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Mitigating the Effects of Test Anxiety through a Relaxation Technique Called Sensory Activation

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by

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This Dissertation has been approved as partial fulfillment of the requirements for the degree of Doctor of Education Lindenwood University, School of Education

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Declaration of Originality

I do hereby declare and attest to the fact that this is an original study based solely upon my own scholarly work at Lindenwood University and that I have not submitted it for any other college or university course or degree.

Marylynne Abbott

Signature: Marylynne Abbott Date: 9-19-16

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Abstract

Test anxiety is a phenomenon which has been researched for decades. Student performance, goal attainment, and personal lives are all negatively affected by the multiple factors of test anxiety. This quantitative study was designed to determine if a particular relaxation technique, called sensory activation, could mitigate the symptoms and effects of test anxiety. The Test and Anxiety Examination Measure, developed by Brooks, Alshafei, and Taylor (2015), was used to measure test anxiety levels before and after implementation of the sensory activation relaxation technique. Two research questions guided the study using not only the overall test anxiety score from the Test and Anxiety Examination Measure, but also using the five subscale scores provided within the instrument. After collection and analysis of data, the results for research question one indicated a statistically significant positive difference in mean levels of overall test anxiety. Not only were overall mean test anxiety levels lowered, but findings for research question two showed significant decreases in worry and state anxiety subscale scores. Considering the sensory activation relaxation technique was used during the examination period, it is reasonable to assume its effectiveness would be limited to lowering state anxiety levels rather than trait anxiety levels. Also, results from prompt 10 of the Test and Examination Anxiety Measure (Brooks et al., 2015) indicated the sensory activation relaxation technique could serve as a possible deterrent to the "going blank" problem as described anecdotally by students. Instructors could introduce the sensory activation relaxation technique to their students prior to the first testing event in the course, thus producing the desired outcomes of better test performance and less anxiety.

Table of Contents

List of Tables

List of Figures

Chapter One: Introduction

A certain amount of test anxiety can help a student focus and perform at peak levels (Abuhamdeh & Csikszentmihalyi, 2012). However, high levels of test anxiety can negatively affect a student's academic progress (May, 2015). According to Davidson, McFarland, and Glisky (2006), "some anxiety and arousal improves performance; excess anxiety harms performance" (p. 15).

Previous research has shown both intelligence and achievement are negatively correlated with test anxiety (May, 2015). In order for students to progress academically without interference from test anxiety responses, those responses need to be mitigated. This study focused on determining whether a relaxation technique called sensory activation had a decreasing effect on the level of test anxiety experienced by students.

In this chapter the historical background of test anxiety research is briefly covered. The theoretical framework for this study is discussed, and the purpose explained for each theoretical aspect. This study's research questions and the corresponding limitations and assumptions are also presented. A comprehensive list of terms related to this research is carefully defined.

Background of the Study

In the early days of test anxiety research, the challenge was to determine if there was a type of anxiety for testing alone, which was distinct from other types of general anxiety (Cassady, 2010). Freud (as cited in Sarason, 1980) viewed anxiety as one's response to threat and one's inability to cope; a learned-helplessness response combined with heightened self-awareness. In the mid-1800s, Kierkegaard (as cited in May, 2015) proposed that one's freedom or possibilities were entwined with feelings of anxiety.

Kierkegaard (as cited in May, 2015) felt more freedom or more possibilities inherently created more potential anxiety.

Seymour Sarason and George Mandler, in the early 1960s, began the early research with a theory which posited test anxiety is an underlying personality trait (Sapp, 2013). After more than two decades of research, Spielberger and Vagg (1995) developed a transactional process model conceptualizing test anxiety as being a contextually specific construct of both state and trait anxiety. State anxiety is most easily thought of as a transient event of anxiety occurring only in specific situations, while trait anxiety is more pervasive and consistent (Wine, 1971). State anxiety is also related to the physiological response to a threatening situation and the autonomic response often referred to as the fight or flight response (Spielberger & Vagg, 1995).

Sarason (1980) eventually incorporated emotionality and worry as cognitive interference aspects of the test anxiety response into his research. Emotionality refers to the "affective-physiological experience generated from increased autonomic arousal" (Deffenbacher, Michaels, Michaels, & Daley, 1980, p. 112). Attentional focus, on the other hand, is the worry component of test anxiety where one's "concerns about performance, consequences of failure, negative self-evaluation" create cognitive interference (Deffenbacher et al., 1980, p. 112).

Other aspects of test anxiety, rumination and distractibility, have also been researched. Rumination refers to repetitive thoughts which tend to interfere with cognitive processing and working memory capacity (Calvo, Gutiérrez, & Fernández-Martín, 2012). Working memory is used to "temporarily manipulate and store information during thinking and reasoning tasks" (Henry, 2011, p. 1). Therefore,

rumination can reduce one's working memory capacity during a testing event (Henry, 2011).

Distractibility within psychological realms refers to the ease of which attention can be diverted from a task (Brooks, Alshafei, & Taylor, 2015). Specifically, proponents of the attentional control theory, have stated "anxiety disrupts the balance between these two systems by enhancing the influence of stimulus driven bottom-up processes over the efficient top-down goal driven processes" (Derakshan & Eysenck, 2009, p. 170). Using the attentional control theory as a lens to study anxiety, it is assumed productive functioning of the goal-directed attentional system is impaired and the degree to which cognitive processing is driven by the stimulus-driven attentional system is increased (Eysenck, Derakshan, Santos, & Calvo, 2007). Anxiety not only lowers attentional control, it also increases the amount of attention paid to threat-related stimuli (Eysenck et al., 2007).

In order to quantitatively describe test anxiety, an instrument needed to be developed. Among the first to develop the most widely used scale to measure test anxiety levels was Sarason, Davidson, Lighthall, and Waite (1958), who named this first instrument the Test Anxiety Scale. The Test Anxiety Scale measured the physiological symptoms experienced by subjects rather than the more intricate psychological aspects (Sarason, 1980).

