursing students reported the highest test anxiety scores (47.5±16.5). Fourteen students from this semester participated in phase two of the study. During this phase, the students were introduced to three relaxation techniques including diaphragmatic breathing, progressive muscle relaxation, and autogenics training. They were asked to practice the relaxation techniques they were taught during the following week for fifteen minutes a day and record their respiratory rates, peripheral skin temperatures, and pulse rates. Findings showed statistically significant changes in respiratory rates and skin temperatures during the diaphragmatic breathing session; changes in respiratory rates and peripheral skin temperatures were statistically significant during the progressive muscle relaxation training session, and statistically significant changes in respiratory rates, peripheral skin temperatures, and pulse rates were found during the autogenic training sessions.

There was no statistically significant difference between the first Spielberger Test Anxiety Inventory (TAI) and the second TAI. For further analysis, the students were divided into two groups, those who were able to learn the techniques, as evidence by a change in all three physiological variables; and those who were unable to learn the techniques. The pre and post TAI scores were compared between these two groups and there was no statistical significance between the difference scores.

The researcher then artificially divided the participants into two groups, according to their score on the first TAI. Group one was comprised of those scoring above the TAI 1 mean; and group two was comprised of those scoring below the TAI 1 mean. The researcher compared TAI scores after the relaxation training using an unpaired t test.

There was no statistical significance between the high and low scoring students on the second TAI 1. This suggests that the lack of effect of training on test anxiety was not related to the initial test anxiety level.

In conclusion, the subjective test anxiety scores of the students did not decrease by the end of the biofeedback assisted relaxation training program. The students were able to learn how to control their respiratory rate, and as a result peripheral skin temperatures increased significantly during each training session. The training strategy that resulted in the greatest change in physiological measures, and presented the most significant findings was the autogenic training session. The students reported this training to be effective and useful, and 100% reported they would use this training in the future to reduce their physiological reactions associated with anxiety.

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CHAPTER 1

INTRODUCTION

The United States is experiencing a nursing shortage and the shortage has been predicted to become larger in the future. One problem nursing schools face is the attrition rate of the nursing students in bachelor's degree programs across the United States, estimated to range from 24-28% (Gray, 2008; Keeling, 2009). Attrition rate is defined as 'wastage', 'turnover' or 'dropout'; loss of individuals from programs (Deary, Watson, & Hogston, 2003). When students do not progress as expected in their programs and must repeat a course, they fill a seat, preventing other applicants from being accepted. The American Association of Colleges of Nursing (2007-2008) reported that approximately 40,000 qualified nursing students were refused admission in the previous year because of the limited number of faculty, clinical space, and resources. Due to the limited resources schools of nursing have it is imperative to identify reasons admitted students are not progressing and identify interventions to keep them in their programs. Potential students are refused admission if current students are not progressing. To deal with failure to progress, nursing faculty should identify possible reasons why students who are accepted into nursing schools, and therefore expected to have the ability to meet the curricular requirements, have difficultly either progressing from one level to the next, or completing requirements for graduating. There are many theories related to the high attrition rates, but one postulate may be that attrition is due to the stress of nursing school and examinations.

Nursing school is highly stressful. Two stressors related to nursing school may be stress of testing and high threshold standards that nursing schools implement in their programs; many programs require that students achieve certain percentages on every examination in order to progress. Thus, testing has high consequences and this may exacerbate any anxiety associated with testing. Test anxiety may place nursing students at risk for being unsuccessful in their programs due to their inability to demonstrate their knowledge base. The consequence of not receiving certain criterion scores on every examination affects attrition rates of nursing students across the country, compounding the problem of nursing shortages. Nursing faculty should not decrease the requirements for progression within their program and graduation, but they should identify students who are struggling with test anxiety and offer methods of reducing it.

Interventions aimed at decreasing test anxiety and alleviating negative consequences of test anxiety must be implemented in nursing programs. Implementing a biofeedback assisted relaxation training (BART) program for nursing students who suffer from test anxiety may help those students learn to control their physiological and psychological reactions associated with test anxiety and positively impact attrition rates.

Problem Statement

The literature lacks study of BART programs within university systems, specifically in nursing programs, to decrease anxiety associated with testing. There is minimal literature that addresses specific strategies to decrease test anxiety in nursing students.

Background and Significance to Nursing

The United States is in the midst of an unprecedented shortage of registered nurses (RNs) (American Association of Colleges of Nursing, 2005). The shortage of RNs in the U.S. could reach as high as 500,000 by 2025 according to a report released by Dr. Peter Buerhaus and colleagues in March 2008 (American Association of Colleges of Nursing, 2008). Though the American Association of Colleges of Nursing reported a 5.4% enrollment increase in entry-level baccalaureate programs in nursing in 2007 over the previous year, this increase is not sufficient to meet the projected demand for nurses (American Association of Colleges of Nursing, 2008). At least 390,000 of the nursing vacancies projected by the U.S. Bureau of Labor Statistics will be for RNs who are baccalaureate prepared (American Association of Colleges of Nursing, 2005). Government analysts project that more than 587,000 new nursing positions will be created through 2016 (a 23.5% increase), making nursing’s projected job growth the nation’s top profession (American Association of Colleges of Nursing, 2008).

Nursing faculty are well aware that one potential problem compounding the nursing shortage is the net number of nursing students who graduate from nursing programs. Historically, nursing students have been predominately women from non-minority backgrounds (Salamonson & Andrew, 2005). Schools of nursing have taken actions to expand and diversify their applicant pool to better meet the health care needs of our diverse nation. Diversification of student recruitment may help to meet the endemic shortage and increase qualified nursing applicants (Salamonson & Andrew). In light of the recent strategies to increase nursing school graduation rates, the literature continues to report that nursing schools have high attrition rates. Schools of nursing must not assume that once more students are accepted into programs the nursing shortage will be resolved. There may be other factors that come into play when addressing nursing school attrition rates. Data provided by the universities in 2006 revealed a national attrition rate of 24.8 percent (Gray, 2008). Since 2006, attrition rates have risen to 26 percent and this lost of students from nursing programs results in the wasting millions of dollars of public funding used to support nursing education (Gray; Keeling, 2009). Starck, Love, & McPherson (2008) report that ‘on time’ graduation rates for BS nursing programs are 56.7%. ‘On time’ graduation is defined as students progressing from one semester to the next without any breaks or leaves of absence.

It is, therefore, critical to determine factors that contribute to the high attrition rates within schools of nursing so that strategies to reduce these can be implemented. One possible contributing factor to high attrition rates is the high stress levels nursing students feel as they progress through their program. Rosburg (1988) compared the stress levels of 300 students in three occupational groups of college students (nurses, police officers, and fire fighters) with that of 515 full time general college students at the same campus in Southern California. He found that student nurses suffer from the highest state of stress among all groups. These findings have been validated by more recent studies as well (Deary et al., 2003; Gibbons, Dempster, & Moutray, 2008; Watson et al., 2008).

One specific stress that student nurses often report is that of examination stress. Examination processes within schools of nursing are rigorous. Students are expected to maintain test scores above certain levels, or they will not progress to the next level within their curriculum. Nursing, as a career, is one that requires knowledge in variety of areas and it is important to graduate only those who are capable of performing nursing duties in a safe and efficient manner.

For some students the stresses of the examination may not be due to the examination itself, but rather to the anxiety associated with testing. There are numerous definitions of test anxiety. “Test anxiety refers to a set of cognitive, physiological, and behavioral responses related to concerns about possible failure or poor performance on an exam or similar evaluate situation” (Bodas, Ollendick, & Sovani, 2008, p. 387). Bembenutty (2008, p. 123) defines test anxiety as the “worry that interferes with the attention, concentration, and effective information processing”. Lazarus and Averill (1972, p. 30) define test anxiety as “an emotion based on the appraisal of a threat, an appraisal which entails symbolic, anticipatory, and uncertain elements; anxiety results when cognitive systems no longer enable a person to relate meaningfully to the world”. Research on test anxiety has shown this to be a complex, multi-dimensional, and dynamic construct; and there has evolved a distinction between the cognitive (worry) and affective (emotionality) dimensions of test anxiety (Bodas, Ollendick, & Sovani). The worry component refers to the evaluative concerns about one’s performance (Bodas, Ollendick, & Sovani); this can begin days to weeks before the stressful stimulus is introduced. The emotionality component involves subjective awareness and interpretation of physiological arousal in evaluative situations (Bodas, Ollendick, & Sovani); this occurs minutes before the stimulus is introduced. The worry component can be viewed as the cognitive component. Test anxiety has been shown to produce an information-processing deficit approach, which suggests that worry during an examination distracts the learners’ attention, decreasing their capacity to do specific tasks while creating retrieval deficits

(Bembenutty). A curvilinear relationship has been used to describe the association between test anxiety and test performance (Wong, 2008). This relationship predicts that individuals who are usually low-anxious benefit from anxiety producing test conditions; and those who are high-anxious benefit from a more relaxed testing environment (Wong).

Detrimental effects of test anxiety have been well documented and include physiological, emotional and cognitive consequences. Students, however, may employ a number of available strategies to ameliorate the detrimental effects of test anxiety (Bembenutty, 2008). Ample evidence reveals that many psychiatric disorders, including test anxiety, are characterized by autonomic imbalances (Reiner, 2008), which can be monitored by biofeedback techniques. A simple, non-invasive direct route to assess real-time autonomic activity is to monitor heart rate, respiratory rate, and peripheral skin temperature. One possible strategy to decrease test anxiety, thereby reducing one stressor associated with nursing school, may be the use of a biofeedback assisted relaxation training (BART) program. Clinical biofeedback has helped people alter their behaviors by using feedback from their physiology. Through a BART program, the test-anxious students should be able to visualize and identify their emotional and physiological consequences associated with the anxiety they experience and learn to control these reactions. By allowing participants to visualize their physiological changes under stress, and teaching them relaxation techniques to control these reactions, the negative consequences of anxiety, specifically test anxiety, may be decreased.

Purpose of Study

The purpose of this study was to evaluate the effect of BART program on self-reported test anxiety of undergraduate nursing students. The training program involved multiple individual sessions and home practice. Test anxiety was measured subjectively using Spielberger's Test Anxiety Inventory. Objectively, pulse rate, respiration rate, and peripheral skin temperature was monitored during the BART program, as an indication of whether or not the student learned the techniques.

CHAPTER 2

REVIEW OF RELATED LITERATURE

The review of literature will begin with an overview of anxiety and then focus in on test anxiety, gender and cultural differences associated with test anxiety, physiological measures of anxiety, previous interventions used to decrease test anxiety, and biofeedback and relaxation strategies utilized to lessen test anxiety. Articles were reviewed from the health science disciplines spanning the years of 1966 through 2009.

Anxiety

The concept of ‘anxiety’ was not fully recognized as a pervasive human condition until the 20th century (Spielberger, 1983). Over the past 80 years human anxiety and its consequences have been researched. Prior to 1950 there was little research on human anxiety (Spielberger). This was due to differing conceptual frameworks being used to define the phenomenon, few instruments to measure it, and ethical problems associated with inducing anxiety in laboratory settings (Spielberger). Definitions of test anxiety can be found in Table 1.

Test Anxiety

Test anxiety has been conceptualized in multiple ways throughout the years. Some researchers refer to the cognitive impairments involved, and others to the emotional reactions. Definitions of test anxiety can be found in Table 2.

Table 1 Definitions of Anxiety

Lazarus & Averill (1972)	An emotion initiated by the appraisal of a threat; a state that is associated with feelings of uncertainty helplessness, and a threat to the core of the personality.
Spielberger (1983)	An emotional state at a given moment in time and at a particular level of intensity which is characterized by "tension, apprehension, nervousness, and worry, and an activation of the autonomic nervous system" (p. 4).
Beck, Emery, & Greenberg (1985)	Steps a person takes to reduce danger, an emotional process accompanied by physiological reactions.
DSM IV	A. Excessive anxiety and worry (apprehensive expectation), occurring more days than not for at least 6 months, regarding a number of events or activities (such as work or school performance). B. The person finds it difficult to control the worry. C. The anxiety and worry are associated with three (or more) of the following six symptoms (with at least some symptoms present for more days than not for the past 6 months). (1) feeling restlessness or feeling keyed up or on edge (2) coming easily fatigued (3) experiencing difficulty concentrating or having mind going blank (4) exhibiting irritability (5) feeling muscle tension (6) having sleep disturbance (difficulty falling or staying asleep, or restless unsatisfying sleep) D. The anxiety, worry, or physical symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

Table 2   Definitions of Test Anxiety

Beck, Emery, & Greenberg (1985)	An unpleasant emotional reaction to real or imagined dangers; anticipation of a specific confrontation with an evaluation; a feeling of vulnerability.
Tobias (1985)	An information-processing deficit approach worry during an examination distracts the learner's attention, decreasing their capacity to do specific tasks and creating retrieval deficits.
Howell & Swanson (1989)	A negative perception of academic ability based on actual past academic performance, study, and testing skills.
Hembree (1998)	Negative perception of achievement in college related to performance and well being.
Stober (2004)	A situation-specific trait; a disposition to react with heightened anxiety in the face of situations that are specifically related to tests and performance.
Zeidner (2007)	Interference with competence in both lab settings and testing situations in college.
Bembenutty (2008)	The worry that interferes with the attention, concentration, and effective information processing.

Although multiple definitions have been introduced for anxiety and test anxiety, there is broad agreement that anxiety can be classified into two components, which are state and trait anxiety (Cheung, 2006).

Table 3   Definition of Trait and State Anxieties

Trait Anxiety	The stable individual differences in anxiety proneness (Spielberger, 1983). A general way of responding to the world which becomes stable over time (Zeidner, 2007).
State Anxiety	Transitory emotional condition that is characterized by subjective, consciously perceived feelings of tension, apprehension, nervousness, and worry (Spielberger, 1983).

These concepts are important to understand because one can delineate differences in state and trait anxiety. Trait anxiety is unchangeable and is how an individual reacts to anxiety on a day-to-day basis. State anxiety can be altered because it refers to how a person copes with and responds to different levels of anxiety and stress in his/her life. Test anxiety can be subdivided further into the 'worry' and 'emotionality' concepts. These are the concepts which researchers are concerned with when evaluating responses to anxiety inducing situations, such as examinations.

Worry and Emotionality Associated with Test Anxiety

Liebert, Spiegler, and Morris (1974) differentiated two major components of test anxiety, the 'worry' and 'emotionality'. Definitions of these are listed below in the table:

Table 4 Definition of Worry and Emotionality Components

Worry Component	Refers to the evaluative concerns about one's performance worry. Is more enduring and can be aroused several days before an examination and stays throughout the examination (Bodas, Ollendick, & Sovani).
Emotionality Component	Involves subjective awareness and interpretation of physiological arousal in evaluative situations. Is more transient and occurs immediately before an examination (Bodas, Ollendick, & Sovani).

These concepts were subsequently incorporated into the standard measures of test anxiety (Stober, 2004) and are the basis of Spielberger's Test Anxiety Inventory (TAI) (see Appendix A). Since test anxiety is complex and multidimensional, it is imperative to understand the differences between the cognitive aspects, or 'worry', and also physiological aspects, or 'emotionality', of test anxiety. Cognitive theorists have postulated that judgments students make about their testing situation are correlated with their affective response systems (Davis, DiStefano, & Schutz, 2008). The ‘worry’ component is a cognitive characteristic of test anxiety because it refers to a “chain of thoughts and images; concerns future events whose outcomes are uncertain” (Hirsch, Hayes, & Mathews, 2009, p. 44). Wine (1971) reports that worrying is an attentionally demanding cognitive activity, and during an examination the highly anxious person is focused both on *self* and the *task*. The low anxious individual, on the other hand, is focused solely on the task. Sarason (1984) concurs with this postulate and suggests the allocation between the concern for the *self* and the *task* in the individual with high test anxiety is the result of interfering cognitive responses when the individual is placed in a high stress or anxiety producing environment. The ‘emotional’ aspect associated with test anxiety refers to the physiological consequences associated with the anxiety such as rapid respirations, increased pulse rates, and decreased peripheral skin temperatures.

Cognitive Theories Related to Test Anxiety

Cognition plays an instrumental role in test anxiety. Negative cognitive responses associated with test anxiety may lead to the emotional reactions experienced by the individual (Hollandsworth et al., 1978). Ellis (1991) hypothesized that belief systems determine emotional consequences of events; irrational beliefs lead to negative emotional consequences.

Beck et al. (1991) defend the notion that there are three cognitive constructs. Cognitive error can occur in the cognitive content of core beliefs, intermediate beliefs, and automatic thought. Beliefs individuals have are thought to stem from their schema, or the underlying cognitive structure for organizing and interpreting information. Schemas account for repetitive themes in dreams and free association, and these schemas help individuals interpret events that occur; most of the time they are inaccurate. The repetitive inaccurate schemas lead individuals to form biases, and the biases at the core belief level represent dysfunctional attitudes or intermediate belief levels (Beck, 1995). After these beliefs are reinforced repeatedly to oneself, the thoughts become automatic in any situation. Beck posits that the cognitive triad involves negative core beliefs about the self, the world and the future. Intermediate beliefs involve misinterpreting information from the external world (e.g., I will fail this test"). Negative automatic thoughts are distorted thoughts that arise automatically and are the end product of the core beliefs and the intermediate beliefs. The distorted realty and the negative beliefs are believed to be responsible for disorders such as anxiety and depression (Beck et al., 1985).

Wong (2008) conducted a study to determine relationships between the variables associated with the cognitive triad, irrational beliefs, and test anxiety to determine if cognitive variables were predictive of test anxiety, and to explore the relationship between the cognitive triad and irrational beliefs. The researcher concluded that all variables associated with the cognitive triad and irrational beliefs are correlated with test anxiety, and the negative view of self was found to be the only predictor of test anxiety. This study suggests that those individuals who have a negative self view are more likely to experience some form of test anxiety. Wong recommends combining cognitive interventions with behavioral interventions to reduce negative emotional responses to test anxiety, since the emotional responses to test anxiety are a result of the negative cognitive thoughts and associations.