In the 1980s, Spielberger developed the Test Anxiety Inventory designed to measure test anxiety as a situation-specific personality trait (Spielberger & Vagg, 1995). Eventually, this inventory was revised to include reporting levels of test anxiety in terms of either state or trait anxiety, hence the State-Trait Anxiety Inventory was created

(Spielberger & Vagg, 1995). The Trait Anxiety Inventory and State-Trait Anxiety Inventory have now been in use for decades (Brooks et al., 2015).

In 1988, Hembree conducted a meta-analysis of 562 studies on test anxiety to determine overall themes in causes, effects, and treatments. Hembree (1988) concluded test anxiety can cause a reduction in academic performance, but various treatments do assist in test anxiety reduction. When a reduction in test anxiety occurs, it is directly related to improved grade point averages and test performance (Hembree, 1988). Findings in a study by Szafranski, Barrera, and Norton (2012) showed that since the Trait Anxiety Inventory was normed in the 1980s, the Trait Anxiety Inventory may no longer be applicable to current students. For example, the percentage of first-generation college students, where neither parent graduated nor attended college, has increased (Szafranski, Barrera, & Norton, 2012). In addition, diversity among college students, including cultural, gender, and age, has also changed (Szafranski, Barrera, & Norton, 2012).

Most recently, advances in neurological research have shown there are chemical aspects to the anxiety response and specifically to cognitive interference being not only a psychological effect but a physiological effect of the limbic portion of the brain in response to threat (Lissek, 2012). In particular, researchers have found increases in cortisol levels during heightened threat responses cause neurological electrical blockages between the synapses (Rana & Mahmood, 2010). This blockage between synapses can then often impede memory formation and retrieval (Rana & Mahmood, 2010).

Because of the previous neurological research, some test anxiety researchers have focused on interventions which prevent or alleviate the fight or flight response. In particular, Wong, Chair, Leung, and Chan (2014) found students practicing pranayama

breathing techniques were able to lower their levels of test anxiety. Students participating in group therapy were able to increase their ability to cope with test anxiety responses during testing (Uzun Ozer, Demir, & Ferrari, 2013).

Theoretical Framework

Research into sources, elements, and interventions for test anxiety has been performed for almost a century. Psychologist Sigmund Freud was one of the first to study the construct of anxiety during the early 1900s (May, 2015). Freud (as cited in May, 2015) noticed a psychological confliction between the response to a true threat and a perceived threat, which he termed a neurotic fear. Freud's studies into the emotional factors of anxiety soon inspired other cognitive and behavioral researchers to develop their own theories well into the twentieth century (May, 2015).

The cognitive interference theory was researched and developed thoroughly during the mid-twentieth century (Spielberger & Vagg, 1995). According to cognitive interference theory, poor cognitive performance is the result of increases in test anxiety due to irrelevant, disruptive thoughts (Coy, O'Brien, Tabaczynski, Northern, & Carels, 2011). Emotionality and worry, aspects of anxiety, are considered to be one of the causes of the interference. (Sapp, 2013; Zeidner, 1998). Worry, a cognitive aspect of anxiety, refers to negative, catastrophic thoughts, while emotionality is considered a behavioral factor of anxiety (Sapp, 2013; Zeidner, 1998). The emotionality aspect of anxiety concerns the physical manifestations of nervousness and tension. (Zeidner, 1998).

The worry-emotionality aspect of test anxiety has been found to be a type of state anxiety (Sarason, 1980). State anxiety is a temporary experience and is limited in duration (Sarason, 1980). Students "experiencing high levels of stress across a wide

range of situations" are coping with trait anxiety (Salend, 2012, p. 20). Trait anxiety is tied to a person's everyday experiences, while someone dealing with state anxiety will return to a normal, anxiety-free state when the anxiety producing event is over (Sarason, 1980).

In a meta-analysis of test anxiety studies, Hembree (1988) found students experience a larger amount of cognitive interference during testing events. Hembree (1988) discovered behavioral treatments were more potent in reducing test anxiety as compared to cognitive treatments alone. More importantly, Hembree (1988) concluded test anxiety seemed to be a behavioral construct, and study skills training, or any cognitive treatment used alone, was not as powerful as when cognitive and behavioral treatments were used in conjunction.

In the mid-1990s, a transactional process model for test anxiety was developed by Spielberger (Spielberger & Vagg, 1995). The transactional process theory is an idea where worry and emotionality are considered part of a complex process of cognitive transactions between perception of a threat, through the emotional psychological aspects, to the memory storage and processing parts of the brain (Spielberger & Vagg, 1995).

Current neurological research into working memory capacity has led to test anxiety being viewed through the lens of attentional control theory (Owens, Stevenson, Hadwin, & Norgate, 2014). Anxiety consumes a larger portion of the attentional abilities of the brain, thus disrupting cognitive processing (Owens et al., 2014). This interruption can lead to poor test performance (Eysenck et al., 2007).

Statement of the Problem

In order to successfully complete a college degree, students must pass numerous exams. Test anxiety may inhibit optimal performance on exams (Hembree, 1988). A certain amount of test anxiety can help a student focus and perform at peak levels (Abuhamdeh & Csikszentmihalyi, 2012). However, high levels of test anxiety can negatively affect a student's academic progress (Hembree, 1988). The consequences of high test anxiety on cognitive tasks can be extensive, leading to unsatisfactory educational outcomes such as low GPA or attrition (Owens et al., 2014). In order to assist test anxious students in achieving their educational goals, effective interventions need to be found. A student's ability to achieve his or her educational goal will improve when anxiety is not an issue in hindering his or her performance during testing situations (Owens et al., 2014).

Purpose of the Study

The purpose of this investigation was to determine if a relaxation technique, sensory activation, designed to decrease test anxiety, was effective in reducing perceived levels of test anxiety. Within this study, the relaxation technique is referred to as the sensory activation relaxation technique. This research was designed to identify any differences of perceived test anxiety before and after implementing the sensory activation relaxation technique as measured by the Test and Examination Anxiety Measure, which includes five factors of the test anxiety response: state anxiety, trait anxiety, distractibility, rumination, and worry (Brooks et al., 2015).

Developed by the researcher, the sensory activation relaxation technique consists of a variety of cognitive and behavioral interventions. Previous research has shown the

most effective treatments involve both cognitive and behavioral aspects (Hembree, 1988; Parker, Vagg, & Papsdorf, 1995). Specifically, the sensory activation relaxation technique includes breathing techniques, visualization, cognitive exercises, as well as emotionally tied memory.

Mavilidi, Hoogerheide, and Paas (2014) purported if negative thoughts can be released during a testing event, more working memory resources are available for performing on the test. Mowbray (2012) found altering "attentional processes away from salient threat-related stimuli" freed cognitive resources, which could be applied to the testing event with the expectation of improved outcomes (p. 148). According to Kuhbandner and Pekrun (2013), emotional salience is a prominent factor in remembering information. Nemati and Habibi (2012) found practicing pranayama, a yogic breathing technique, could reduce test anxiety. Zargarzadeh and Shirazi (2014) concluded using a progressive muscle relaxation technique before and during a testing event could assist in reducing test anxiety. Finally, meditation or mindfulness training has also been effective in reducing test anxiety (Lang, 2013).

Research questions and hypotheses. The following research questions and hypotheses guided this study:

1. What difference, if any, exists in the mean level of perceived test anxiety as reported by students who completed the Test and Examination Anxiety Measure before and after implementation of the sensory activation relaxation technique?

$H1_0$: There is no measurable difference in mean level of perceived test anxiety as reported by students who completed the Test and Examination Anxiety Measure before and after implementation of the sensory activation relaxation technique.

$H1_a$: There is a measurable difference in mean level of perceived test anxiety as reported by students who completed the Test and Examination Anxiety Measure before and after implementation of the sensory activation relaxation technique.

2. How much difference, if any, exists in any of the Test and Examination Anxiety Measure mean composite subscale scores before and after implementation of the sensory activation relaxation technique?

$H2_0$: There is no measurable difference in any of the mean Test and Examination Anxiety Measure composite subscale scores before and after implementation of the sensory activation relaxation technique.

$H2_a$: There is a difference in at least one mean Test and Examination Anxiety Measure composite distractibility subscore before and after implementation of the sensory activation relaxation technique.

Definition of Key Terms

For the purposes of this study, the following terms are defined:

Emotionality. According to Anderson and Sauser (1995), emotionality is "Physiological and affective arousal" (p. 22).

Rumination. Repetitive, self-defeating thoughts (Brooks et al., 2015).

State anxiety. According to Salend (2012), state anxiety is a type of anxiety felt during a specific time or event.

Trait anxiety. Anxiety which is prevalent across a variety of situations and is not event-specific (Salend, 2012). Anxiety experienced by a person on a regular basis due to his or her personality (Brooks et al., 2015)

Worry. Concern about failure and its effect on self-image (Brooks et al., 2015). Anderson and Sauser (1995) stated worry is a "cognitive concern about the outcome of an event" (p. 22).

Limitations and Assumptions

The following limitations were identified in this study:

Only students enrolled in 11 sections of a Basic Algebra course at the participating two-year college were involved in this study. Therefore, the results of this research may not be generalized. Also, the results are limited in scope (Creswell, 2013).

The following assumptions were accepted in this study:

1. The responses of the participants were offered honestly and without bias.
2. The Basic Algebra courses were taught using similar pedagogy following a similar timeline.

Summary

Test anxiety is prevalent on college campuses and can often inhibit successful goal completion (Cassady, 2010; Coy et al., 2011; Hembree, 1988). In particular, grade point average levels are reduced and attrition is effected (Brown & Tallon, 2015; Hembree, 1988). Researchers have found cognitive interference and attentional control theories to be the current prevailing lenses to view the aspects and effects of test anxiety (Cassady, 2010; Coy et al., 2011; Owens et al., 2014; Salend, 2012).

Interventions used to assist students in reducing test anxiety levels include a variety of treatments. These treatments could include breathing techniques, progressive muscle relaxation, and meditation (Lang, 2013; Nemati & Habibi, 2012; Zargarzadeh &

Shirazi, 2014). Treatments, which include both cognitive and behavioral aspects, have been shown to be most effective (Hembree, 1988).

In Chapter One, the theoretical framework, cognitive interference, and attentional control theory were presented. The statement of the problem and purpose of the study were also discussed. In Chapter Two, a comprehensive review of the relevant literature is explored. First, the history of the test anxiety concept is presented. Then, current theories on the concept and causes of anxiety are reviewed. Following this, test anxiety instrumentation and the large variety of test anxiety interventions are discussed in detail.

Chapter Two: Review of Literature

Anxiety is prevalent in today's world; it is thought of as an abnormal amount of apprehension, nervousness, and even fear (Akca, 2011). It is so prevalent that Akca (2011) posited, "A life without anxiety would rate as utopian in today's world" (p. 101). Anxiety relates specifically to perceived threats, which may be unavoidable, and they need not be even physical in nature (Akca, 2011). The fear component of anxiety specifically relates to behaviors of avoidance and escape (Akca, 2011). During a crisis situation, anxiety can generate feelings of helplessness and uncertainty (Yang, Urao, Chung, & Chang, 2014).

In addition to anxiety being prevalent in the general population, Kim and Seo (2013) found students attending college are especially prone to elevations in anxiety; this was as compared to the years prior to college entry and also compared to their non-college-attending peers. With students, anxiety and fear are nearly indistinguishable, and students who feel both can suffer confusion and interference in their ability to achieve academic success (Basol & Zabun, 2014). Peleg (2009) confirmed these findings when participants in a high anxiety group reported significantly lower academic performance than participants in a low anxiety group. With academic testing on the increase in the lives of students, the pressure to perform can cause anxiety to manifest, and when related to testing, it is referred to as test anxiety (Sarason, 1980). Simply stated, test anxiety is defined as the emotional responses which are temporarily produced during stressful assessment situations (Yang et al., 2014).