Test Anxiety and DSM IV

Test anxiety also has been classified in the literature as a clinical syndrome; but the current Diagnostic and Statistical Manual of Mental Disorders Fourth Edition (DSM IV) does not classify test anxiety as an Axis 1 disorder (Putwain, 2008). Although test anxiety is not an Axis 1 diagnosis, there is literature that supports a relationship between test anxiety and social anxiety, which is an Axis 1 diagnosis (Schmidt, & Riniolo, 1999). King et al., (1995) demonstrated that 60% of test anxious subjects met criteria in the Diagnostic and Statistical Manual Third Edition for an anxiety disorder; the most common of the anxiety disorders were social and overanxious disorders.

In social and evaluative anxieties there are vicious cycles that are created when an individual anticipates an extreme, irreversible outcome, which in turn creates more fear, defensiveness, and inhibition when entering a situation (Beck, Emery, & Greenberg, 1985). “Social and evaluative anxieties stem from fears of being the center of attention, experiencing negative evaluation by another person, and having one’s weaknesses exposed” (p. 152). The most crippling consequences of social and evaluative anxieties are interference with fluid speech, thinking, recall and memory (Beck, Emery, & Greenberg).

Test anxiety may be triggered by numerous variables. These include: an irrational fear of failure, a fear of what others may think of the individual if he or she does not successfully pass a test, a fear of performance situations where he or she may be scrutinized or tested in some way, or the fear of an examination. The definition of the DSM IV diagnosis of social anxiety is outlined in Table 5.

Table 5   DSM IV Definition of Social Anxiety

- A marked and persistent fear of one or more social or performance situations in which the person is exposed to unfamiliar people or to possible scrutiny by others. The individual fears that he or she will act in a way (or show anxiety symptoms) that will be humiliating or embarrassing.
- Exposure to the feared social situation almost invariably provokes anxiety, which may take the form of a situationally bound or situationally predisposed panic attack.
- The person recognizes that the fear is excessive or unreasonable.
- The feared social or performance situations are avoided or else are endured with intense anxiety or distress.
- The avoidance, anxious anticipation, or distress in the feared social or performance situation(s) interferes significantly with the person's normal routine, occupational (academic) functioning, or social activities or relationships, or there is marked distress about having the phobia.

Summary

In summary, test anxiety is differentiated from general anxiety by specifying a situation or context. It occurs in an evaluative situation (Putwain, 2008), although test anxiety shares many of the same defining characteristics and is associated closely with, social anxiety disorders. Test anxiety refers to a set of cognitive, physiological, and behavioral responses related to concerns about performance on examinations or other similar situations (Bodas, Ollendick, & Sovani, 2008; Wong, 2008). Anxiety can be further divided into Trait and State anxiety. State anxiety occurs shortly before the stimulus is presented; whereas Trait anxiety is the stable individual difference in anxiety proneness. When an individual has test anxiety, he or she will experience two specific components, the ‘worry’ and ‘emotionality’. The ‘worry’ component occurs days or weeks before the stimulus is presented and the ‘emotionality’ occurs immediately before being tested. The ‘worry’ (cognitive) and ‘emotionality’ (physiological) components are the two concepts measured in the Spielberger’s Test Anxiety Inventory (Spielberger, 1984).

Test Anxiety and Gender

Male and female students differ in measures of test anxiety. As early as elementary school, female students show higher anxiety levels than male students (Altermatt & Kim, 2004). Altermatt and Kim (2004) report that females in elementary school agree more to statements such as “I worry about whether I am really smart” and “I worry about doing well on test in school” than males. Wine (1980) reported that females devalue their academic performance and exhibit higher levels of test anxiety compared to males, and because of this, females are at a disadvantage in testing situations. Females have been found to be overly anxious about being evaluated, reacting in a more emotional manner. High levels of test anxiety have been shown to decrease cognitive performance. As stated earlier, emotional and worry components are factors related to test anxiety. Although both factors are associated with test anxiety, the ‘worry’ component has been linked more closely to academic performance than the ‘emotional’ component. When the worry component is activated, the test taker displaces the focus from the test and places it more on the self-related cognitions, which decrease performance abilities (Zeidner, 1990).

Test Anxiety and College Males and Females

Mean test anxiety scores for female college students in the United States are higher than those of males (Spielberger et al., 1980; Hembree, 1988; Lowe & Reynolds, 2005; Baloglu & Kocak, 2006; Lynch, 2008). Spielberger (1983) reported higher mean scores for women than men on the Trait subscale of the State-Trait Anxiety Inventory. This finding indicates that females have higher day to day anxiety levels as compared to males.

Mwamwenda (1993) found similar results when examining gender and test anxiety. Sixty-three women and 29 men were asked to complete the Anxiety Achievement Test which consisted of 10 statements describing the way in which a person feels while tasking tests. Women scored a mean of 27.5; and men scored a mean of 25.6, indicating the women reported higher test anxiety. Feingold (1994) found extensive evidence of this after she examined the literature pertaining to the relation of gender differences and test anxiety from 1940 to 1992; and concluded that females consistently score higher than men on measures of anxiety. The gender differences were constant over age, education, and nationality.

Lowe and Reynolds (2005) utilized the Adult Manifest Anxiety Scale-College (AMAS-C) version to assess gender differences in test anxiety. The sample was composed of 608 women and 335 men. Women scored higher than men on three of the four anxiety subscales ($p < .05$): Physiological Anxiety, Test Anxiety, and Worry/Oversensitivity. Although women scored higher on the fourth subscale, Social Concerns/Stress, the gender difference was not statistically significant (Lowe & Reynolds).

In summary, gender differences associated with test anxiety can be observed as early as elementary school, with females showing higher levels. These findings are consistent throughout adolescent and adult years. Overall, the results of multiple studies support one another in demonstrating a gender difference associated with test anxiety. This is especially relevant to nursing school because 85% of nursing students are female (Pryjmachuk, Easton, & Littlewood, 2009).

Test Anxiety and Culture

Test anxiety has been researched in many countries including the United States, Czechoslovakia, Egypt, Germany, Holland, Israel, Japan, and India, signifying that test anxiety is pervasive across geographic and cultural boundaries (Bodas & Ollendick, 2005). Due to the high attrition rates nursing schools are experiencing, there has been an increase in diversification efforts to alleviate the nursing shortage. In light of these strategies, nursing classrooms are becoming quite culturally diverse. It is therefore imperative to research possible cultural variations associated with testing and standards.

The culturally diverse student brings unique challenges and needs, and it is only with modifications of teaching strategies that culturally diverse students can be recruited and retained (Davidhizar & Shearer, 2005). Minority groups may be at a disadvantage in testing situations because the students may feel overly anxious about being evaluated (Zeidner, 1990).

Schwarzer and Kim (1984) compared Korean students with students from different nations; Korean students had higher mean scores of test anxiety using the TAI. Oener and Kaymak (1987) conducted a study which concluded that Turkish students have equal or lower levels of test anxiety, as compared to Korean, American, German, Hungarian, and Indian students. Hembree (1988) reported that non-white American students reported higher levels of test anxiety when compared with those of other ethnicities. He concluded that test anxiety scores of North American children plateau around the 9^{th} grade and continue to decrease throughout the high school years. Seipp and Schwarzer (1996) analyzed Spielberger's TAI scores across 14 nations and reported that Egypt, Jordan, and Hungary had the highest levels of test anxiety, while China, Italy, Japan, and the Netherlands had the lowest reported test anxiety. A study completed by Dion and Toner (2001) investigated test anxiety and ethnic differences using the Test Anxiety Scale (TAS), a 37 item self report scale, and a self reported ethnicity questionnaire. They found Chinese students scored significantly higher on the test anxiety measure than those of European or Anglo ethnic backgrounds. Putwain (2007) found students from white ethnic backgrounds reported lower test anxiety than those of Black, Asian, or other ethnicities. Contrary to these findings, Zeidnder and Safir (1989) report non-significant results in terms of ethnicity and test anxiety levels. It appears that culture may be an important variable in determining the expression of test anxiety, the degree to which one culture expresses test anxiety, from a complex number of factors specific to that group (Putwain, 2007).

With increasing diversity in schools of nursing, it is important to identify possible cultural barriers when testing students. Unfortunately, the literature is inconclusive regarding those cultures that experience higher levels of test anxiety.

Physiological Measures Related to Anxiety

The physiological reaction that has been termed the fight or flight response (Selye, 1976) may disrupt equilibrium, depending upon the individual and a given situation (Edelman & Focorelli, 2005). One of the reactions to anxiety involves shunting of blood away from the non-essential organs to essential organs for flight, such as the brain, heart and muscles. When these reactions occur, peripheral skin temperatures decrease, pulse rates increase, and respiratory rates increase.

Anxiety and Pulse Rates

During anxiety induced via physical or psychological stress, physical and autonomic changes occur. It is, therefore, reasonable to assume that measuring autonomic function is an excellent tool for measuring psychological states (Shinba et al., 2008). Allostasis is the process by which living organisms maintain homeostasis during physiological challenges. Comprising the allostasis adaptive system is a) corticotrophin releasing hormone (CRH), b) norepinephrine (NE), and c) hypothalamic-pituitary-adrenocortical (HPA) (Chida & Hamer, 2008). When an individual experiences anxiety, the HPA is activated by the CRH, increasing the production of corticotropin, which results in cortisol production (Chida & Hamer). The nervous system is comprised of the sympathetic and parasympathetic nervous systems. The sympathetic nervous system is the activation system, and innervates the heart, vasculature, and adrenal medulla via neurotransmitters such as acetylcholine, norepinephrine, serotonin, and dopamine (Mueck-Weymann et al., 2002). When epinephrine, a systematic catecholamine, is released, sympathetic nerve terminals that line the vasculature release NE, accounting for the vasodilation response (Chida & Hamer). The parasympathetic nervous system innervates the heart muscle as well; and when anxiety or stress occurs the parasympathetic nervous system (PSNS) mediates the sympathetic nervous system response.

Heart rate variability (HRV) represents the relationship between the sympathetic and parasympathetic responses on the heart rate (Appelhans & Luecken, 2006). By monitoring the HRV, one can monitor externally the autonomic responses within the body. When an individual has a low HRV, it refers to the time it takes the parasympathetic nervous system to innervate the heart and slow it down; whereas a high HRV indicates the parasympathetic nervous system reacts quickly to bring the body back to homeostasis. Short and long term stress reactions will decrease the HRV, and the literature corroborates the relationship between low HRV and an increase in psychiatric and anxiety disorders (Reiner, 2008).

Appelhans and Luecken (2006) posit that HRV monitoring is one way to investigate individual differences in cognitive functioning under stressful situations, because HRV has been linked to cognitive functions such as attention and working memory. When an individual is under physical or psychological stress, the sympathetic nervous system is activated. Therefore by measuring the HRV one can postulate that emotional responses can be monitored at the same time (Appelhans & Luecken). HRV can be understood to be an index of self-regulation because of its ability to reflect feedback mechanisms within the CNS (Thayer & Lane, 2000). Studying cardiac reactivity to anxiety is one of the better ways to investigate the allostatic systems (Chida & Hamer, 2008). Hansen, Johnsen, and Thayer (2007) conducted a study to examine the relationship between HRV and cognitive function. Two cognitive tasks were given to sixty five participants, and their HRV was measured before, during, and after the tasks. Their conclusions were that those with high HRV demonstrated superior performance on the cognitive tasks, deducing that those with high HRV are more stress tolerant and resilient than those with low HRV.

Shinba et al. (2008) conducted a study using employees from a business company. The participants did not have a history of psychiatric, neurological, cardiac, or pulmonary disease. The researchers used the STAI as the measure of psychological anxiety during a mathematical stress task. The subjects were seated in chairs with their left arms situated on pillows and pulse sensors were placed over their left radial arteries. They were asked to write a series of digit numbers (0-9) in Arabic numerals with a pen and paper matrix, following the speed of metronome beeping sounds from the top left to the right bottom in a random fashion. The random number generation was used for applying stress to the participants. HRV changes due to the mental challenges presented were analyzed. The results demonstrated HRV and heart rate responsiveness increased as psychological anxiety increased. This suggests that as cognitive stress increases, it takes the parasympathetic nervous system a longer time to innervate the heart to bring back homeostasis.

McTeague et al. (2009) conducted a study of 75 adults diagnosed with social phobia and 75 control subjects. The diagnostic criteria of social phobia included physiological hyper-arousal to a range of socially relevant external cues. The researchers wanted to evaluate whether or not socially anxious people would show physiological changes to imaged fears as well. 24 narrative scripts were used: 2 social threats, 4 survival threats, and 2 neutral events. The participants sat quietly in a darkened room and electrodes were placed on their body to measure physiological reactivity. Every trial consisted of a 1 second baseline, 6 seconds of script reading by the researchers, 12 seconds of imagery, and relaxation. Baseline heart rate increased linearly with symptomatology ($p < .001$) from the control group to the social phobia group. Heart rates declined during the neutral images for both groups, but the social phobia group had a greater acceleration in heart rate during the social threat exercise. In conclusion, individuals with social phobia displayed defensive physiological hyper-arousal to internally generated images depicting scenes of failure and performance anxiety. As indicated earlier, test anxious individuals share many similar characteristics of individuals diagnosed with social anxiety or social phobia. One reason for the physiological reactions associated with test anxiety may be attributed to the mental image the student has of the test or the mental image of an interpersonal failure prior to taking a test.

Anxiety and Respiratory Rate

A relationship between respiration patterns and emotions exist (Homma & Masaoka, 2008). As anxiety increases, respiratory rates increase. Mental stress elicits the release of hormones such as epinephrine and NE, and the hormone release prepares the body for “fight or flight” (Webb et al., 2008). “Fight or flight” mode is characterized by arousal and rigidity of the sympathetic nervous system and decreased activation of the parasympathetic nervous system (Reiner, 2008). When an individual is anxious, there is an increased sensitivity to elevations in pCO_2 levels which trigger the medullary suffocation alarm that stimulates breathing (Conrad et al., 2007). When an individual first responds to anxiety, his or her breathing is rapid and shallow; once the medulla is stimulated, the breathing rate and depth increase to expel the excess $pCO_{2.}$ Overactivity of the respiratory muscles contributes to feelings of dyspnea in anxious individuals because the shortening of the inspiratory muscles reduces efficiency of the lungs, thereby increasing the work of breathing (Ritz, Leupoldt, & Dahme, 2006).

Diaphragmatic breathing counteracts the fight or flight response (Paul, Elam, & Verhulst, 2007), and modifications of breathing patterns have been incorporated into cognitive-behavioral and meditative therapies of anxious individuals for many years

(Conrad et al., 2007). In terms of anxiety associated with testing, Harris and Coy (2003) recommend that students use deep or diaphragmatic breathing during tests in an attempt to calm, or center themselves. Research has shown that students who meditate or use deep diaphragmatic breathing during tests increase academic learning and achievement (Paul, Elam, & Verhulst, 2007). Changing one's breathing pattern to a slower and controlled pattern may help counteract stressful responses within the body by producing a claming effect. Paul, Elam, and Verhulst report diaphragmatic breathing is central to any meditation activity. These researchers conducted a 10 month longitudinal study over a two year period to assess students' beliefs and symptoms regarding academic stress, and they used Deep Breathing Meditation to counter symptoms associated with testing. The students were introduced to deep breathing by a licensed clinician who used a script to walk the students through the exercises. The students also were also given a one hour lecture regarding the physiological effects of stress and anxiety. They were allowed five minutes of every class period to practice their deep diaphragmatic breathing. The results showed that significant behavior changes occurred when students were given only 5 minutes stress reduction time before class. After six weeks of the intervention the students reported increased concentration, decreased nervousness and self-doubt during testing. The researchers report there are only a few schools currently introducing stress reduction techniques to their students, but they recommend this technique to educate students regarding coping strategies and proactive steps to take to counteract chronic diseases.

The literature suggests that individuals who have a high trait anxiety also engage in excessive worrying. When an individual is experiencing anxiety, he or she has a decrease in working memory capabilities because it is believed that worrying takes up working memory capacity (Hirsch, Hayes, & Mathews, 2009). One reason high worriers may find it difficult to stop worrying is because of their difficulty disengaging from the worrying thoughts because of less working memory being available to switch to non-worrying thoughts. Hirsch, Hayes, and Mathews placed individuals who self reported being "high worriers" into two groups, a control and a "benign meaning" worry group. The control group was given random verbal scenarios that ended either in a threatening or benign way and the benign worry group was given scenarios that only ended in benign ways. Next, each subject was asked to concentrate solely on diaphragmatic breathing for 15 minutes. A tone was sounded 12 random times throughout these breathing sessions, and the subjects were asked to tell the researchers if they were thinking about their breathing or about an intrusive thought. If the subjects were thinking about an intrusive thought, they needed to classify it as being either positive or negative. The results revealed that the "benign meaning" group had fewer negative thought intrusions than the control group during the breathing exercises. This is an important study because it strengthens the argument that people can be taught to restructure their negative and worried thoughts with training, and shows that diaphragmatic breathing does lessen anxiety and worry. This allows the individual to concentrate on his or her body instead of on intruding, negative thoughts. Repeated practice of replacing negative thoughts with positive thoughts has been found to decrease anxiety levels (Hirsch, Hayes, & Mathews).