Many researchers have documented the negative impacts of test anxiety. von der Embse and Hasson (2012) found students who suffer from test anxiety usually have a low

tolerance for the anxiety and tend to see testing events as personally threatening. When students experience test anxiety and the associated symptoms of nervousness, high stress levels, and apprehension, their ability to achieve academically can be negatively affected during testing (Salend, 2012). Similarly, Basol and Zabun (2014) and Farooqi, Ghani, and Spielberger (2012) found test anxiety was negatively correlated with student success, and Flagg (2012) found test performance scores were inversely influenced by test anxiety scores. Mandler and Sarason (1952) stated any anxiety which is present in a testing situation is an important component to consider when determining test performance. Fear of negative or even positive evaluation can create an anxious situation (Rodebaugh, Weeks, Gordon, Langer, & Heimberg, 2012).

Understandably, academic competence and study skills are determinants of academic performance, but lacking in these can also lead to test anxiety (Talib & Sansgiry, 2012). Negative feelings of apprehension due to low confidence in course material may also trigger additional stress and agitation, which creates the feared inadequate performance (Kurbanoğlu & Akin, 2012). People who exhibit anxious affects tend to exaggerate threats which they think may be quickly changing or looming before them, hence intensifying their own anxiety (Riskind, Rector, & Taylor, 2012). According to Tse and Pu (2012), even students who have good study skills, if they also suffer from high test anxiety, will be unable to handle the stress of an assessment event and find it difficult to recall pertinent information during the test.

In other studies, researchers discovered higher levels of test anxiety were found in students who engaged in high-stakes standardized achievement testing as compared to ordinary classroom testing (Segool, Carlson, Goforth, von der Embse, & Barterian,

2013). Students may fail sections of a standardized test because of test anxiety despite knowledge of the material (Huberty, 2009). This was confirmed by Huberty (2009), who found students experiencing severe test anxiety can have significant negative effects on their ability to perform optimally. Generally, test anxiety can affect the well-being, performance, and learning of students, and tends to increase as academic stakes increase (Roykenes, Smith, & Larsen, 2014). According to Sommer and Arendasy (2014), since less competent test takers experienced high levels of anxiety during assessment situations (referred to as state anxiety), test performance and test anxiety were considered highly correlated. Although possible deficits in study skills or test taking skills could account for poor test performance (Tobias, 1985), the resulting anxiety is likely to decrease performance further. Hancock (2001) also found statistically significant interactions between test anxiety and a student's poor performance coupled with effects on the student's level of motivation.

The consequences of test anxiety have been well documented. Talib and Sansgiry (2012) found a significant negative correlation between test anxiety and academic performance, which resulted in a reduction of students' grade point averages. Similarly, in a study of over 5,000 students, Chapell et al. (2005) calculated a small but significant inverse relationship between test anxiety and grade point average. The bottom line is test anxiety can prevent students from performing to their full academic potential (Onyeizugbo, 2010). Akanbi (2013), noting educational and psychological well-being is negatively affected by test anxiety, took it a step further with research that demonstrated a need for educational institutions to find ways to reduce test anxiety.

Soucy Chartier, Gaudreau, & Fecteau (2011) found positive affect prior to a stressful testing event contributed to successful achievement. Ogundokun (2011) further stated, intelligence aside, if a student is over-anxious about a test, he or she may not be able to meet the desired performance goal unless that anxiety level is reduced. Indeed, Ogundokun (2011) found test anxiety to be the most powerful predictor of student learning outcomes, providing an impetus for change in education and counseling. If a student's anxiety about test taking is reduced, performance should be improved (Ogundokun, 2011).

In the next section, theoretical frameworks demonstrating the historical progress of test anxiety research are discussed. First to be covered is a discussion distinguishing two types of anxiety and descriptions of the factors of test anxiety. Next is a discussion of several theories on test anxiety stemming from research dating back to the 19th century and continuing into the present. The research addresses its causes, its consequences, and its impact on specific academic subjects. This is followed by a discussion of the instrumentation used to measure test anxiety. Finally, interventions and treatments are addressed. A summary concludes this chapter.

Theoretical Framework

Several theories on anxiety, and subsequently test anxiety, provided the foundation for the current study. According to Salend (2012), test anxiety is a multi-dimensional phenomenon composed of both psychological and physiological aspects. Anxiety is often manifested in the following ways: cognitively or emotionally, an example of which is worry; behaviorally, an example of which is increased activity; and physiologically, an example of which is rapid heart rate (Huberty, 2009). These can

manifest only in response to a specific situation or can be more generalized in nature. This distinction is addressed before the aspects of anxiety are discussed.

State and trait anxiety distinction. Researchers distinguish between two types of anxiety—state anxiety and trait anxiety. State anxiety is experienced in certain situations which are transitory and temporary (Sarason, 1980). Students "experiencing high levels of stress across a wide range of situations" are categorized as experiencing trait anxiety (Salend, 2012, p. 20). A person experiencing state anxiety will return to his or her normal non-anxious state when removed from the anxiety-producing situation (Sarason, 1980). Students "experiencing high levels of nervousness specific to testing" are said to be experiencing state anxiety (Salend, 2012, p. 2). More specifically, the worry-emotionality aspect of test anxiety has been found to be a type of "state anxiety" rather than a "trait anxiety" (Sarason, 1980).

State anxiety is considered to be situation specific, whereas trait anxiety is more pervasive in a person's everyday life (Salend, 2011). People with higher trait anxiety symptoms perceive their surrounding environment to be more threatening than persons who experience low trait anxiety (White, Skokin, Carlos, & Weaver, 2016). Students who have trait anxiety can experience anxiety continuously and exhibit behaviors which include depression, declines in academic performance, and the inability to concentrate (Karatas, Arslan, & M. Karatas, 2014). Najmi, Kuckertz, and Amir's (2012) findings were consistent with the tenets of cognitive inflexibility in anxiety, specifically trait anxiety. Huberty (2009) stated, "while taking tests, state anxiety may occur, although the student may also have tendencies toward trait anxiety. Therefore, if a student shows high state anxiety, it is possible that he or she has high trait anxiety" (p. 13).