Anxiety and Peripheral Skin Temperature

When individuals experience anxiety, their sympathetic nervous systems are activated, causing elevated pulse (Selye, 1976; Wardell & Engebretson, 2001; Hughes,

2005) and respiratory rates. Blood volume is shifted away from digestive organs and skin toward larger skeletal muscles, causing blood to move away from the peripheral surfaces, which results in lowered skin temperature (Wardell & Engebretson). Peripheral vascular beds are major sites of vasoconstrictor activity and are important for circulatory regulation. Measuring peripheral skin temperature may be useful as an indicator of sympathetic stress reactions (Musante et al., 1994).

Lindblad et al. (2006) measured peripheral vasoconstriction in 6th and 9th graders during an extracurricular test. The researchers distinguished between “the worry group” and the “no worry group” and found that the “worry group” displayed higher levels of peripheral vasoconstriction than the “no worry group”. Peripheral vasoconstriction for the “worry group” increased continuously during the test and continued to increase until 45 minutes after the test completion. This suggests that peripheral vasoconstriction reflects one of the body’s responses to sympathetic activation (Lindblad et al.). This study suggests that measuring peripheral skin temperature is a valid and objective method of measuring anxiety and worry in subjects.

Studies also have demonstrated that subjects voluntarily can learn how to increase or decrease their peripheral skin temperatures with training (Zaichkowsky & Zaichkowsky, 1984; Violani & Lombardo, 2003). Violani and Lombardo conducted a study to investigate the relationship between spontaneous peripheral temperature changes during six sessions of thermal biofeedback training. Forty-four subjects participated in the study, 25 females and 19 males. The participants had not received any prior relaxation or biofeedback training. The training sessions were held twice a week in a laboratory. The room temperature was maintained at 23±1°C. Each session the participants were given 15 minutes to adapt to the environment temperature, 12 minutes of rest, 12 minutes of biofeedback training during which they were instructed how to increase their peripheral skin temperature, and 12 minutes of biofeedback training during where they were instructed how to decrease their peripheral skin temperature. During the *rest* and the *increase skin temperature* sessions, there were significant increases of finger temperature from the first to the last minute. The most revealing finding was a constant increase in peripheral skin temperature during the rest phase; the magnitude was larger than the changes obtained in the biofeedback training sessions. These findings are similar to other skin temperature studies such as Keefe and Gardner (1979), who reported that during the resting state there are constant increases in peripheral skin temperature. Therefore it can be deduced that when individuals are in a resting, or relaxed state, their peripheral skin temperatures increase because the blood is not being shifted away from the extremities to vital organs.

Summary

When an individual is under psychological or physical stress, the body's reaction is to shunt blood away from non-essential organs, such as the extremities, and move it toward the core of the body. When these reactions occur, the peripheral skin temperature of the phalanges decrease; this is due to vasoconstriction and the shift of blood away from the distal aspects of the extremities. The heart is innervated by the sympathetic nervous system which places the body in the stress, or "fight or flight" mode, and the heart begins working harder to oxygenate the large muscle groups, which increase pulse and blood pressure rates. The body compensates for this change in homeostasis by increasing its oxygen demand, leading to an increase in respiratory rate. These three physiological changes are the hallmark signs of stress within the body, whether it is physical or psychological. The studies reviewed demonstrate that physiological changes do occur before, during, and after testing if the test is viewed as stressful.

Relaxation Strategies Used to Decrease Anxiety

Bernstein and Borkovec (1973) report that relaxation training is effective in reducing subjective anxiety and activating the parasympathetic nervous system, which decreases heart and respiration rates and relaxes skeletal muscles. Psychological interventions such as relaxation training have been shown to be effective in reducing stress; and relaxation techniques have a significant effect on emotional variables such as anxiety (Barlow et al., 1984; Luebbert, Dahme, and Hasenbring, 2001; Leon-Pizzaro et al., 2007; Pluess, Conroad, & Wilhelm, 2009). Relaxation is a mind-body intervention used to decrease stress and promote a sense of well being (Louie, 2004). It is aimed at providing a distraction from an anxious thought and changing one's physiology to a more relaxed state (Naussau, 2007). This approach seems as effective in reducing anxiety as medication, and teaching individuals how to control their physiological reactions to anxiety can help to empower them (La Torre, 2001).

Physiological Theory of Relaxation

Relaxation has an effect on the body's natural analgesic, endorphins, which are related to the pleasure centers of the brain. When endorphins are released, the pain threshold in the body is stimulated and the parasympathetic nervous system responds by decreasing respirations and pulse rates (Louie, 2004). The goal of relaxation is to help people gain cognitive control over their autonomic nervous systems so they can recognize signs and symptoms of anxiety and learn to decrease them (Louie).

Biofeedback Assisted Relaxation Techniques

Biofeedback generally is integrated with relaxation (McGinnis et al., 2005). Interventions used with biofeedback training include guided imagery and breathing retraining, and these techniques have shown an ability to reduce subjective levels of anxiety (Goodwin & Montgomery, 2006). Sessions that incorporate relaxation training focus on increasing awareness, and allowing individuals to have a greater range of coping (La Torre, 2001). Biofeedback assisted relaxation to treat anxiety has been reported to be effective in modifying the autonomic nervous system by decreasing physiological arousal (Goodwin & Montgomery; Reiner, 2008). This leads to decreases in chronic stress, peripheral vasoconstriction, and anxiety (McGinnis et al.).

Biofeedback Assisted Relaxation and Respirations

Serok (1991) conducted a study to determine if relaxation and breathing techniques could reduce stress and anxiety in students during examinations. The study occurred during 4 two-hour workshops. All participants were asked to complete Spielberger's State-Trait Anxiety Inventory (STAI). The control group was asked to complete a pre and post-test without intervention. The first session for the experimental group consisted of a) an overview of the program, b) sharing of anxiety experiences, and c) discussion of relaxation techniques. The second session focused on holistic awareness. Session three involved a) training participants to identify anxiety producing situations, and b) learning methods of relaxation. Session four focused on a) methods of anticipating exams, b) anticipating behavior during exams, and c) reviewing relaxation exercises. There was a significant difference in the experimental group between the pre and post-test scores, but no significant difference existed between the two scores for the control group. These findings are similar to Spielberger, Gorasuch, and Lushene (1970), who reported that scores on the State scale increase in response to stress and decrease as a result of relaxation training. This study supports the notion that training individuals to use relaxation does affect subjects' assessments of their anxiety levels.

Reiner (2008) conducted a pilot study to examine the effectiveness of a handheld portable biofeedback device designed to decrease autonomic reactivity by teaching patients how to breathe in a rhythmic and slower fashion. Participants were between 18 and 65 years of age and had a diagnosis of sympathetic over-arousal. The study was divided into four parts: a) introduction of the relationship between the sympathetic and parasympathetic nervous systems and its contribution to stress; b) discussion of the relationship between deep rhythmic breathing and the parasympathetic nervous system; c) discussion of the rationale for biofeedback; and d) introduction of the Stress Eraser. The participants were taught to find their unique breathing inhale-exhale ratio that would maximize their ability to achieve long smooth respiratory sinus arrhythmia (RSA) waves. For each long, smooth wave achieved they would be awarded one point. The goal for the participants was to accumulate 100 points each day. At the end of the study, 75% of the participants reported the Stress Eraser reduced their stress levels, 80% reported intensified levels of relaxation, 46% reported more positive emotions, and 60% reported an increased sense of peace. This study suggests that using biofeedback can be useful for regulating autonomic arousal, and can provide individuals with the means to increase physiological relaxation. It also supports the argument that teaching individuals the benefits of relaxation and breathing retraining does decrease their subject levels of anxiety.

Biofeedback Assisted Relaxation and Heart Rate

Heart rate variability (HRV), as described above, targets autonomic reactivity (Hassett et al., 2007). Training of HRV biofeedback involves slowing the breathing rate to the frequency at which the amplitude of HRV is maximized (Hassett et al.). By breathing at this frequency the baroreflexes are stimulated; when this occurs, high amplitude heart rate and blood pressure oscillations occur due to resonance characteristics of the cardiovascular system (Hassett et al.). The amplitude of the heart rate oscillations caused by breathing at the resonant frequency is greater than at any other frequency. By producing voluntary increases in HRV, the individual learns to breathe at his or her resonant frequency. Increasing HRV amplitude should produce more effective blood pressure modulation through the hypothalamus and limbic system, and regular practice of the technique increases baroreflex gain even at rest (Hassett et al.). Controlled studies have documented that biofeedback training has increased HRV in patients with disorders characterized by autonomic nervous system dysfunction such as anxiety and depression (Siepmann et al., 2008).

Goodie and Larkin (2006) examined whether transfer of heart rate training to tasks not used during training could be improved by using multiple tasks during training. Heart rate was measured in 14 university students using a finger photoplethysmogram. Four tasks were presented to the subjects, including playing a videogame, completing arithmetic problems, using a handgrip, and giving a speech. Each task was repeated until the criterion of heart rate habituation was achieved. This was achieved when there were 3 or 4 consecutive heart rate responses within 5 beats per minute. Next, the participants had heart rate reduction training during each of the four tasks. The participants were able to decrease their heart rates during the feedback training and were able to decrease their heart rate while completing different tasks. The participants stated they tried many methods to attempt to reduce their heart rate, such as changing their breathing, relaxing their muscles, and distracting themselves with thoughts of calming music. This supports the notion that relaxation techniques do decrease heart rate.

Biofeedback Assisted Relaxation and Peripheral Skin Temperature

High anxiety levels have been shown to decrease peripheral skin temperature; therefore it can be deduced that anxiety levels can be reflected in peripheral skin temperatures (Mittenburg & Petersen, 1984). Controlling one's peripheral vasodilation through the use of biofeedback and relaxation has been used in psychophysiology for inducing general relaxation (Violani & Lombardo, 2003). A number of studies have confirmed that participants are able to control their peripheral skin temperature with a few biofeedback training sessions (Mittenburg & Petersen, 1984; Lohaus et al., 2001). Once learned, individuals have the ability to increase their peripheral skin temperature in the future without feedback (Lohaus et al.).

Conclusion

The literature concludes that when an individual is under stress or anxiety, physiological changes occur. These encompass increased pulse and breathing rates and decreased peripheral skin temperatures. Relaxation training has exhibited effectiveness in reducing stress and anxiety. Biofeedback assisted relaxation used to treat anxiety has been reported to be effective in modifying the autonomic nervous system by decreasing physiological arousal. Coupling relaxation training with biofeedback training would allow the individuals not only to visualize their physiological reactions to stress but also to learn to control their responses. Therefore, it seems like biofeedback might help in decreasing test anxiety. The goal of this intervention would be to help people gain cognitive control of their autonomic nervous systems so they can recognize signs and symptoms of anxiety and learn to decrease them.

CHAPTER 3

CONCEPTUAL FRAMEWORK

The theoretical basis of this study is presented in this chapter. Research questions, definitions, and study assumptions based upon this theory also are described.

Spielberger and Vagg's Transactional Process Model For Test Anxiety

The conceptual framework chosen for this study is Spielberger and Vagg's Transactional Process Model for Test Anxiety. Spielberger (1976) differentiated between the stress associated with the test (stressor) and the individual interpretation of the test (threat).

Stressor → Threat → S-Anxiety

The State Anxiety, or S-Anxiety, measures how individuals feel before and during a test, nervous, apprehensive, worry, and/or tense. This is the transitory state that occurs right before one enters a testing situation, and it happens in response to the physiological arousal resulting from the automatic nervous system activation. S-Anxiety varies from one person to another because it is a function of the perceived threat. If students do not feel threatened by a particular test, their S-Anxiety may be low; in contrast, those who feel the test is very threatening may have a high S-Anxiety.

The Trait Anxiety, or T-Anxiety, is a measure of the stable differences in anxiety proneness. If an individual has relatively low T-Anxiety, he or she most likely will score low on S-Anxiety because the disposition to perceive a wide range of situations as threatening or dangerous is low. Because test-anxious individuals have higher elevations in S-Anxiety, test anxiety is viewed as a situation-specific anxiety trait (Spielberger &

Vagg, 1995). Conceptualizing test anxiety as a situation-specific anxiety trait "require specifications of the antecedent conditions that contribute to the development of this trait, the factors that evoke the S-Anxiety, and the effects of the worry and emotionality components during a test" (Spielberger & Vagg, 1995 p. 11). The transactional process model serves as a heuristic framework for presenting antecedent conditions that influence students' reactions to testing, emotional and cognitive processes involved, and the consequences of test anxiety (Spielberger & Vagg).

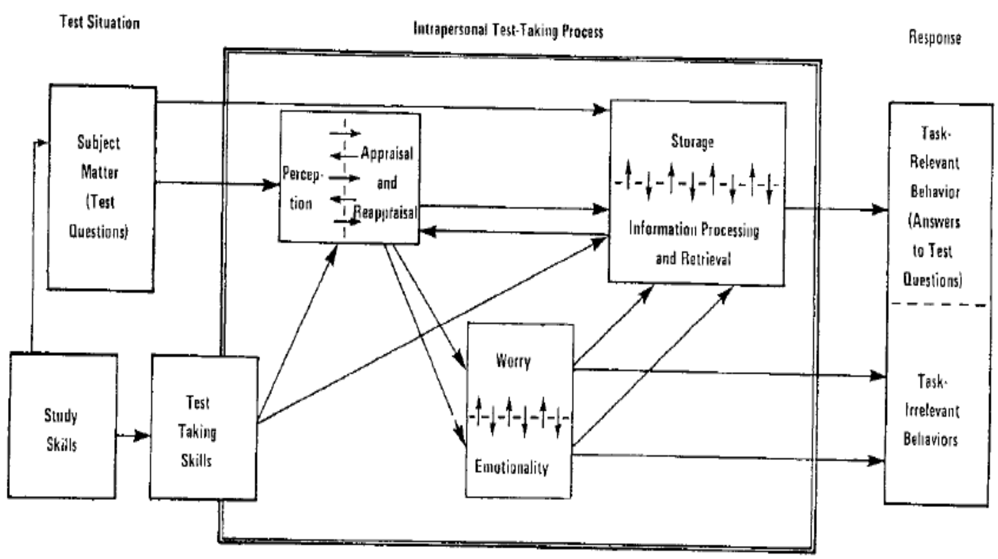

Figure 1 Spielberger and Vagg's Transactional Process Model For Test Anxiety

When a student enters a test, there is an immediate perception about the threat of the situation by the student, followed by a continued appraisal of the situation. The perception of the threat varies from student to student because it is based on the S and T Anxiety one has. If the student perceives the test as very threatening the "S-Anxiety will increase, causing an increase in self-centered thoughts, self-derogatory worry, and other test-irrelevant thoughts" (Spielberger & Vagg, p. 12, 1995). If a student is unable to answer questions correctly early on in the test, his or her S-Anxiety will continue to increase and the student will perceive the test as more threatening as testing progresses As S-Anxiety continues to increase the student begins to have more worry cognitions; physiological reactions associated with the activation of the autonomic nervous system occur. The final aspect of the transactional Process Model is the formulation of a response requiring the student to organize and synthesize information. The two hemispheres of the brain process information differently. The left hemisphere is characterized by logical approaches to processing verbal information, and the right hemisphere processes emotional stimuli (Papsdorf, Ghannam, & Jamieson, 1979). It is suggested that there is an interhemispheric interference resulting from activation of both the right and left hemispheres during testing, and this causes the highly test anxious person to have difficulties with attention throughout the test (Papsdorf, Ghannam, & Jamieson).

Research Questions

1. Does test anxiety differ among each semester of nursing school?

2. Is there a relationship between test anxiety and demographics (sex, ethnicity, and age)?

3. Can nursing students learn to decrease pulse rate, decrease breathing rate, and increase peripheral skin temperature using a biofeedback assisted relaxation training?

4. Does relaxation training decrease test anxiety?

5. Is there a greater decrease in test anxiety for students who start out with high test anxiety?

Definitions

Anxiety is an emotional state at a given moment in time and at a particular level of intensity which is characterized by “tension, apprehension, nervousness, and worry, and an activation of the autonomic nervous system” (Spielberger, 1983 p. 4). Test anxiety was quantified using Spielberger’s Test Anxiety Inventory. Test is a standardized objective test that the students perform either on a computer or by hand. Biofeedback assisted relaxation training involves a series of relaxation training sessions where the subjects will learn deep diaphragmatic breathing techniques, progressive muscle relaxation techniques, and autogenic training techniques; followed by 15 minutes of practice at home every day until the next relaxation training session.

CHAPTER 4

METHODOLOGY

This study had two parts. The first part was a cross-sectional design to compare test anxiety across the four levels of the nursing program. The second part was a single subject design to test an intervention to reduce test anxiety. Data collection took place over two semesters (Spring and Summer 2009) on the UNLV campus in the School of Nursing.

After endorsement by the Dissertation Committee members, approval for this study was obtained through the University of Nevada, Las Vegas Institutional Review Board (IRB). The methodology that was used for this study is described below.

Settings and Design

The study setting was a classroom located on the University of Nevada, Las Vegas campus. The PI contacted the lead didactic instructors of a medical surgical class in the first, second, third and fourth semester baccalaureate nursing students to arrange a meeting with potential participants at the conclusion of a class. The research purpose was explained to the students and consent documents were signed. Students were informed that identifying data would not be utilized in the data analysis; each participant would have an identification number assigned to them so their names will not be known to the researchers during analysis (see Appendix B).

The research project had two parts and two informed consent documents approved by the IRB. During the first part of the study the PI asked the students to participate in completing the Spielberger’s Test Anxiety Inventory (TAI). The consent document for this part of the study allowed the students' scores from the TAI to be used to answer research question 1: *Does test anxiety differ among the four semesters of nursing school?*

After analyzing the results of research question 1, the PI determined during which semester of nursing school the students reported the highest average level of test anxiety. The PI contacted the lead didactic instructor for that particular semester and arranged a meeting with the students at the end of one of their class periods. Students who self reported test anxiety, or any student who wished to partake in the relaxation training program, was asked to participate in this single subject design study. The study required students to complete Spielberger's Test Anxiety Inventory at different times during the study, complete the Weekly Anxiety Scale (see Appendix C), attend relaxation training sessions on campus every week, practice the relaxation techniques taught to them at home, and monitor and record their physiological measurements. The students were introduced to three relaxation techniques including: diaphragmatic breathing, progressive muscle relaxation, and autogenics. The students were compensated monetarily throughout the study. The payment schedule was the following: $50.00 for completing the first two weeks of the study; $75.00 for completing the next week of the study; and $100.00 the last day the student met with the PI at the end of the study. The students were informed they would only receive the compensation after fully participating in all activities up until compensation time.

Every session was an individual session. Prior to the start of each session the PI handed out a scale pertaining to the student's perceived anxiety level that week (e.g., tests, stressors at home). The first session was the baseline session. During this session the students sat quietly for 15 minutes while breathing rate, peripheral skin temperature, and pulse rate were measured without any intervention. For homework, the students were asked to measure and record these variables on a take home sheet (see Appendix D) every day for 15 minutes. The students were informed that after *each* training session they should practice the relaxation techniques taught to them and they should continue to monitor and record their peripheral skin temperature, pulse rate, and respiratory rate for 15 minutes a day, every day between sessions. During the second intervention session the students were engaged in a relaxation training session where they were taught how to control their breathing rates (see Appendix E). The third intervention session was dedicated to learning progressive muscle relaxation techniques (see Appendix F). During the fourth intervention session the students were taught autogenic training techniques (see Appendix G). At the end of the study the students were given a questionnaire (see Appendix H) to complete regarding the usefulness of the training program and their plans, if any, to use the techniques in the future.

During each session every student was connected to the ProComp$^{\infty}$. At home, the students were asked to measure and record their respiratory and pulse rates manually. They were loaned a Digital Feedback Thermometer so they could record their peripheral skin temperature. At the first meeting the students were shown how to attach the thermometer to their index finger and secure it with tape. The students were asked to bring the take home sheet back to the PI the day of the next meeting so the data could be entered into an excel spread sheet. The take home sheets were analyzed by the PI to assess the trends made over the week by each student. The PI wanted to determine that each student’s physiological variables demonstrated they had learned the technique as evidenced by a change in respiratory rate, heart rate, or skin temperature. New interventions were introduced after the PI determined there were changes in at least one of the physiological variables by each student. The students completed the first TAI in the initial phase of the study before one of their tests, and later in the study were given another TAI to complete again right before their next test.

Table 6 Schedule of Weekly Goals and Progress

Week 1 Individual session with PI	• Gave student a copy of the Spielberger's TAI to complete prior to their next examination • Completed Weekly Anxiety Scale • Sat quietly for 15 minutes: recorded breathing rate, peripheral skin temperate, and pulse rates
Week 1 Homework	• Homework: Practiced sitting quietly for 15 minutes and recorded breathing rate, peripheral skin temperate, and pulse rates • Complete take home sheet and returned to PI
Week 2 Individual session with PI	• Completed Weekly Anxiety Scale • Introduced subjects to diaphragmatic breathing **First payment of $50.00 paid to students**
Week 2 Homework	• Homework: Practiced diaphragmatic breathing for 15 minutes a day and recorded breathing rate, peripheral skin temperate, and pulse rates • Completed take home sheet and returned to PI
Week 3 Individual session with PI	• Completed Weekly Anxiety Scale **Second payment of $75.00 paid to the student**
Week 3 Homework	• Practiced diaphragmatic breathing and progressive muscle relaxation for 15 minutes a day and recorded breathing rate, peripheral skin temperate, and pulse rates • Completed take home sheet and email to PI

Week 4 Individual session with PI	• Completed Weekly Anxiety Scale • Gave subject a copy of the Spielberger's TAI to complete prior to their next examination
Week 4 Homework	• Practiced diaphragmatic breathing, progressive muscle relaxation, and autogenic training for 15 minutes a day and recorded breathing rate, peripheral skin temperate, and pulse rates • Completed take home sheet and email to PI
Week 5 Individual session with PI	• Completed Weekly Anxiety Scale • Turned in all completed Spielberger's TAI • Completed questionnaire regarding usefulness of relaxation training program **Final payment of $100.00 paid to the student**

Instrumentation

Pro-Comp

The ProComp$^{\infty}$ is an eight-channel, multi-modality, physiological monitoring device for use with biofeedback software application. This device has the ability to measure eight physiological signals simultaneously, and the researcher will measure three including respiration, pulse rates, and skin temperature. The device samples incoming sensor information signals and transmits the sampled data to a computer via a fiber-optic cable. The unit itself is connected to the computer's USB port. It receives data from the encoder in an optical form and converts it into the format that the port requires to communicate with the software (ProComp$^{\infty}$ Manual). The respiration sensor is a band that is placed over the subject's abdomen. The band is approximately 52" long, weighs 30 grams; and its range is a unitless quantity displayed as 0%-100%. The pulse rate monitor is a photoplethysmograph that is attached to the subject's middle finger and secured with tape. It is approximately 20 mm X 34 mm X 10 mm and weighs 20 grams. This device bounces infra-red light against the skin surface and measures the amount of reflected light (ProComp$^{\infty}$ Manual). The input range is a unitless quantity displayed as 0%-100% with an accuracy of ±5%. The temperature sensor contains a themistor bead which is taped to the subject's index finger. The device converts changes in temperature to changes in an electrical current. Data collected during the individual biofeedback sessions will be recorded and the data stored on this software for analysis at a future date.

Digital Feedback Thermometer

The Digital Feedback Thermometer (model SC911) is produced by Bio-Medical Instruments, Inc. This personal biofeedback trainer is easy to use, portable and accurate to 0.1°F. It reads temperatures between 50°-158° and displays them on a ¾" high digital liquid crystal display, and the reading updates every 2 seconds.

Test Anxiety Inventory

The Test Anxiety Inventory (TAI) is a 20-item scale that asks respondents to report how frequently they experience specific symptoms of anxiety before, during, and after tests. Scores can range from 20-80 and measures proneness to anxiety in testing situations. It is comprised of two subscales that assess worry and emotionality (TAI/W and TAI/E; range 8-32) (Taylor & Deane, 2002). Norms for the TAI are available for large samples of American college undergraduates, college freshmen, and high school students, as well as a smaller sample of community college students. These normative samples allow for comparison between appropriate reference groups because the TAI was developed primarily to be used with students. Reliability for the TAI is .80 to .81 for a two week to one month period. After six months the reliability is .62. Studies of test-retest and internal-consistency reliability as well as concurrent and construct validity have supported the use of the TAI (Taylor & Dean). The TAI was chosen as the instrument for this research because it represents the most widely used measure of test anxiety (Benson et al., 1992), has been translated and used internationally, can be given weeks before an examination and does not need to be taken right before the actual test (Putwain, 2008).

Data Handling

The PI transferred the data from written form into an excel spreadsheet for data analysis. After all sections of data were entered, the PI rechecked it for accuracy. Every tenth record was checked by an external person.

Data Analysis

Students involved in both parts of the study are described through the demographic data including semester within the program, age, sex, and ethnicity. Data was analyzed then to address each research question. Alpha was set at .05.

1. Does test anxiety differ among the four semesters of nursing school?

We tested the null hypothesis for this study stating that there are no differences in test anxiety among students in different semesters of nursing school.

Ho: $\mu_1 = \mu_2 = \mu_3 = \mu_4$

Analysis of variance was used to compare the means of TAI scores across the 4 semesters. Our plan was if the null hypothesis is not rejected, we would conclude that student test anxiety does not differ among students in different semester of nursing school. If the null hypothesis was rejected, then post hoc tests would be run to determine where the differences are.

2. Is there a relationship between test anxiety and demographics (gender, ethnicity, and age)?

An unpaired t test was used to determine if there are gender differences within the TAI scores. ANOVA was used to determine if there are age and ethnicity differences with the TAI scores.

3. By the end of the study, will nursing students have learned to decrease pulse rate, decrease breathing rate, and increase peripheral skin temperature using biofeedback assisted relaxation training?

During the third, forth, and fifth individual sessions, the last minute of the baseline session was compared with the last minute of the relaxation session. We anticipated that those students who had learned to control these physiological responses would be able to decrease their pulse rate and respiratory rate and increase their skin temperature.

Using paired t-tests, we tested the null hypothesis that the mean of the first minute is equal to the mean of the last minute for pulse rate, breathing rate, and skin temperature.

H_o: D = 0

We repeated this analysis at the end of the study to assess the trajectory of the variables. If the null hypothesis was not rejected by the end of the study, we would conclude that students are not able to learn to decrease pulse rate, decrease breathing rate, and increase peripheral skin temperature using a multi week biofeedback assisted relaxation training.

4. Does relaxation training decrease test anxiety?

To address this question, we compared TAI scores pre and post training. Using a paired t-test we tested the null hypothesis that the mean of the first TAI score is equal to the mean of the last TAI score.

H_o: D = 0

If the null hypothesis was not rejected, we would conclude that the relaxation training had no effect on test anxiety. However, it may be that some of the students were not able to learn the relaxation techniques. If so, we would divide the group into those that were able to learn the techniques and those that were not and compare the pre and post TAI differences of these groups over time using an unpaired t test.

5. Is there a greater decrease in test anxiety for students who start out with high test anxiety?

It is possible that TAI is not high enough for the intervention to produce any change in TAI. Therefore, we artificially divided the participants into two groups. Group one was those scoring above the TAI mean on the first TAI (session one), and group two was those scoring below the mean obtained during the first administration of the TAI (session one). For each group, we compared TAI scores after the relaxation training using an unpaired t test.

Ho: $\mu_1 = \mu_2$

If the null hypothesis were not rejected, we would conclude that initial TAI had no effect on the post intervention TAI.

CHAPTER 5

FINDINGS

This chapter summarizes the findings of this study. The first section focuses on determining if test anxiety differs among the four semesters of nursing school and if there is a relationship between test anxiety and demographics. The second section focuses on the effects of the biofeedback-assisted relaxation training program. Demographics of the participants are described and the findings of the research questions are presented. The Statistical Package for the Social Sciences (SPSS 16.0 Inc., 2009) software was used to analyze the data.

Phase One Descriptive Statistics

One hundred fifty-six nursing students participated in the first part of the study which was conducted in the Spring of 2009, but one student did not complete the demographic form, therefore there was missing data. Forty-two students from semester one, 40 students from semester two, 37 students from semester three, and 37 students from semester four participated in this portion of the study. Thirty-one students were male (20.0%) and 124 were female (80.0%). The mean age of the sample was 25 years of age with a standard deviation of 5.5. Seventy-five (48.4%) students self-identified as White, 10 students (6.5%) as Black, 14 students (9.0%) as Hispanic, 55 students (35.5%) as Asian/Pacific Islander, and 1 student (0.6%) as Other. Ninety-six students (61.5%) did not report a history of anxiety, and 60 students (38.5%) reported a history of anxiety.

Results

Research Question 1

1. Does test anxiety differ among the four semesters of nursing school?

The means and standard deviations of the Total TAI are shown in Table 7 and Figure 2 below.

Table 7 TAI Scores across Nursing Semesters

Semester	N	Mean ± Standard Deviation
One	42	41.0 ± 10.8
Two	40	43.6 ± 13.6
Three	37	47.5 ± 16.5
Four	37	39.8 ± 13.5

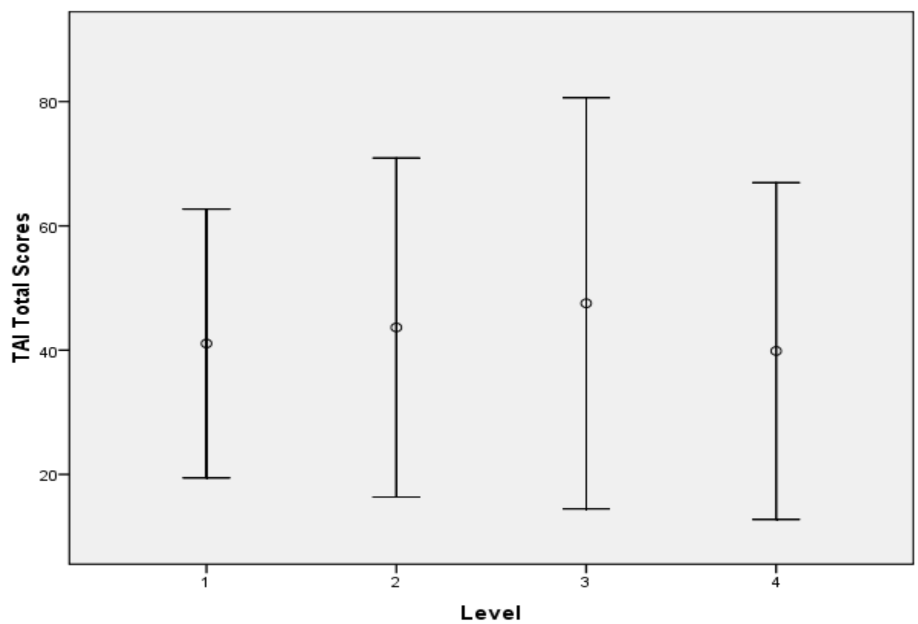

Figure 2 TAI Scores across Nursing Semesters

Student scores on the Emotionality and Worry components of the TAI are shown in Table 8 and Figures 3 and 4.

Table 8 Mean Scores and Std. Deviation on Emotionality and Worry Scores

Semester	Mean ± SD of Emotionality Scores	Mean ± SD of Worry Scores
One	17.4 ± 5.4	14.4 ± 4.1
Two	18.8 ± 6.0	15.1 ± 5.5
Three	20.8 ± 7.6	16.0 ± 5.8
Four	17.0 ± 6.7	13.9 ± 13.9

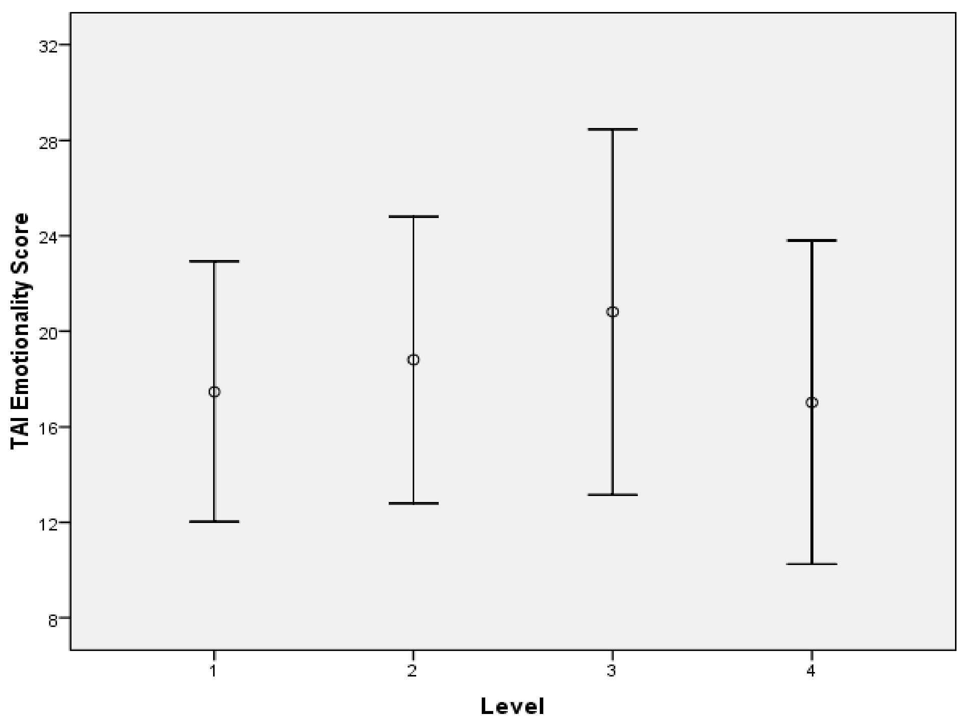

Figure 3 Emotionality Scores across Nursing Semesters

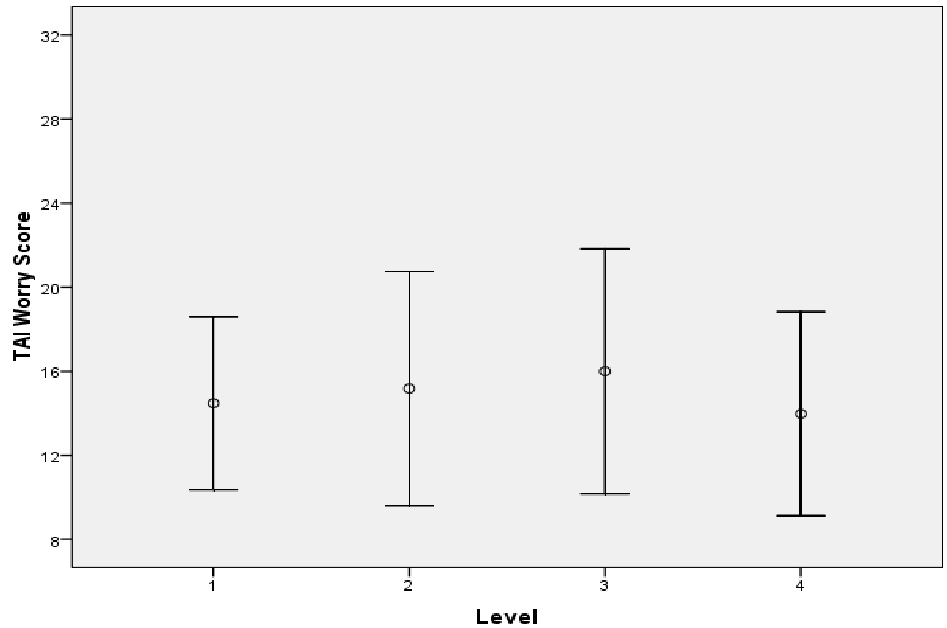

Figure 4 Worry Scores across Nursing Semesters

Analysis of variance was used to compare the means of the Total TAI and the Emotionality and Worry components of the TAI across semesters one, two, three, and four. While there was a small difference in TAI, Emotionality and Worry scores among the semesters of nursing school, the differences were not statistically significant, as shown in Table 9. However, because students in semester 3 showed the highest level of TAI, Emotionality and Worry, students in this semester were selected for the second part of the study.