Factors of test anxiety. Test anxiety is a complex construct with many characteristics, multiple interrelated variables, and varied effects on student performance (Owens et al., 2014; Salend, 2012). Over the years, test anxiety has undergone several changes in its definition; however, most researchers agree it encompasses at least one or more of the aspects, or factors, presented here. These include rumination, worry, and emotionality (Brooks et al., 2015).

Rumination. Rumination can be described as repetitive passive thoughts of past, current, and future anticipated consequences of poor performance (Reynolds, Searight, & Ratwik, 2014). Xiaobo Yu, Chen, Liu, Xiaodong Yu, & Zhao (2015) found people with low optimism showed intensified rumination, which in turn raised their levels of anxiety. Grant and Beck (2010) reported high levels of trait test anxiety and anticipatory processing tended to cause individuals to experience prolonged amounts of rumination. Reynolds et al. (2014) stated rumination is likely to be clinically significant in anxiety, and Yu et al. (2015) found a positive correlation between anxiety and rumination. Thus, individuals with high rumination levels were found to be more likely to have high anxiety symptoms (Yu et al., 2015). In addition, Rukmini, Sudhir, and Math (2014) found rumination to be linked to perfectionism. People with lower optimism tend to approach events in a negative manner, leading to rumination; therefore, higher dispositional optimism could mediate the effect of rumination on anxiety levels (Yu et al., 2015).

Worry. Worry is the cognitive aspect of anxiety (Sapp, 2013). It deals with negative thoughts and thinking about the consequences of failure (Sapp, 2013; Zeidner, 1998). The worry factor of test anxiety can be thought of as the cognitive concern about possible failure, disappointment, or embarrassment, which tend to cause difficulties in

concentration (Brown et al., 2011). Worry, as a factor of anxiety, is primarily composed of negative, verbal thoughts (Judah et al., 2013). One avoidance model suggested people with anxiety disorders might be extra sensitive to dramatic changes in negative emotions, which usually accompany negative events, so they use worry to avoid these changes (Llera & Newman, 2014).

Excessive and uncontrollable worry was found to be strongly associated with overall high levels of stress (Szabo, 2011). Evidence of this was seen when students who scored high on the worry subscale of Spielberger's *Test Anxiety Inventory* were found to more likely have negative thoughts while in a testing situation (Minor & Gold, 1985). Worry is a more demanding cognitive activity than is autonomic arousal during a testing performance (Wine, 1971), which further implies worry is more demanding of a student's attentional resources than physical symptoms (Wine, 1971). This is consistent with Keogh, Bond, French, Richards, and Davis (2004), who found test anxiety and worry were also linked to being highly susceptible to distraction. In addition, some researchers proposed worry is related to inefficient filtering of threatening distractors from working memory (Stout, Shackman, Johnson, & Larson, 2014). As such, worry can cause difficulties in preventing threat-related information from taking too much of the working memory's capacity (Stout et al., 2014).

Correlations have been found between anxiety and both catastrophizing and worry (Riskind et al., 2012). Generally, worry was inversely related to one's competency belief (Putwain & Symes, 2012). The self-focused attention that results from worry can also disrupt normal cognitive functions such as memory and information processing (Kriegshauser, 2014). Consistent with this, Sarason (1980) found "in the college sample,

worry, but not emotionality, formed an inverse relationship with test performance, and the worry-performance relationship was greater than the emotion-performance relationship" (p. 115). Negative beliefs about rumination and worry are integral to the maintenance and development of depression and anxiety (Hartley, Haddock, Vasconcelos e Sa, Emsley, & Barrowclough, 2014). When worry, intrusive thoughts, and rumination are present, they can manifest into unreasonable levels of anxiety and unhealthy physical symptoms (Fergus, 2013).

Emotionality. In anxiety research, emotionality refers to the feelings of nervousness and tension that manifest in symptoms such as sweating, nausea, and rapid heartbeat (Zeidner, 1998). The emotionality factor of test anxiety can be distinguished from worry by the appearance of physical symptoms such as those (Brown et al., 2011). Simply stated, emotionality deals with the physical and behavioral aspects of anxiety (Sapp, 2013; Zeidner, 1998).

Emotionality was found to be significantly related to reported arousal measures, while worry was associated with measures of internal dialogue or rumination (Minor & Gold, 1985). In addition, Walen and Williams (2002) found students' negative emotional responses were often focused on the timed nature of the exams. Participants experiencing negative emotions—that is, those in a negative mood—performed worse and had poorer reasoning skills than participants in a positive mood (Jung, Wranke, Hamburger, & Knauff, 2014). Students use many strategies such as suppression, appraisal, and rumination to cope with emotions during academic tasks (Ben-Eliyahu & Linnenbrink-Garcia, 2013); however, reappraisal or reframing of a stressful situation tends to only work when a student's emotions are at lower levels (Ramos-Cejudo & Schmitz, 2013).

In contrast, people tended to prefer distraction-coping mechanisms when emotions were running high (Ramos-Cejudo & Schmitz, 2013). The most powerful of the emotion-regulation strategies proved to be the ability to tolerate and accept negative emotion and the willingness to confront anxiety-producing situations (Wirtz, Hofmann, Riper, & Berking, 2014). Thus, it is possible lower anxiety can be achieved using emotion-regulation strategies (Wirtz et al., 2014).

Early views of anxiety. Test anxiety could be one variable causing interference with the realistic measurement of student achievement (von der Embse & Hasson, 2012); thus, it is essential to understand the underlying causes and find ways to mediate it. Theories on the causes and treatments of test anxiety have been discussed and studied for decades. Some of the earliest inquiries into the phenomenon of anxiety were made by a philosopher, Søren Kierkegaard; a naturalist, Charles Darwin; as well as a noted psychologist, Sigmund Freud (May, 2015; Spielberger & Vagg, 1995). These early theorists considered anxiety to be a physical phenomenon affecting psychological well-being due to societal changes (May, 2015). The next discussion centers on the differing views and overriding themes in the theories of anxiety.