Table 9 Significance Levels between Semester Scores

	F	p
Total TAI between groups	2.309	.079
Worry scores between groups	1.110	.056
Emotionality scores between groups	2.582	.347

Research Question Two

2. Is there a relationship between test anxiety and demographics?

An unpaired t test was used to determine if there were differences between the Total TAI score, Emotionality score and Worry score, and gender. There were no significant differences between gender and test anxiety as shown in Table 10.

Table 10 Gender and Test Anxiety Scores

TAI Component	Gender	N	Mean ± SD	p
Worry Score	Male	31	14.2 ± 4.8	.441
	Female	124	15.0 ± 5.2	
Emotionality Score	Male	31	17.5 ± 6.2	.377
	Female	124	18.6 ± 6.6	
TAI	Male	31	40.6 ± 12.7	.314
	Female	124	43.5 ± 14.1	

Analysis of variance was used to determine if there was a relationship between test anxiety and ethnicity. There was no statistical significance between ethnicity and test anxiety scores based on the Total TAI, Emotionality scores and the Worry scores, as shown in Table 11.

A Pearson correlation was conducted to determine if test anxiety was correlated with age. No significant differences were found between age and the Total TAI score, Emotionality score, or the Worry score. However, the Total TAI, Emotionality, and the Worry scores were highly correlated with one another, as expected. Please see Table 12.

Table 11 Ethnicity and Test Anxiety Scores

TAI Component	Ethnicity	N	Mean ± SD	P
TAI	White	75	40.8 ± 14.6	.434
	Black	10	45.3 ± 15.1	
	Hispanic	14	46.2 ± 12.6	
	Asian/Pacific Islander	55	44.7 ± 12.7	
	Other	1	31.0	
Emotionality	White	75	17.6 ± 6.9	.405
	Black	10	19.5 ± 6.4	
	Hispanic	14	20.8 ± 6.7	
	Asian/Pacific Islander	55	18.8 ± 6.0	
	Other	1	14.0	
Worry	White	75	14.1 ± 5.2	.220
	Black	10	14.7 ± 6.8	
	Hispanic	14	15.0 ± 3.7	
	Asian/Pacific Islander	55	16.1 ± 4.8	
	Other	1	10.0	

Table 12 Correlation between Age and Test Anxiety Scores

	Age	Worry Score	Emotionality Score	Total TAI
Age	1.00	-.095	-.115	-.096
Worry Scale	-.095	1.000	.748**	.896**
Emotionality Score	-.115	.748**	1.000	.955**
Total TAI	-.096	.896**	.955**	1.000

**Correlation is significant at the 0.01 level

An unpaired t test was used to determine if those who self reported a history of test anxiety had higher Total TAI, Emotionality Scores and Worry Scores. Those reporting a history of anxiety had higher Total TAI, Emotionality scores and Worry scores.

Table 13 History of Anxiety and Test Anxiety Scores

TAI / History of Anxiety		Mean ± SD	Significance
Total TAI Score	no yes	39.4 ± 13.2 48.7 ± 12.9	.000
Emotionality Score	no yes	16.8 ± 6.0 21.2 ± 6.4	.000
Worry Score	no yes	13.9 ± 4.9 16.3 ± 5.0	.004

Phase Two

This part of the chapter summarizes the findings of the second part of the study: determining if the students have learned to decrease pulse rate, decrease respiratory rate, and increase peripheral skin temperature using biofeedback assisted relaxation training; determining if relaxation training decreases test anxiety; and, determining if there is there a greater decrease in test anxiety for students who start out with high test anxiety. Demographics of the participants are described and the findings of the research questions are presented.

Descriptive Statistics

Sixteen nursing students from semester three agreed to participate in the study and signed the consent document. This phase of the study occurred during the Summer semester 2009. One student did not return the email to schedule an appointment, and one student did not return after the first week; so in the end 14 nursing students completed the intervention. One student was male (7.2%) and 13 students were female (92.8%). The mean age of the sample was 24.5 with a standard deviation of 4.7. Seven students

(50.0%) self identified as White, 3 students (20.0%) as Hispanic, and 5 students (30.0%) as Asian/Pacific Islander.

Results

Research Question 3

3. By the end of the study, will nursing students have learned to decrease pulse rate, decrease respiratory rate, and increase peripheral skin temperature using biofeedback assisted relaxation training?

Paired t-tests were used to examine data collected in sessions three, four, and five to determine if the mean of the first minute (baseline minute) was equal to the mean of the last minute (end of training minute) for pulse rate, respiratory rate, and skin temperature.

During the first training session the students were introduced to diaphragmatic breathing. The means, standard deviations, t values, and significance are shown in Table 14.

Table 14 Diaphragmatic Breathing Training Session

Baseline and End of Training Minutes	Mean	Standard Deviation	t	p
Baseline pulse rate	77.2	3.4		
End of training pulse rate	76.2	2.8	1.07	.301
Baseline respiratory rate	12.2	.77		
End of training respiratory rate	7.0	.64	5.26	.000
Baseline skin temperature	90.3	.75		
End of training skin temperature	92.2	.87	-3.03	.010

The respiratory rate decreased from 12 to 7 breaths per minute (p<.000) during the diaphragmatic breathing training. There was no correlation between baseline and end-of-training respiratory rates; this was expected because participants were being trained to decrease their respiratory rate. While there was a small decrease in pulse rate, this was not statistically significant. There was a statistically significant increase in peripheral skin temperature. Baseline and end-of-training pulse rates were highly correlated (r =.974, p =.000), as were skin temperatures (r =.726, p =.003).

During the next training session, the students were introduced to progressive muscle relaxation. The means, standard deviations, t values, and significance are shown in Table 15.

Table 15 Progressive Muscle Relaxation Training Session

Baseline and End of Training Minutes	Mean	Standard Deviation	t	p
Baseline pulse rate	86.8	15.8		
End of training pulse rate	84.2	13.7	1.60	.133
Baseline respiratory rate	12.6	2.7		
End of training respiratory rate	10.6	2.9	2.67	.018
Baseline skin temperature	90.4	3.7		
End of training skin temperature	92.9	2.1	-4.17	.001

Respiratory rate decreased from 12.6 to 10.6 (p =.018) breaths per minute with training. There was a moderate correlation between baseline and end of training respiratory rate (r =.548, p =.043). These were accompanied by a rise in skin temperature from 90.4 to 92.9^{o} F (p =.001). There was a small decrease in pulse rate, but this was not statistically significant (p =.133). Baseline and end-of-training pulse rates were highly correlated (r =.924, p =.000), as were skin temperatures (r =.876, p =.000).

The final training session was autogenic training. The means, standard deviations, t values, and significance are shown in Table 16.

Table 16 Autogenic Training Session

Baseline and end of Training Minutes	Mean	Standard Deviation	t	p
Baseline pulse rate	82.8	10.0		
End of training pulse rate	76.8	7.8	4.17	.001
Baseline respiratory rate	12.0	1.6		
End of training respiratory rate	9.5	3.2	3.33	.005
Baseline skin temperature	90.4	3.9		
End of training skin temperature	92.3	1.4	-2.36	.034

The decrease in the pulse rate and respiratory rate, and the increase in peripheral skin temperature were all statistically significant at the end of the autogenic training. The correlations and p values between the pre and end of training minutes for pulse rate was r =.851 (p =.000); for respiratory rate was r =.498 (p =.070), and for skin temperature was r =.759 (p =.002). All three of the variables showed statistically significant changes during the third relaxation training session.

Research Question 4

4. Does relaxation training decrease test anxiety?

To address this question, we compared the TAI scores pre and post training. Using a paired t-test we tested the null hypothesis that the mean of the first TAI score is equal to the mean of the last TAI score. The students were given two Spielberger Test Anxiety Inventories: one at the beginning of the study and one at the end of the training sessions immediately before their next test. Two of the students did not complete the second TAI so they were excluded from this analysis. The means and standard deviations of the TAI pre and post training of these students are shown in Table 17.

Table 17 Pre and Post Test Anxiety

Test Anxiety	Mean	Standard Deviation
Spielberger TAI 1	53.4	14.1
Spielberger TAI 2	54.8	15.0

A paired t-test showed no statistical significance between the pre and post Spielberger TAIs ($t = -.852$, $p = .412$); in fact the TAI scores increased from pre to post testing times. This lack of difference could be due to students' inability to learn the relaxation techniques. Therefore, the researcher divided the group into those who learned the relaxation techniques (i.e., Success) and those who did not. The criteria for "learned the relaxation technique" was defined as being able to 1. decrease pulse rate, 2. decrease respiratory rate, and 3. increase peripheral skin temperature. The researcher determined which students were successful, and those who were not, at meeting all of the criteria after each training session.

Case summary data showing students' demographics, their first Spielberger TAI score, and their training success are shown in Table 18. Students with ID numbers 1 and 10 did not complete the second TAI and were excluded from further analysis.

Table 18. Case Summaries

ID	Success 1	Success 2	Success 3	Age	Gender	Ethnicity	TAI 1	TA I 2
1	no	yes	yes	22	Female	White	53	
2	yes	no	yes	23	Female	White	56	63
3	no	no	no	34	Female	White	71	71
4	yes	yes	no	21	Male	Asian	36	36
5	no	yes	no	22	Female	Asian	62	66
6	yes	no	yes	33	Female	White	28	29
8	yes	yes	yes	30	Female	White	35	37
9	yes	no	no	20	Female	Hispanic	65	56
10	yes	no	no	22	Female	White	72	
11	yes	yes	yes	25	Female	Asian	51	43
12	yes	yes	yes	22	Female	Asian	66	70
13	no	yes	yes	21	Female	White	67	73
15	yes	no	yes	22	Female	Asian	57	56
16	no	yes	yes	20	Female	Hispanic	47	58

By the end of training session 3, 8 students were able to use the relaxation training to decrease their respiratory rates and pulse rates and increase their skin temperature and 4 students were unable to meet all three criteria. The difference scores and standard deviation of the differences are shown in Table 19.

Table 19 Difference Scores between TAI 1 and TAI 2

Relaxation Training Success	Mean Difference TAI 1 – TAI 2	Standard Deviation
Yes (n=8)	-2.7	5.8
No (n=4)	1.2	5.5

An unpaired t-test showed no statistical significance between the difference scores (TAI 1 – TAI 2) between the two groups (t= -1.151, p = .277). This suggests that the lack of effect of training on test anxiety was not related to the ability to learn the relaxation techniques.

Research Question 5

5. Is there a greater decrease in test anxiety for students who start out with high test anxiety?

As shown in Table 20, TAI ranged from TAI 1 ranged from 28 to 71, with a mean of 53.4 The TAI 1 may have been too low in some of these students for the intervention to result in a reduction in TAI 2. Therefore, the investigator artificially divided the participants into two groups. Group one was comprised of those scoring above the TAI 1 mean (n = 7) and group two was comprised of those scoring below the TAI 1 mean (n = 5). For each group, the researcher compared TAI scores after the relaxation training using an unpaired t test. The number of students in each group, the mean difference between scores and the standard deviation of the differences are shown in Table 21.

Table 20 High and Low TAI Groups and Significance

	N	Mean Difference TAI 1 – TAI 2	Standard Deviation
TAI 1 >54	7	-1.6	5.5
TAI 1 <54	5	-1.2	6.7

There was no statistical significance between the high and low scoring students on the TAI 1 and TAI 2 ($t = -.105$, $p = .918$). This suggests that the lack of effect of training on test anxiety was not related to the initial test anxiety level.

At the completion of the study the students completed a questionnaire about the study's usefulness and their anxiety level since the training program. Two questions were asked: 1) How useful was the biofeedback training experience? and 2) How anxious have you felt about tests you have had since learning these techniques? The scale was a likert scale with a range from 0 to 10; 10 being the highest rating. Table 22 lists the mean and standard deviations for the answers.

Table 21 Means and Standard Deviations for Questionnaire

	Mean	Standard Deviation
Question 1	8.1	1.4
Question 2	4.8	1.6

The range of the scores for the first question was 6 to 10, suggesting that students generally found the training experience useful. The range for the second question was 2 to 8, suggesting that students report varying levels of anxiety regarding test-taking.

CHAPTER 6

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This chapter includes discussion and interpretation of the study findings and the study limitations. Recommendations for nursing educators are also included.

Discussion and Interpretation

Research Question 1

The first research question was “does test anxiety differ among the four semesters of nursing school”? There were small differences between the Total TAI, Emotionality, and Worry components among the four semesters of nursing school; although the differences were not statistically significant. The mean of the TAI among the semesters ranged from 39.9 to 47.5. The third semester nursing students showed the highest scores on the TAI, and this was the semester chosen for the biofeedback relaxation training program.

The TAI was administered at the beginning of the summer semester. Nursing students have greater anxiety levels compared to students in other majors (Deary et al., 2003; Gibbons, Dempster, & Moutray, 2008; Watson et al., 2008); however, there is not literature that supports an exact semester in which test anxiety levels are the highest. These data suggest that students in the middle of the second semester or the beginning of the third semester have the highest levels of anxiety. In this particular program, the second semester students are introduced to gerontology, obstetrical, and pediatric didactic and clinical courses. Since the TAI was administered within the first two weeks of the semester it may be that the students entering second semester have not delved deep enough into the curriculum to obtain an accurate test anxiety measurement.

Research Question 2

Research question two was "is there a relationship between test anxiety and demographics"? Demographics measured were ethnicity, age, and gender. There were no statistically significant differences between test anxiety, ethnicity and age. Though not statistically significant, Hispanic students had the highest level of the Total TAI and the Emotionality Component. The Asian/Pacific Islander students had the highest level of test anxiety in regards to the Worry Component. This may be attributed to language and cultural barriers. Overall, this is consistent with the literature that reports there is little support for test anxiety being associated with any one particular ethnicity (Schwarzer & Kim, 1984; Oener & Kaymak, 1987; Hembree, 1988; Seipp & Schwarzer, 1996; Putwain, 2007).

There were no statistically significant differences in anxiety between the genders; although these data show a trend that females have a higher level of Total TAI, Emotionality and Worry Components. This is consistent with the literature that reports females are consistently higher on test anxiety inventories than men. Altermatt & Kim (2004) found that females in elementary school have higher levels of test anxiety than males and this is a trend that continues through the college years. This research builds on earlier research conducted by Wine (1980) and Zeidner (1990) who found that females are more anxious about being evaluated and this causes an emotional reaction to the situation. When the student focuses on inward emotions, she is unable to focus on the outward task (Sarason, 1984).

Research Question 3

Question three was "by the end of the study, will nursing students have learned to decrease pulse rate, decrease respiratory rate, and increase peripheral skin temperature using biofeedback assisted relaxation training"? To answer this question the last minute of the baseline session was compared to the last minute of each training session. The first training session focused on diaphragmatic breathing, the second session focused on progressive muscle relaxation, and the third session focused on autogenic training. There were differences between the last minute of the baseline session and the last minute of the training session for each session.

Diaphragmatic breathing training was chosen as the first session because the researcher wanted the students to focus only on one physiological system, and also because breathing is a meditation activity that is quick to learn (Paul, Elam, & Verhulst, 2007). Diaphragmatic breathing techniques have been incorporated into behavioral modifications for anxiety for many years (Conrad et al., 2007). Focusing on one's breathing patterns can easily and quickly help the individual become centered and calm (Harris & Coy, 2003). The respiratory rate decreased and peripheral skin temperature increased significantly during the training. This is to be expected because the session was focused on cognitively slowing the students' breathing.

The next session focused on progressive muscle relaxation. This training was chosen because of its simplicity to learn, and its benefits on automatic balance (Ghafari et al., 2008). This technique has been widely used with patients with anxiety disorders, effective in decreasing respiratory and pulse rates, and increasing alpha waves in the brain that are responsible for producing feelings of calmness (Hall & Long, 2009).

During this training session, the respiratory rate decreased and peripheral skin temperature increased significantly. The students were constantly reminded to slow their breathing and focus on taking long breaths which possibly accounts for the statistically significant finding for the breathing rate. Peripheral skin temperature is an indicator of relaxation and one's peripheral skin temperature increases as relaxation occurs (Keefe & Gardner, 1979). In progressive muscle relaxation training, students tense and relax their muscles; this may account for an increase in pulse rate because of the physical movement. Also, the progressive muscle relaxation training was only 20 minutes in length and this might not have been a long enough time for the pulse rates to decrease enough to be statistically significant.

The final training session focused on autogenic training. During this session the students were once again reminded to take long breaths. The changes in pulse rate, respiratory rate, and peripheral skin temperature were all statistically significant during this session. This session did not have the students moving any part of their body, but rather had them focus on breathing rates, blood running to their fingers, and decreasing their pulse rate. Whether the autogenic training was solely responsible for the physiological changes, or if the training leading up to this session played a role is uncertain. Autogenic training was the most successful in terms of being statistically significant so this may be one easy technique that nurse educators could use in their classrooms before tests. This session took 15 minutes and the students responded most favorably to this session.