Kierkegaard's view. In the early nineteenth century, a cultural shift occurred in which emotions and rational thought were being compartmentalized (May, 2015). Kierkegaard referred to anxiety as a learning experience (May, 2015). In support of this view, May (2015) stated, "Anxiety is an even better teacher than reality, for one can temporarily evade reality by avoiding the distasteful situation; but anxiety is a source of education always present because one carries it within" (p. 43).

Darwin's view. Darwin's view of anxiety "focused on the biological, universal characteristic in both animals and humans" (Spielberger & Vagg, 1995, p. 4). What is now referred to as the activation of the fight or flight response, Darwin considered the physical manifestations of fear, or anxiety, as an adaptive response to dangerous stimuli (Spielberger & Vagg, 1995). Even though Darwin's theories were brought forth in the late 1800s, researchers still find fear responses cause avoidance and interfering thoughts during stressful situations, including performance or testing (Coy et al., 2011; Fox, Yates, & Ashwin, 2012).

Freud's view. The psychological discord between the response to a true threat and a perceived threat inspired Freud to delve into the unconscious realm and find techniques to assist people find a more harmonious way of thinking and being (May, 2015). While Darwin's studies focused on the biological aspects of fear, or anxiety, Freud separated anxiety into rational fears and neurotic fears (Spielberger & Vagg, 1995). According to Freud, neurotic fears manifest an emotional response, which is out of proportion to the actual danger (Spielberger & Vagg, 1995). In Freudian theory, anxiety was explained as an everyday phenomenon used to describe various neuroses (Strongman, 1995). Fear was considered an everyday anxiety or realistic anxiety, but panic attacks or free-floating anxiety were thought of as neurotic (Strongman, 1995). Freud's early look into the emotional anxiety response to danger, or stress, was quickly followed by several cognitive and behavioral researchers through the early to mid-twentieth century (May, 2015).

Cognitive and emotional theories of anxiety. Researchers have provided much data demonstrating the causes and consequences of anxiety. Unfortunately, there is great

overlap, and there are inconsistencies in how some of the concepts are used. What is clear, though, is that anxiety impacts students cognitively, emotionally, physically, and behaviorally. Discussions of some of the more dominant theories follow.

Attentional control theories. The emotionality and worry components, along with neurological research into working memory capacity, have led to test anxiety being viewed through the lens of attentional control theories (Owens et al., 2014). In attentional control theories, anxiety is assumed to impair efficient function of the attentional system and to increase processing influenced by the attentional system (Eysenck et al., 2007). Unfortunately, increased attention can impair successful performance by disrupting the automatic use of well-learned skills (Schroerlucke, 2015).

In the self-focus version of this approach, it was suggested successful performance is impaired by an increased attention to the task at hand rather than a distraction away from the task (Schroerlucke, 2015). In one study investigating the visual modality, the ability to pay attention to relevant visual information in a proficient manner was compromised by anxiety through a narrowing of the focus of visual attention (Najmi et al., 2012). Najmi et al. (2012) concluded persons reporting high levels of anxiety were impaired in their ability to widen their range of attention.

Also, in attentional control theories, is the thought anxiety can interfere with the efficient function of the attentional system by increasing a person's attention specifically to threat-related stimuli (Passolunghi, Caviola, DeAgostini, Perin, & Mammarella, 2016). Thus, an integral component of anxiety is thought to be cognitive bias toward threatening information (White et al., 2016). As such, Owens et al. (2014) suggested anxiety takes a bigger share of the attentional abilities of the brain. Test-anxious students may have a

tendency to use an unusually large amount of their cognitive resources because of their attentional bias toward threatening stimuli (Lawson, 2006). Individuals with anxiety disorders may have less flexibility in their ability to change their attention away from unpleasant or perceived threatening stimuli (MacNamara & Proudfit, 2014). Confirming these findings, Eysenck et al. (2007) stated, "adverse effects of anxiety on processing efficiency depend on two central executive functions involving attentional control: inhibition and shifting" (p. 336). Highly anxious persons will divide their attention between self-relevant and test-relevant items during a testing event (Wine, 1971). When facing an anxiety-provoking stressor, students with high test anxiety may have an increased susceptibility to distracting thoughts (Lawson, 2006). Susceptibility to distraction from threat among students with high levels of test-anxiety was evident and suggested an inability to ignore seemingly threatening, task-irrelevant stimuli (Keogh & French, 2001).

Hankin, Stone, and Wright (2010) found worrisome thoughts, or co-rumination, tended to increase the generation of stressors and levels of anxiety. The work of Nicholson, Hopkins-Doyle, Barnes-Holmes, and Roche (2014) showed worry about a threat to a student's current goal, such as poor performance on a test, can cause elevated levels of anxiety. Worry and co-rumination are considered distractors with the attentional control theory, suggesting the importance of a task can cause more attention to be paid, hence, more memory resources consumed, to the distracting thoughts and causes a decrease in goal-oriented desire (Dorey, Piérard, Chauveau, David, & Béracochéa, 2012; Nicholson et al., 2014).

Within other attention research was the concept of biased orienting (Shechner et al., 2012). Biased orienting was a term given to this phenomenon of a student's tendency to orient his or her attention away from a threatening stimulus (Shechner et al., 2012). Similarly, Tobon, Ouimet, and Dozois (2011) confirmed students with anxiety tend to have an attentional bias toward threatening stimuli. Attentional biases occur more often when students are experiencing stressful situations such as examinations; thus, the need to learn to orient their attention toward the task is imperative (Ramos-Cejudo & Schmitz, 2013). Aligned with this, Baddeley (2013) stated evidence exists which indicates an anxious student will have to pay more attention to threat-related stimuli, and Fernández-Castillo (2013) found a logical relationship with threat responses and test anxiety. In his research, Fernández-Castillo (2013) discovered the perception of a test as a threating situation may be linked to fear of failure and the student's motivation. Fernández-Castillo (2013) said, "it is common for anxiety-related reactions to be associated with aggressiveness in situations perceived as threatening, which could be especially applicable to the case of examinations" (p. 73).