Research Question 4

Research question four was “does relaxation training decrease test anxiety”? This question was answered by having the students complete the Spielberger’s Test Anxiety Inventory twice. The TAIs were completed at the beginning of the study and at the end of the study. The pre and post TAIs were compared to see if there was a decrease in the scores. Reliability for the TAI is .80 to .81 for a two week to one month period (Taylor & Deane, 2002), and the TAIs were given within a one month time period for this study. The test-retest reliability for this study was 0.92. The pre and post TAI scores increased slightly but there was no statistical significance found. This may be attributed to the week in the semester in which the final TAI was completed since the students were preparing for and taking midterm evaluations.

Since there was not a statistically significant finding when comparing the pre and post TAIs, the researcher divided the students into two groups. The two groups consisted of those who were able to learn the techniques, as evidenced by a decrease in pulse and respiratory rates and an increase in peripheral skin temperature, and those who were unable to learn the techniques. Pre and post TAI scores in the two groups were compared. The change in TAI scores was not statistically different between the two groups. The TAI is a measurement of the situation-specific personality trait (Spielberger & Vagg, 1995), and this five week session with the students was not enough time to change this personality trait. Various treatments have been tested to reduce test anxiety including systematic desensitization, behavioral methods, relaxation training, anxiety-management training, massed desensitization, counseling, cognitive-behavioral treatment, and computer assisted training (Gonzalez, 1978). Behavioral approaches have been effective in reducing test anxiety, but an improvement in grades is rare (Gonzalez). The largest change in subjective test anxiety scores and physiological reactions to test anxiety has occurred when study counseling is coupled with structural behavioral techniques aimed at teaching students how to observe, measure, and change their behaviors (Gonzalez). Lavigne (1974) paired cognitive therapy, study counseling, and relaxation training to an experimental group and compared the results to the control group and found significant reductions in test anxiety relative to the control group. A combination of cognitive therapy (CT), systematic desensitization (SD), and study counseling (SC) might be the optimal approach for decreasing test anxiety (Algaze, 1980). Worry and emotionality are the two factors involved in test anxiety, and if the worry component was decreased by the use of CT, SD would decrease the emotionality reactions, and SC would teach the student successful learning skills (Algaze).

Research Question 5

Research question five was “is there a greater decrease in test anxiety for students who start out with high test anxiety”? This question was answered by dividing the students into high TAI scores and low TAI scores based on the first administration of the TAI. There was no statistical significance between those who started out high versus those who started out lower on the TAI. This may be attributed to the small sample size of the study and also the placement of the second TAI administration because once again this occurred around midterm evaluations.

Limitations

One limitation of this study is the sample size of (14 students). The sample size was small because the sample pool consisted of only third semester nursing students from one university.

Only one semester was used to gather the baseline data during phase one. Perhaps if the Speielberger TAI was given to each class throughout an entire semester there would be different results pertaining to which semester has the highest level of test anxiety.

Another limitation of this study was that it was short in duration. The students were introduced to each relaxation technique one time and asked to practice on their own. The students were not monitored as they practiced the techniques at home so it is not known if the students actually practiced the techniques for fifteen minutes a day. The students submitted a daily log of their baseline, five, and fifteen minute physiological variables each day during the week but again this was not monitored so it is unclear if the students actually measured these variables.

Each student was asked to complete the Spielberger's TAI at two different points throughout the study. They were asked to complete the TAI right before they were handed a test. The completion of the TAI was not monitored so it is not known if the students completed it when they were asked to.

Conclusions

In conclusion, this study has revealed that nursing students self reported test anxiety. The range for the Spielberger TAI is 20 to 80 and the range recorded in this study across all semesters was 20 to 78. These results are consistent with other studies indicating that females have higher levels of test anxiety, while ethnicity and age is not a determining factor.

Third semester nursing students from this program revealed the highest level of test anxiety after phase one of the study, therefore this was the semester chosen for the relaxation training intervention. The diaphragmatic breathing and progressive muscle relaxation sessions resulted in a statistically significant change in respiratory rates and skin temperature. The autogenic training session appeared to be most effective in showing a statistically significant change in decreased respiratory and pulse rates, and increased peripheral skin temperature. The autogenic training was well received from all of the students as well. This occurred during the third training session and the stronger effects may be due to cumulative effects of training.

The lack of change in test anxiety was not due to the ability of the students to learn the relaxation techniques or to their starting level of test anxiety. In evaluating the final questionnaire about the usefulness of the study, 100% of the participants scored the usefulness above a 6 out of 10 and indicated they would be using the techniques in the future before tests.

For nurse educators it is important to identify those students who suffer from test anxiety and teach them strategies to decrease their anxiety. Diaphragmatic breathing training is a simple relaxation training strategy that can be taught to students within fifteen minutes. Autogenic training had the most significant effect in regards to physiological measurements and this is also a simple relaxation training strategy that the students enjoyed and learned within fifteen minutes. Once the students controlled their breathing, the other physiological measures responded accordingly. This is an easy, inexpensive way to help students take control of their physiological stress and become relaxed.

For future studies it is recommended that there be a larger sample size. This study had 14 participants who started and completed the study in five weeks, but it may be valuable to try this on larger number of subjects in different semesters. This study did not show a decrease in the overall Test Anxiety Inventory within one semester, but this may be due to short duration of the training. It would also be recommended that there be a longitudinal study in which a group of students are followed throughout their nursing education program to determine if their test anxiety can be decreased with consistent, long term training. It would be interesting to also follow their TAI scores from beginning to end because this is reflective of their trait anxiety. It may be useful in determining exactly what time period is needed before one's trait anxiety begins to change.

The researcher asked the students to practice the techniques at home for 15 minutes a day and record their pulse rates, respiratory rates, and peripheral skin temperatures at baseline, five, and fifteen minutes. It may be beneficial to have the students only record the baseline and final readings so their relaxation practice is not interrupted by taking measurements. It is also recommended that nurse educators ask the students which relaxation techniques worked best for them because some of the students responded better to one relaxation method over another.

In conclusion, the students responded well to the training sessions and indicated that this is a skill they will use not only for nursing school, but in other aspects of their lives as well.

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APPENDIX A

TEST ANXIETY INVENTORY

Test Anxiety Inventory

Test Booklet

"Test Attitude Inventory"

by Charles D. Spielberger, Ph.D.

Distributed by Mind Garden, Inc.

info@mindgarden.com
www.mindgarden.com

Test Attitude Inventory

Please provide the following information:

Name____ Date_______________

Gender (please circle): Male Female

Directions

A number of statements which people have used to describe themselves are given on the following page. Read each statement and then circle the appropriate number to the right of the statement to indicate how you *generally* feel:

1 = Almost Never, 2 = Sometimes, 3 = Often, 4 = Almost Always.

There are no wrong or right answers. Do not spend too much time on one statement but give the answer which seems to describe how you generally feel.

Please answer every statement.

Please turn the page for the statements.

Do not write below this line.

Score: T___________ W____________ E________________

Test Attitude Inventory

	ALMOST NEVER	SOMETIMES	OFTEN	ALMOST ALWAYS
1. I feel confident and relaxed while taking tests	1	2	3	4
2. While taking examinations I have an uneasy, upset feeling	1	2	3	4
3. Thinking about my grade in a course interferes with my work on tests	1	2	3	4
4. I freeze up on important exams	1	2	3	4
5. During exams I find myself thinking about whether I'll ever get through school	1	2	3	4
6. The harder I work at taking a test, the more confused I get	1	2	3	4
7. Thoughts of doing poorly interfere with my concentration on tests	1	2	3	4
8. I feel very jittery when taking an important test	1	2	3	4
9. Even when I'm well prepared for a test, I feel very nervous about it	1	2	3	4
10. I start feeling very uneasy just before getting a test paper back	1	2	3	4
11. During tests I feel very tense	1	2	3	4
12. I wish examinations did not bother me so much	1	2	3	4
13. During important tests I am so tense that my stomach gets upset	1	2	3	4
14. I seem to defeat myself while working on important tests	1	2	3	4
15. I feel very panicky when I take an important test	1	2	3	4
16. I worry a great deal before taking an important examination	1	2	3	4
17. During tests I find myself thinking about the consequences of failing	1	2	3	4
18. I feel my heart beating very fast during important tests	1	2	3	4
19. After an exam is over I try to stop worrying about it, but I can't	1	2	3	4
20. During examinations I get so nervous that I forget facts I really know	1	2	3	4

Test Anxiety Inventory

Scoring Key

"Test Attitude Inventory"

by Charles D. Spielberger, Ph.D.

Distributed by Mind Garden, Inc.

info@mindgarden.com
www.mindgarden.com

TAI Emotionality Subscale (E)

Items # 2, 8, 9, 10, 11, 15, 16, 18. **Minimum E Score: 8, Maximum: 32.**

Add the circled values (1, 2, 3, or 4) marked for items # 2, 8, 9, 10, 11, 15, 16, and 18. Enter the sum on the appropriate line on the answer sheet. (If 1 or more items are omitted, see the scoring instructions in the Manual.)

TAI Worry Subscale (W)

Items # 3, 4, 5, 6, 7, 14, 17, 20 **Minimum W Score: 8, Maximum: 32.**

Add the circled values (1, 2, 3, and 4) for items # 3, 4, 5, 6, 7, 14, 17, and 20. Enter the sum on the appropriate line on the answer sheet.

TAI Total Score (T)

Items # 1(values of item 1 are reversed), 12, 13, and 19 **Minimum T Score: 20; Maximum: 80**

To obtain the TAI Total Score, add the values (1, 2, 3, and 4) marked for item 1 (reversed values), 12, 13, and 19 and add the sum to the scores obtained for W and E. The grand total is the TAI Total Score and should be entered on the appropriate line of the answer sheet. NOTE THAT THE VALUES OF RESPONSES TO ITEM 1 ARE REVERSED: i.e., "almost never" is 4 instead of 1, "sometimes" is 3 instead of 2, "often" is 2 instead of 3, and "always" is 1 instead of 4.

If you have not computed W and E scores, the total score may be obtained by adding the circled values of responses to all 20 items; be sure to reverse the face values of responses to item 1.

APPENDIX B

DEMOGRAPHIC FORM

ID Number ____________________
Insert ERI ID number

Age ______

Gender ☐ Male ☐ Female

Ethnicity ☐ White
☐ Black
☐ Hispanic
☐ Native American
☐ Asian/Pacific Islander
☐ Other _______________

Do you have a history of anxiety? If yes, please explain.

Is there anything else you think I should know about you relevant to this study?

APPENDIX C

WEEKLY ANXIETY SCALES

Today my anxiety level is

0 1 2 3 4 5 6 7 8 9 10

Overall, my anxiety level this week has been

0 1 2 3 4 5 6 7 8 9 10

At home my anxiety level is

0 1 2 3 4 5 6 7 8 9 10

Do you have an examination this week? Yes No

APPENDIX D

TAKE HOME BIOFEEDBACK TRAINING FORM

Identification Number:

Pulse Rate: PR
Skin Temperature: ST

Directions: Please fill in the pulse rate and skin temperature and respiration rate readings at 5, 10, and 15 minutes during practice.

ID	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
Resting	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:
5 minutes	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:
10 minutes	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:
15 minutes	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:	PR: ST: RR:

APPENDIX E

PRE-WRITTEN SCRIPT

Respiration

TALK ABOUT CHEST BREATHERS: Tell the subject that most people are chest breathers and this puts extra stress on neck muscles. Chest breathing is stressed breathing (for example: people hold in their stomachs).

DIAPHRAGMATIC BREATHING: Teach the patient diaphragmatic breathing or natural breathing. Explain to the subject that "When you breathe in, the stomach pushes out, when you breathe out the stomach goes down. The diaphragm muscle which lies right below the lung is doing the work. When you breathe in, the diaphragm pulls down. This pulls air in and pushes the stomach out. (Demonstrate for the subject). When you breathe out, the diaphragm muscle relaxes and the air is pushed out, the stomach goes in."

1) have them hold their belly with their non-dominant hand
2) tell them to practice breathing deeply
3) count for them in 2-3-4-5; out 2-3-4-5
4) practice on their own

Have the subject try a few times and then try a deep breath to show the difference. Tell the subject, "When you are breathing this way, your shoulders should be relaxed and you should be moving the belly, not the upper body. This helps in two ways, it relaxes the upper body and it brings in more oxygen into the lungs equaling more efficient breathing."

APPENDIX F

PRE-WRITTEN SCRIPT

PROGRESSIVE MUSCLE RELAXATION

Ask participants to turn off cell phones and pagers.

EXPLAIN PMR TO SUBJECTS: Use a rubber band to symbolize a muscle. Explain how sometimes we have tension but we don't realize it because it becomes a normal feeling. Pull the rubber band and then pop it in the opposite direction. Show how the muscle when tensed on purpose will go in the opposite direction. Show how the muscle when tensed on purpose will go in the opposite direction when released. This is progressive relaxation.

Close your eyes for a few minutes and get relaxed. Adjust yourself if need be in your chair. For the first two minutes of the session, observe how the subject is breathing. Have them sit quietly and observe/record their temperature levels. Review breathing technique, if necessary.

We will focus your attention to your head, neck and shoulders.
In terms of stress, this is muscle group contains the most important stress muscles in your body.

Turning the focus to your head, raise your eyebrows as high as you can. Hold it. Now relax and smooth it out.
Let yourself imagine your entire forehead and scalp becoming smooth and at rest. Raise your eyebrows again, as high as you can.
Let it all go.
Allow your forehead to become smooth as silk.

Close your eyes now and squint them together very tightly. Hold them together and now relax your eyes.
Let them remain closed gently and comfortably.
Once more, close your eyes very tightly, hold them shut tight.
And relax. Feel your smooth relaxed face.

Now clench your jaw. Bite hard enough to feel tension, but not so hard that you hurt your teeth.

Notice the tension throughout your jaw, then relax your jaw. When your jaw is relaxed your lips will be slightly parted.

Let yourself really appreciate the contrast between tension and relaxation in your jaw.

Now clench your jaw muscles again. Hold them tightly
and relax. Feel the relaxation spreading as your lips part.
Now press your tongue against the roof of your mouth.
Force it upwards and feel the ache in the back of your mouth,
then relax. Allow your mouth to fall slightly open again.
Now press your tongue upward again. Hold it, hold it, and relax as the warm calm feeling takes over.

Press your lips outward now in an "0" shape, really stretch them out and
hold it. Now let them return to normal.
Once again, press your lips outward, hold them tightly
and relax. Notice if your lips feel tingly or warm.
Notice how your forehead, scalp, eyes, jaw, tongue, and lips are all relaxed.

Now, press your head back as far as it can comfortably go and observe the tension in your neck. Roll your head to the right and feel the changing location of the tension. Roll it to the left.

Straighten your head and bring it forward, pressing your chin against your chest.
Feel the strain in your throat in the back of your neck.
Now relax, allowing your head to return to a comfortable position. Let the relaxation deepen. Once more put your head back, to the right, to the left, forward and relax. *(pause in between each position)*

Notice how relaxed this very common locus of tension has become.

Now shrug your shoulders.
Keep the tension as you hunch your head down between your shoulders.
Now relax your shoulders and allow them to drop back. Feel the relaxation spreading through your head, neck, and shoulders.
Feel pure relaxation deeper and deeper.
Once again hunch your shoulders. Now relax.
Now sit still and feel a heaviness throughout your
body. Let the relaxation deepen.
Experience the relaxation deepening in your shoulders, arms, and hands - deeper and deeper. Notice the feeling of looseness and relaxation in your neck, jaw, and all your facial muscles. Take a deep breath, hold it a moment and let it out slowly.

When you open your eyes in a while, you will feel alert and refreshed.
As you go about your daily routine, you will recall the state of deep relaxation and use your memory to relax muscles that would otherwise tense up during stress.
Now continue breathing slowly. Visualize the details in the room around you. When you feel ready, open your eyes slowly.
Orient yourself to your surroundings. Now stretch.

Notice how relaxed, refresh and alert you feel. This feeling can be yours anytime you want to achieve it.

APPENDIX G

PRE-WRITTEN SCRIP

AUTOGENIC TRAINING

Autogenic training helps you to slow your breathing, improve blood flow, and increase your finger temperature. In autogenic training, we repeat simple phrases over and over in the back of our mind, to give our body an instruction to follow. By repeating the phrases over and over, it causes a calming effect and helps keep our mind off our problems and distractions that keep us from relaxing. This is a "passive" technique, we don't have to TRY ... we just allow the relaxation to happen.

Explain that we are going to increase blood flow to their fingers and decrease their pulse rates.

Tell the subject that you will read some phrases aloud that you want them to recite over an over in their mind to promote relaxation.

USE SCRIPT: Read each phrase on the script one time. Between each time, sit quietly to allow the subject to try some phrase in their mind. Have the subject close their eyes as you watch how their temperature is affected. The first couple of times, the temperature may go down. This is because the subject may be trying too hard or their muscles may not be relaxed. Remind them to relax their muscles if they forget.
TELL PARTICIPANTS TO GET INTO RELAXED POSTURE: FEET FLAT ON GROUND AND HANDS AT THE SIDE.

1. I feel quite quiet.
2. I am beginning to feel quite relaxed.
3. My feet feel heavy and relaxed.
4. My ankles, my knees and my hips feel heavy, relaxed and comfortable.
5. The whole central portion of my body feels relaxed and quiet.
6. Concentrate on diaphragmatic breathing
7. My hands, my arms and my shoulders, feel heavy, relaxed and comfortable.
8. My neck, my jaws, and my forehead feel relaxed. They feel comfortable and smooth.
9. My whole body feels quiet, heavy, comfortable and relaxed.
10. I am quite relaxed.
11. Concentrate on diaphragmatic breathing
12. My fingers are heavy and warm.
13. I feel quite quiet.
14. My whole body is relaxed and my fingers are warm, relaxed and warm.
15. My fingers are warm.
16. Concentrate on diaphragmatic breathing
14\. Warmth is flowing into my fingers, it is warm, warm.
15\. I can feel the warmth flowing down my arms.
16\. My fingers are warm, relaxed and warm.
17\. My whole body feels quiet, comfortable and relaxed.
18\. My mind is quiet.