Chew, Swinbourne, and Dillon (2014) found a "consistent negative correlation between statistics anxiety and statistics achievement" (p. 1452). However, more generally applicable, Chew et al. (2014) also found a student's attentional bias toward threat stimulus was positively related to the level of a student's anxiety. That is, "individuals high in anxiety will favor the processing of emotionally threatening, anxiety-related stimuli" over cognitive processing required by the task at hand. (Chew et al., 2014, p. 1452).

Hirsh et al. (2011) suggested causal contributions to worry may come from attentional engagement with threat stimuli. In addition, Hu, Bauer, Padmala, and Pessoa (2012) found threat-related thoughts caused a slowing of cognitive performance. Individuals suffering anxiety can often feel as if threatening events are happening very quickly because of a distorted sense of time (Riskind et al., 2012). Thus, threat-related attentional bias is implicated in the causes and continuation of anxiety (Bar-Haim, Morag, & Glickman, 2011). The constant distraction and resulting re-focusing—components of anxiety and worry—are drains on cognitive resources (Moser, Moran, Schroder, Donnellan, & Yeung, 2013). Students reporting high levels of anxiety also reported the lowest levels of tension-reduction or task-focusing strategies (Davis, DiStefano, & Schutz, 2008).

Working memory capacity. Working memory involves the cognitive task of controlling attentional processes (Baddeley, 2013). It provides a temporary storage of information needed in order to process tasks happening right now (Henry, 2011). Within the working memory construct is an understanding that one can consciously direct one's attention (Henry, 2011). Thus, when attentional skills are impacted by test anxiety, it will in turn debilitate a student's performance by reducing the working memory capacity (Tobias, 1990; Mattarella-Micke, Mateo, Kozak, Foster, & Beilock, 2011). Other researchers have come to similar conclusions. Klemm (2007) stated test anxiety can interfere with memory and can even stop memory formation, and Owens et al. (2014) said, "anxiety disrupts working memory processes leading to lowered cognitive performance" (p. 2).

Impairment in cognitive ability is especially apparent when a person deals with task-irrelevant emotional information (Krug & Carter, 2012). One explanation for the inability to recall previously learned information is memory retrieval depends upon certain cues which are associated with the information when learned (Klemm, 2007). Since working memory can be conceptualized as a system consisting of multiple parts allowing for temporary information storage and processing, any irrelevant information or stimuli can reduce this capacity and hinder performance on a task (Alloway, 2011). Alloway (2011) even noted anecdotal evidence discovered in his research that teachers tend to misinterpret signs of a student's poor working memory capacity as daydreaming or a lack of motivation.

Paying attention to intrusive thoughts creates the need for more working memory processing, thereby pulling attention from the main task (Ashcraft, 2002). This lowered working memory capacity during a testing event is clearly caused by the interference from test anxiety (Shobe, Brewin, & Carmack, 2005). Beilock and O'Callaghan (2011) found "in stressful situations, the ability of working memory to direct attention to what is relevant is compromised" (p. 28).

If a student is experiencing test anxiety, some of the working memory capacity is reduced (Shaughnessy & Moore, 2014). Any test anxiety may cause a high demand of working memory resources, which may leave enough resources for easy problem solving, but not enough for more difficult problems (Shobe et al., 2005). Students who begin a task with a high working memory capacity and high levels of worry will soon lower their working memory capacity and cognitive ability (Trezise & Reeve, 2014). Individuals with less working memory capacity are thought to also have limited problem solving

capacity, which all imply anxiety-induced use of working memory resources may be reduced below the level required for successful problem solving (Ramirez, Gunderson, Levine, & Beilock, 2013). Spachtholz, Kuhbandner, and Pekrun (2014) similarly stated since working memory capacity is high during tasks requiring higher precision, if there is too much distraction in the environment, the sensory overload can fill up working memory causing a decrease in performance. Tasks which require a great deal of precision will be strongly affected at the attentional level by stressors (Nieuwenhuys & Oudejans, 2012).

The inhibitory processes in working memory are usually able to modulate the effect of captured attention by fear and anxiety (Baddeley, 2013); however, high-pressure academic testing situations can trigger distracting worries and thoughts, which negatively affect working memory processing (Grant & Beck, 2010). Stress-related demand can consume attentional resources (Sato, Takenaka, & Kawahara, 2012). Overall, negative affect has detrimental effects on working memory performance (Spachtholz et al., 2014). According to Trezise and Reeve (2014), individuals who have larger working memory capacities are better able to regulate their emotional states during stressful testing events. The more working memory resources an individual has, the better performance and the ability to regulate emotions becomes (Ramirez et al., 2013).

Cognitive interference. In 1988, Hembree conducted a meta-analysis of 562 previous test anxiety studies. Hembree's (1988) goal was to observe the 35th anniversary of the anxiety construct, which he attributed to the work of Mandler and Sarason in 1952, by integrating the findings of previous test anxiety studies. Sarason (1984) had given a cognitive view of anxiety, calling it a self-assessment of personal inability to meet the

demands of a particular situation. In support of this assertion, Hembree (1988) found test anxiety "relates inversely to students' self-esteem and directly to their fears of negative evaluation" (p. 47). If anxious, students experience more encoding difficulty when learning, more cognitive interference when tested, and more state-anxiety reactions to the testing situation (Hembree, 1988).

Theories of cognitive interference have been studied to determine relevance to test anxiety, in particular (Tobias, 1985). Older theories of forgetting tended to revolve around the idea of interference, where it was thought memory could be interfered with by either previously learned information, known as proactive interference, or by newly learned information, known as retroactive interference (McLeod, 2008). The premise behind cognitive interference shows unrelated interfering thoughts impede a student's ability to recall previously learned information (Tobias, 1985).

During an easy-item testing situation, Covington and Omelich (1987) found evidence for the interference phenomenon. Covington and Omelich (1987) stated an interference interpretation of anxiety would imply anxiety temporarily disrupts cognition and can temporarily block previously learned information. Wolters et al. (2012) found extreme attention to possible threats may be related to anxiety disorders, but selective attention to threats is a normal, adaptive mechanism. Wolters et al. (2012) found attentional bias for threat often precedes behavioral interference. Within the interference model, it is assumed learning occurs, but the evaluative threat posed by the testing situation interferes with the ability to retrieve what was learned (Tobias, 1985). Furthermore, poor academic performance can occur whether the trigger producing the

anxiety is physically present or just a perceived threat, such as a testing event (Eysenck et al., 2007).