19. I withdraw my thoughts from the surroundings and feel serene and still.
20. My thoughts are turned inward and I am at ease.
21. Concentrate on diaphragmatic breathing
22. Deep within my mind I can see myself as relaxed, comfortable and still.
23. I am alert, but in an easy, quiet, inward-turned way.
24. My mind is calm and quiet.
25. I feel an inward quietness.
26. The relaxation is concluded and the whole body is reactivated with a deep breath and the following phrases: "I feel life and energy flowing through my body, my fingers are warm and my pulse is slow.

Try letting all of the breath out of your body. Now let your lungs fill up with air all by themselves. Follow your breath as it moves through your nose and into your lungs. Notice how gentle it is inside your nose and how it fills your nose completely.
When you breathe in next time, let the air go all the way down to your belly button - push your belly button out as you breathe in, then let the air out slowly. Breathe in again, letting the air fill your tummy, then your chest. Count slowly to yourself as you breathe in and out. Breathe in for 4 counts and out for 4 counts. Breathe in, 2, 3, 4; breathe out 2,3,4. In, 2, 3, 4; Out 2,3,4. Etc. Count to yourself as you think how easy it is to breathe this way.

Notice also how the tension is beginning to go out of your body. Your muscles relax, becoming softer, looser, more and more comfortable. Notice how some parts of your body may feel heavier and other parts may feel lighter. Notice how your body is becoming warmer.

Imagine a warm relaxing place. For example picture yourself at the beach, hear the soft rhythmic sound of the waves lightly arriving on the shore, feel the warm of the sun on your body, particularly in your fingers. Feel the blood flowing to your fingers.

Continue to breathe in 2,3,4; Out 2,3,4. Think about your fingers and how warm they feel. Feel the blood flowing to your organs and delivering oxygen and nutrients. Breathe in 2, 3, 4; Out 2, 3,4.

Now concentrate on the peaceful feelings in your body. Feel how relaxed your muscles are, how calm and peaceful you feel. Slowly open your eyes, you'll be feeling relaxed and rested.

APPENDIX H

QUESTIONNAIRE ABOUT BIOFEEDBACK RELAXATION TRAINING PROGRAM

1. How useful was the biofeedback training experience?

0 1 2 3 4 5 6 7 8 9 10

0= not useful
10= extremely useful

2. How anxious have you felt about tests you have had since learning these techniques?

0 1 2 3 4 5 6 7 8 9 10

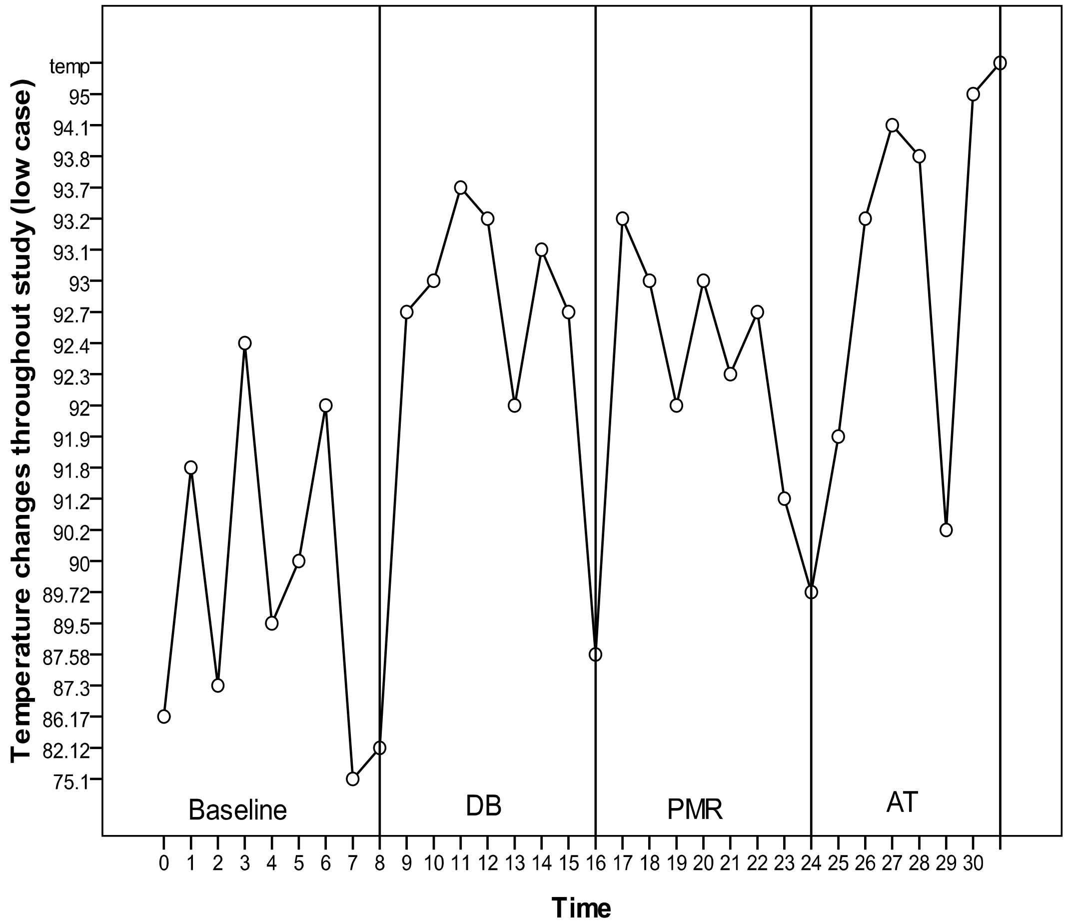
0= Not anxious at all
10= extremely anxious

3. Do you plan on using the biofeedback techniques you learned before examinations in the future? Please explain.

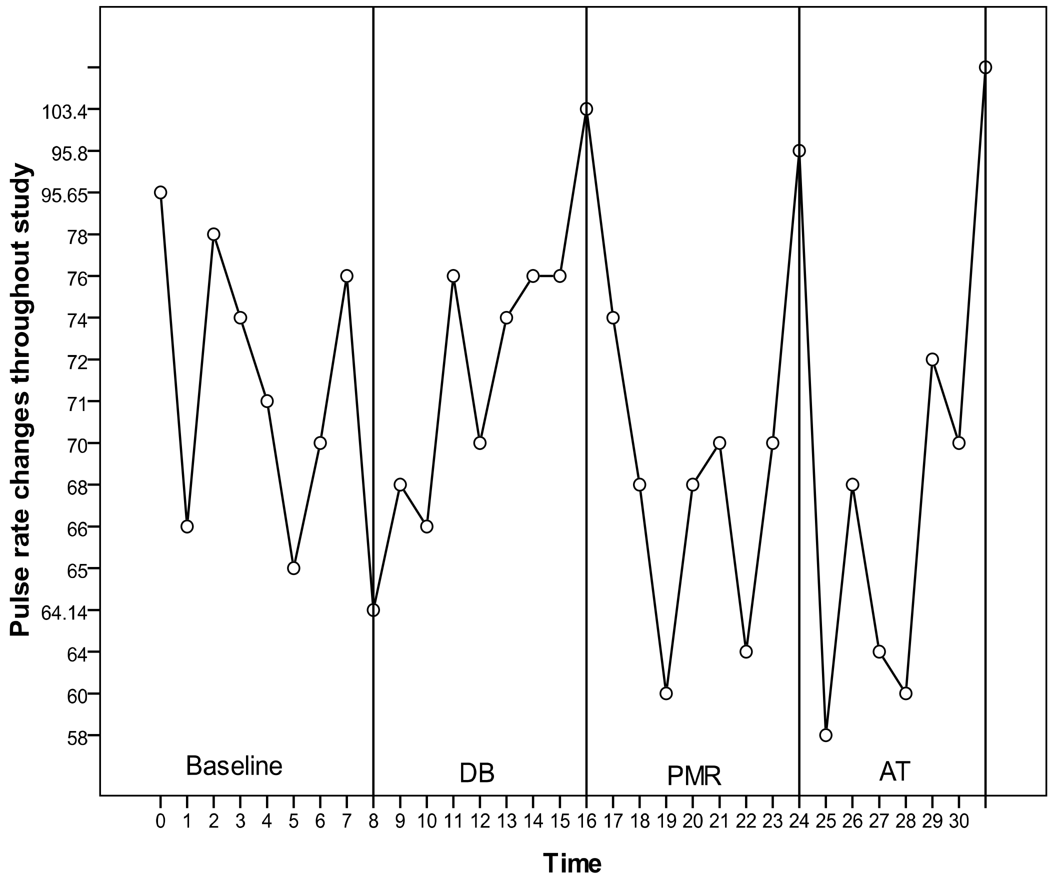
APPENDIX I

LOW BASELINE TEMPERATURE CASE STUDY OVER TIME

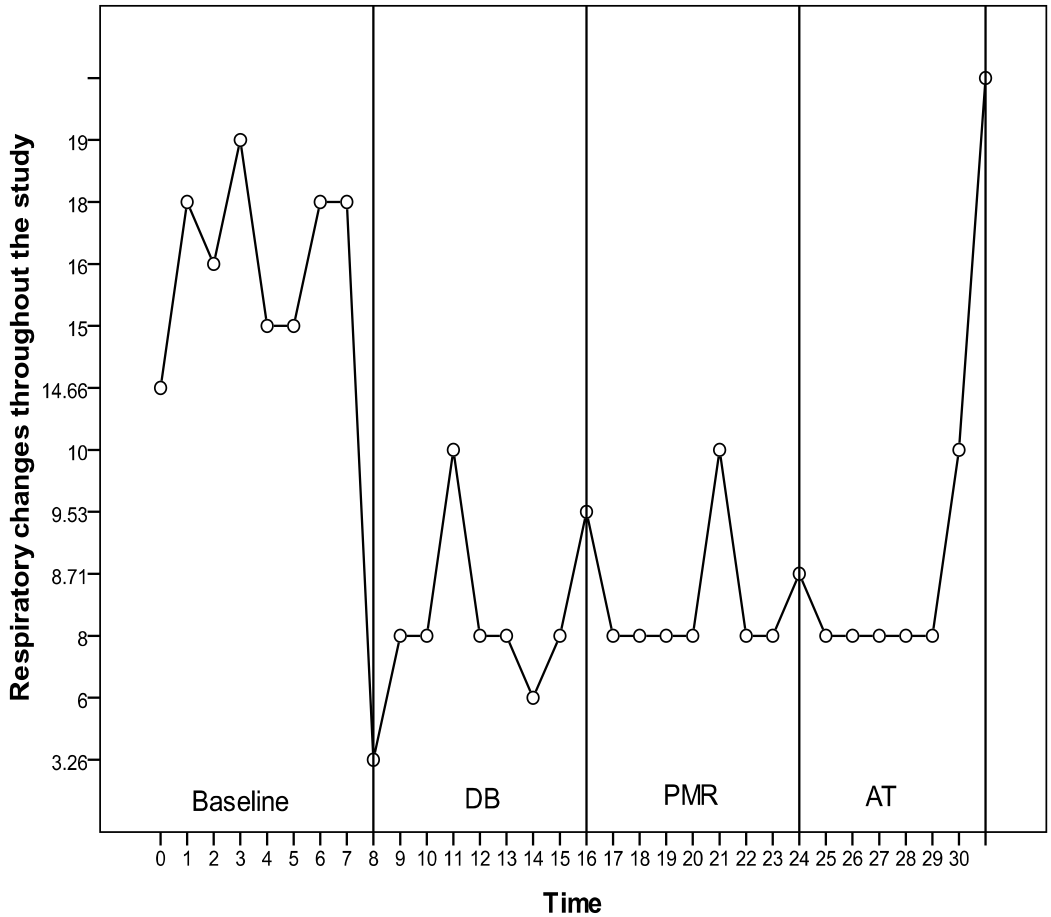
A graphical representation of the student who started out with the lowest peripheral skin temperature at the beginning of the study is shown below. Time 0 begins with the first individual session in which there was not any training provided. The other times represent the final record on the take home work sheet after practicing for 15 minutes. Time 8, 16, and 24 represent the individual training in which diaphragmatic breathing (DB), progressive muscle relaxation (PMR), and autogenic training (AT) were taught. The first graph indicates the temperature changes for this student from the first individual meeting, the last minute recorded on the homework sessions, and the last individual session. The second and third graphs represent the changes in pulse and respiratory rates for the same time periods.



This graph indicates that the student who started out with the lowest temperature was able to increase her peripheral skin temperature from the beginning of the study to the end. Her initial skin peripheral skin temperature was 86.17°F and the final temperature reading was 95°F. There is an upward trend from the beginning of the study throughout the study.



The student's pulse rate decreased with home practice and individual sessions. Time 0 was the initial meeting with the researcher where there was no training involved. After the training began (time 8) the student was able to decrease her pulse rate. The greatest decrease came the first day of homework after the autogenic training session. The mean pulse rate throughout the study is around 70 bpm which is a great decrease from the initial 95 bpm.



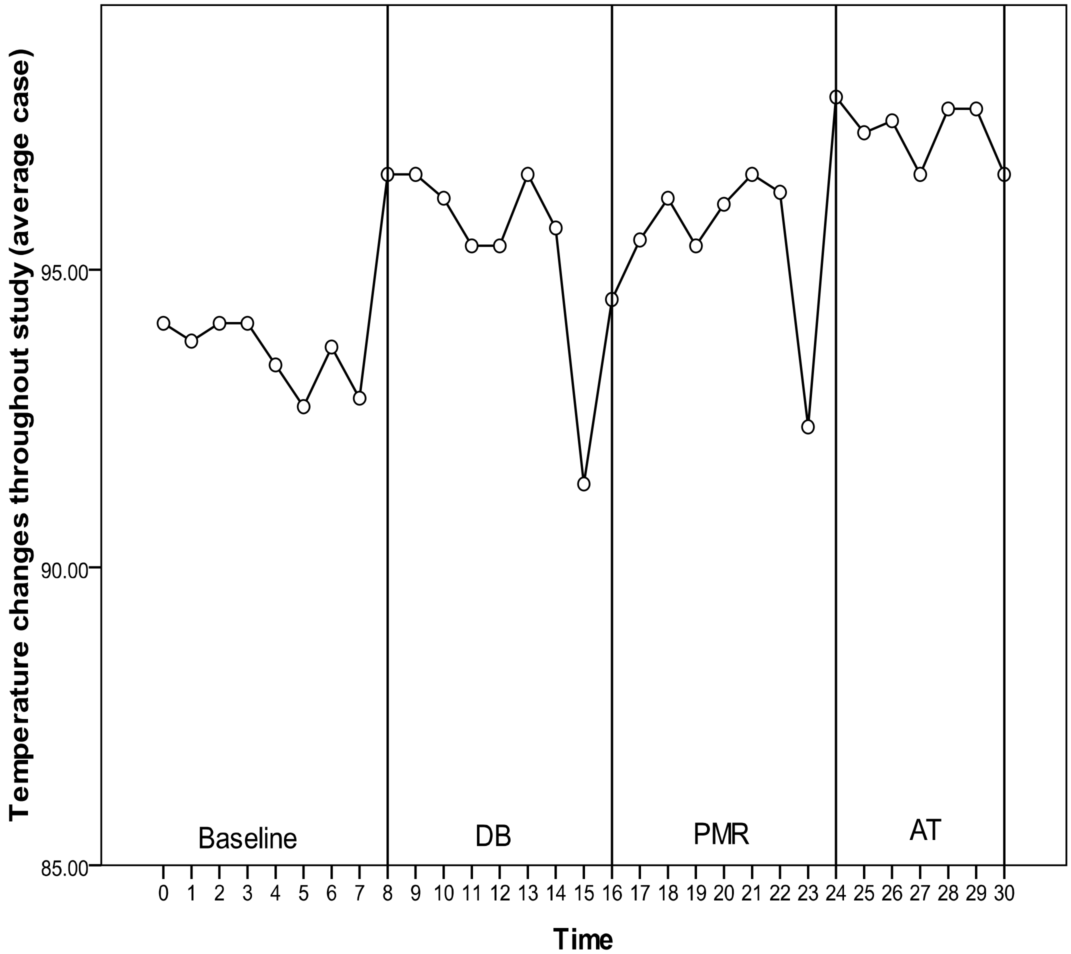
The student's respiratory rate at the beginning of the study was between 14 and 19 breathes per minute. After the training sessions began (time 8) she was able to control her respiratory rate and keep this below 10 breathes per minute except for the very last day of homework.

In conclusion, these graphs represent a student who started out with low skin temperature, high pulse rates, and high respiratory rates. Throughout the study she was able to increase her skin temperature, and decrease her pulse and respiratory rates. This suggests that she did learn the relaxation techniques as evidenced by a change in the three variables measured. A student who begins with a low skin temperature has the potential to increase the temperature multiple degrees and this is an indication of relaxation.

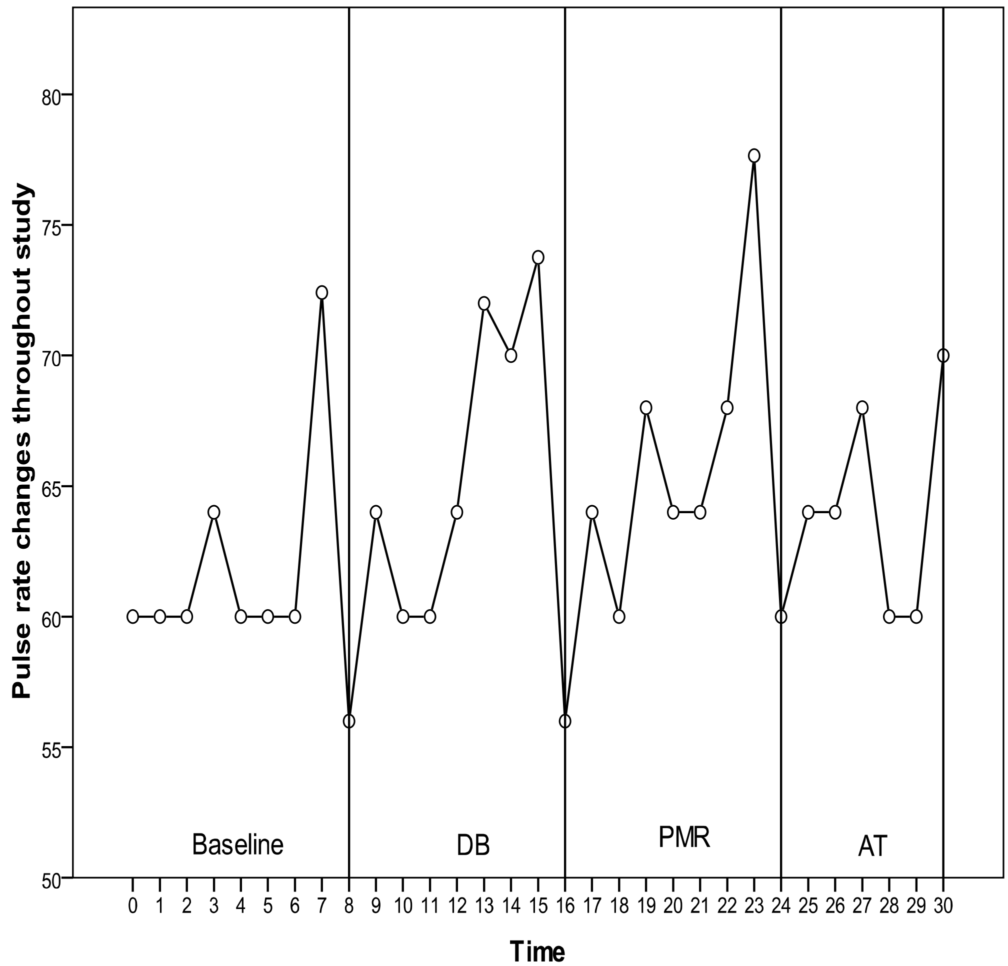
APPENDIX J

AVERAGE BASELINE OF TEMPERATURE, PULSE, AND RESPIRATORY CHANGES OVER TIME

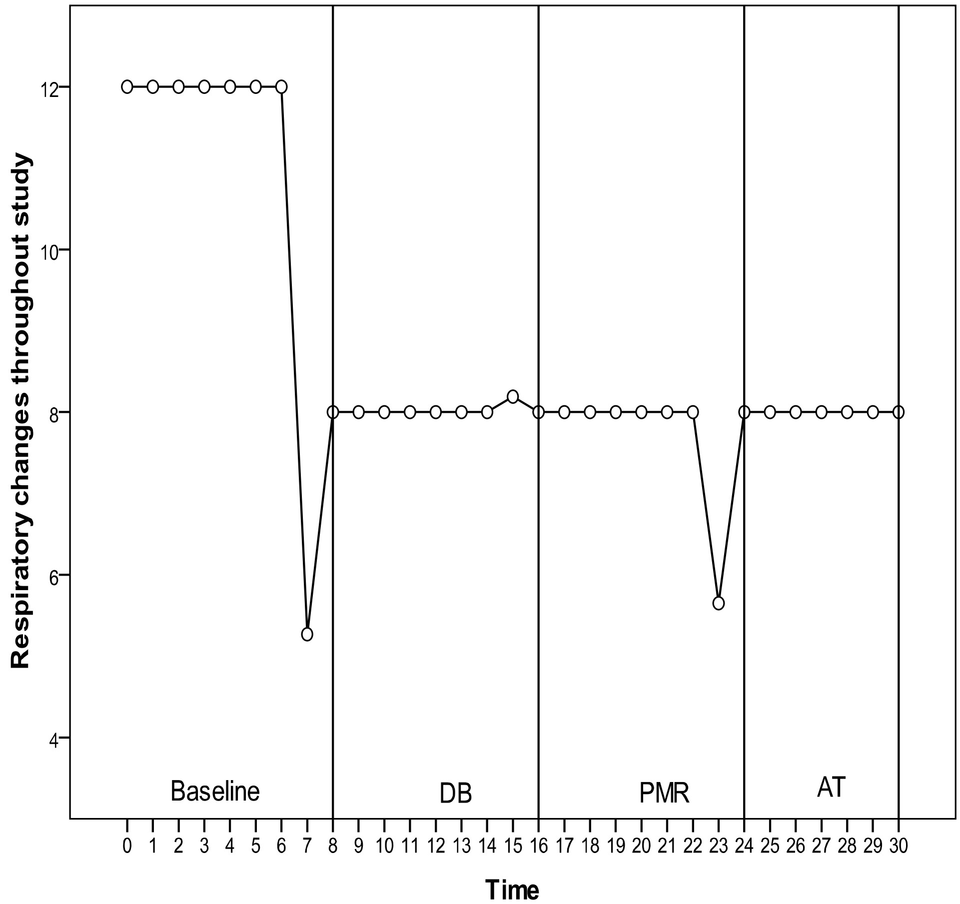
A graphical representation of the student who started out with an average peripheral skin temperature at the beginning of the study is shown below. Time 0 begins with the first individual session in which there was not any training provided. The other times represent the final record on the take home work sheet after practicing for 15 minutes. Time 8, 16, and 24 represent the individual training in which diaphragmatic breathing (DB), progressive muscle relaxation (PMR), and autogenic training (AT) were taught. The first graph indicates the temperature changes for this student from the first individual meeting, the homework sessions, and the last individual session. The second and third graphs represent the changes in pulse and respiratory rates for the same time period.



The student who started out with an average temperaure in the study did show an upward trend in temperature readings. The greatest increase in temeprature is shown during the autogenic training session.



The pulse rate for this student was stable around 60 beats per minute the first week of the study during which time she did not receive any training. She was able to decrease her pulse rate to 55 beats per minute during the diaphragmatic breathing sessions, progressive muscle relaxation training sessions, and the autogenic training sessions. The mean pulse rate for this student is around 65 bpm which is the same pulse rate that she started with.



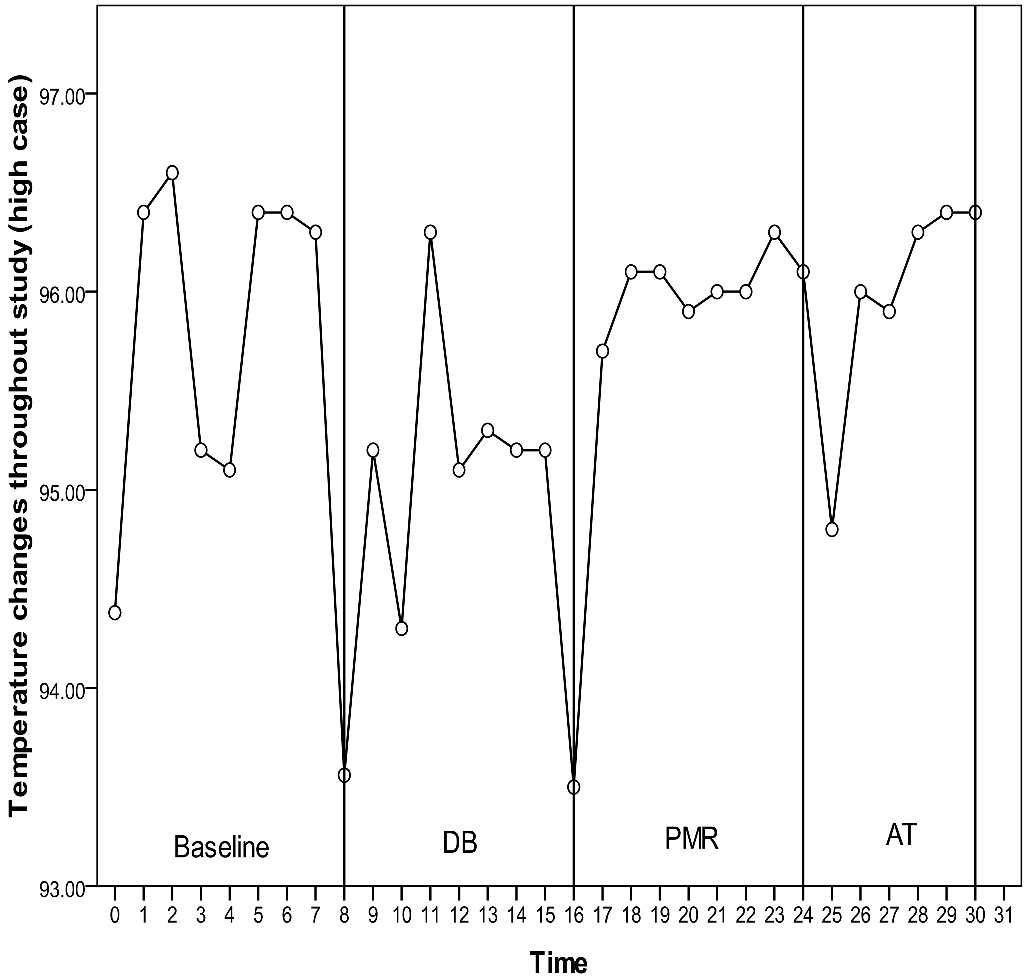
During the first week in which she did not receive any training her respiratory rate was around 12 breaths per minute. Throughout the study she was able to decrease her respiratory rate to 8 breaths per minute during home and individual sessions.

In conclusion, this student learned the relaxation techniques as evidenced by the changes in her skin temperature, pulse rates, and respiratory rates. Her skin temperature did gradually increase and her respiratory rate decreased after the first DB session. Her pulse rate was not consistent each day, but over all there was a decrease in this measurement also.

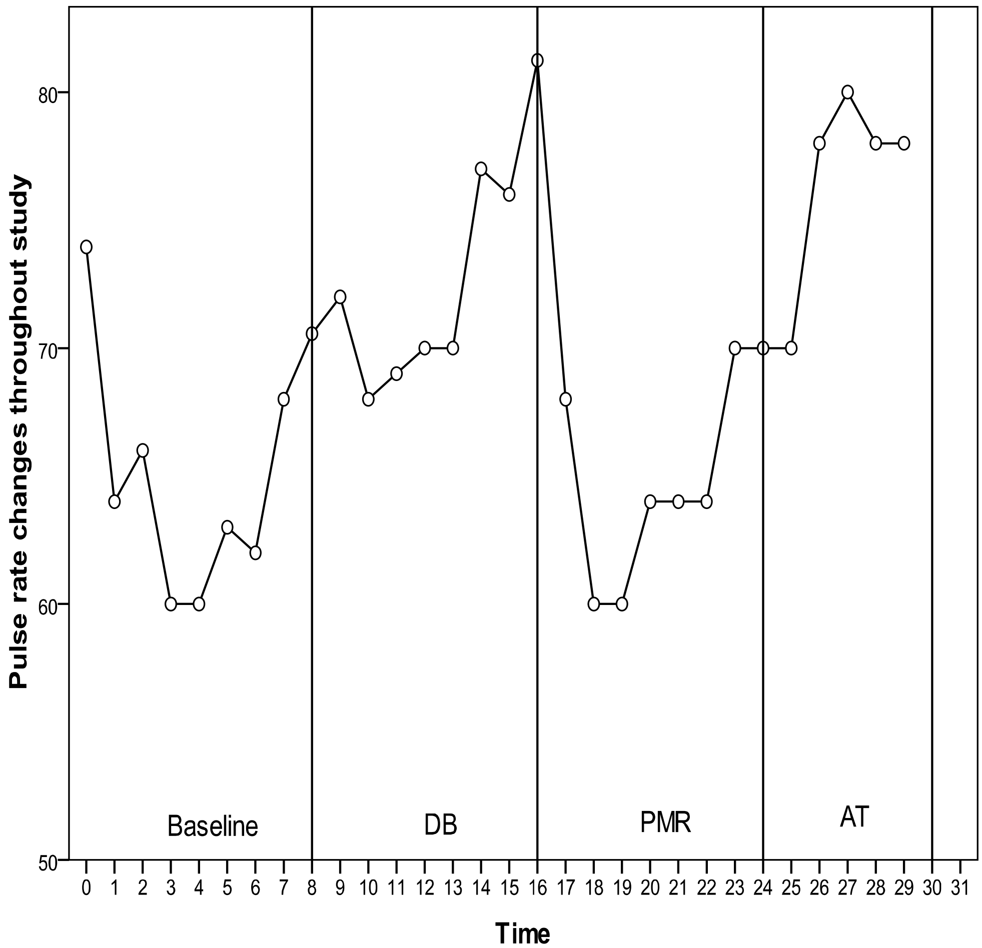
APPENDIX K

HIGH CASE BASELINE OF TEMPERATURE, PULSE, AND RESPIRATORY CHANGES OVER TIME

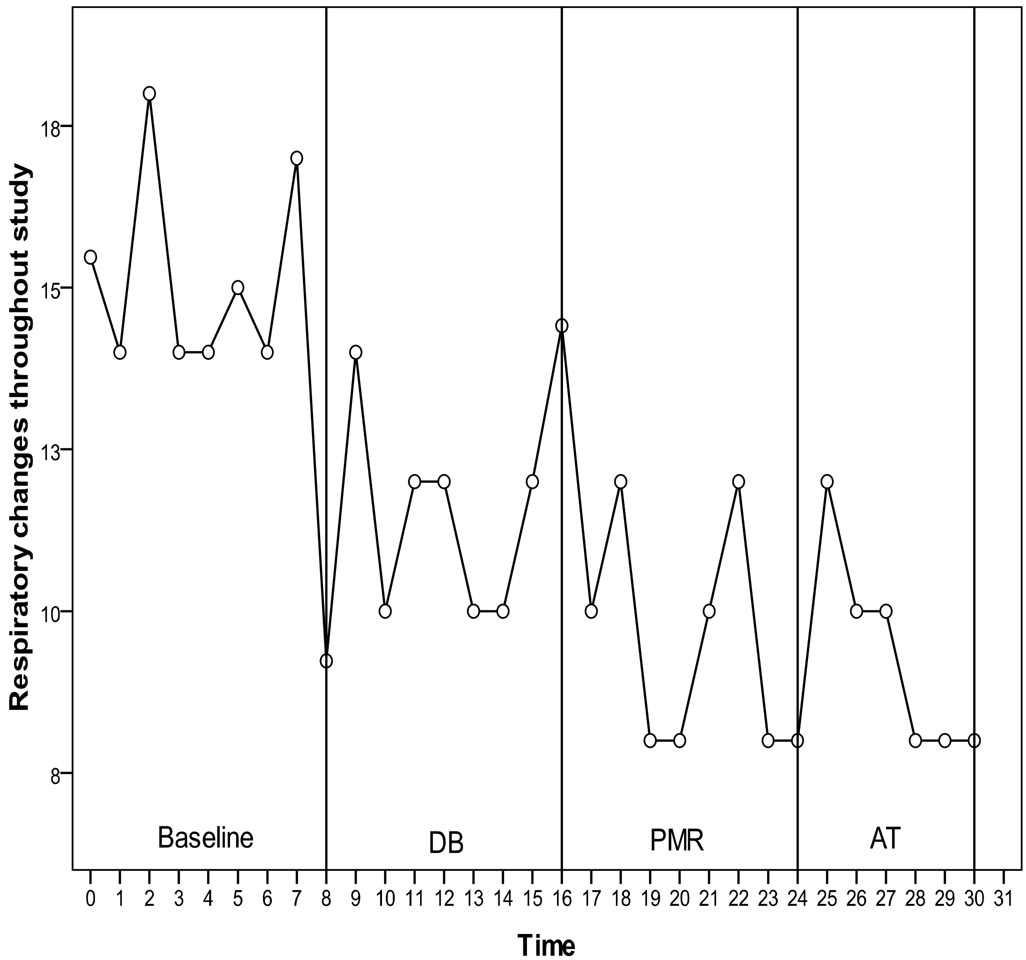
A graphical representation of the student who started out with the highest peripheral skin temperature at the beginning of the study is shown below. Time 0 begins with the first individual session in which there was not any training provided. The other times represent the final record on the take home work sheet after practicing for 15 minutes. Time 8, 16, and 24 represent the individual training in which diaphragmatic breathing (DB), progressive muscle relaxation (PMR), and autogenic training (AT) were taught. The first graph indicates the temperature changes for this student from the first individual meeting, the homework sessions, and the last individual session. The second and third graphs represent the changes in pulse and respiratory rates for the same time period.



This graph represents the student who began the study with the highest temperature reading. Her initial reading was 94.5°F and her highest reading was actaully during the second day of home practice (96.5°F). Her temperature dropped during the relaxation training sessions excpet for the autogenic training session; although her temperature only fluctuated between a small range throughout the study.



Throughout the study her pulse rate fluctuated between 60 and 80 beats per minute. The lowest reading was noted during week 1 in which she did not receive any training and week 3 in which she learned progressive muscle relaxation.



There is a downward trend for her respirations throughout the study. She started between 14 and 19 breathes per minute, but after each training session she decreased her rate. The last week of homework practice her respiratory rate was between 13 and 8 breathes per minute after 15 minutes of practicing.

In conclusion, it is difficult to use this student's skin temperature as an indication of relaxation because she started out with such a high temperature at baseline. The respiratory rate did change the greatest during this study; she was able to control her rate of 8 breaths per minute by the end of the study. For a student who begins with such a high skin temperature, it would be best to use other physiological measures to assess for relaxation.

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