It is also assumed test anxiety increases negative off-task thoughts, which then result in poorer cognitive performance (Coy et al., 2011; Spielberger & Vagg, 1995). This interference experienced by students can be partially explained by worry and emotionality (Zeidner, 1998). Interference may cause information in long term memory to become combined or confused with other data during the encoding phase, thereby disrupting or distorting memories (McLeod, 2008). That is, cognitive inhibition—the ability to ignore irrelevant stimuli—is impaired when a student is experiencing a high level of anxiety; thus, retrieval-induced forgetting is high (Law, Groome, Thorn, Potts, & Buchanan, 2012). In addition, retroactive interference can occur when recent memory interferes with the retrieval of older memories (Anderson & Neely, 1996).

Test anxiety can interfere with retrieval of prior learning (Tobias, 1985). The effect cognitive interference creates is sometimes reported by students, anecdotally, as freezing up or going blank during exam events (Tobias, 1990). According to interference theory, learning has occurred during subsequent processing, but the threat of the testing event interferes with the ability to retrieve previously learned information (Tobias, 1990). This has also been referred to as retrieval-induced forgetting. Retrieval-induced forgetting refers to the situation where the "retrieval of one memory trace suppresses the retrieval of other rival memory traces" (Law et al., 2012, p. 712). The retrieval failure theory was supported in a study by Naveh-Benjamin, McKeachie, Lin, and Holinger (1981) when results showed high test-anxious students were unable to efficiently retrieve previously learned information. In the retrieval failure theory, information in the long

term memory is accurately encoded; however, it cannot be retrieved or accessed due to missing retrieval cues (McLeod, 2008). In a displacement theory of forgetting, new information displaces old information in the short term memory (McLeod, 2008).

Transactional process model. In 1995, Spielberger developed a transactional process model for test anxiety (Spielberger & Vagg, 1995). Elements of the transactional process model include a complex process of cognitive transactions of both worry and emotionality (Spielberger & Vagg, 1995). The transaction occurs from the perception of the stressor, or test, to the emotion and worry psychological factor, to finally the storage and informational processes occurring in the memory storage areas of the brain (Spielberger & Vagg, 1995). The transactional model developed by Spielberger and Vagg (1995) also included distinctions between state and trait anxieties.

Contributing factors to anxiety. Chronic stress and depression are strongly related to test anxiety (Augner, 2015). Kinderman, Schwannauer, Pontin, and Tai (2013) found abusive or traumatic life experiences had a strong correlation to high levels of anxiety. Childhood emotional maltreatment can be linked to anxiety in adulthood through a neurodevelopmental mechanism (Fonzo et al., 2016). Byllesby, Durham, Forbes, Armour, and Elhai (2016) hypothesized anxiety would have a high degree of correlation with the anxious arousal factor of post-traumatic stress disorder. Thus, students who have experienced disaster events and are showing symptoms of post-traumatic stress disorder are at risk for high levels of test anxiety (Weems et al., 2013). Even students with academic challenges can experience higher levels of anxiety (Custodero, 2013). Anxiety can significantly affect college students with learning disabilities in their feelings of control (Custodero, 2013). Peleg (2009) stated students

with learning disabilities have such intense distress that their academic performance is expected to be impaired.

Another issue of concern for teachers is how an instructor presents directions prior to a high stakes activity in class can determine how well students perform. Anxiety-inducing instructions prior to an exam could cause significantly lower memory recall as well as lower performance (Hindley, 2014). Fear appeals, such as messages to students regarding the importance of an exam or the negative consequences of failure, do not motivate students, but instead, contribute to increases in test anxiety and a reduction in test performance (Putwain & Best, 2012). Hindley (2014) hypothesized anxiety-inducing instructions would cause participants to perform poorly on memory recall tasks. Hindley (2014) concluded the differences in performance on the tasks were explained by state anxiety.

Coupled with the instructor's role was the finding of Yesilyurt (2014), who stated tendencies toward academic dishonesty significantly correlated positively with levels of test anxiety. Academic self-efficacy was also a significant predictor of test anxiety as well as academic dishonesty (Yesilyurt, 2014). The feeling of time constraints can cause an individual to fear the inability to cope with the expected pace, thus lowering his or her self-confidence (Riskind et al., 2012).

Self-induced negative attitudes on the part of students were also found to be an issue. Excuse-making can shift the reasons for negative personal outcomes from something tied to a person's sense of self to an outside cause (Suhr & Wei, 2013). Therefore, excuse-making protects self-esteem and lowers levels of anxiety (Suhr & Wei, 2013). M. Dragan, W. Dragan, Kononowicz, and Wells (2012) found emotional

reactivity and perseverance positively correlated with state anxiety and cognition; however, briskness, the tendency to quickly react, was negatively correlated with state anxiety and cognition (Dragan et al., 2012). Kuhbandner and Pekrun (2013) found experiencing negative affect during a testing event led to occurrences of forgetting. In addition, students who possess perfectionistic personality traits can be impacted with higher levels of test anxiety (Kandemir, 2013). Rukmini et al. (2014) defined perfectionism as "the desire to achieve the highest standards of performance along with the tendency to be unduly self-critical" (p. 240). Levels of academic self-efficacy, state and trait anxiety, and perfectionism all had a stronger relationship with test anxiety than the fear of negative evaluation (Ravin, 2008).

Other theorists confirmed high levels of test anxiety are related to several types of cognitive problems such as irrational beliefs, dysfunctional attitudes, and negative automatic thoughts (Wong, 2008). Cunha and Paiva (2012) stated high test anxiety can cause greater feelings of inadequacy and self-disgust when facing failures. Also, heightened test anxiety can cause less capacity for mindfulness, a method of meditation which puts the focus on the here and now (Cunha & Paiva, 2012).

When looking at goal setting, anxiety symptoms were found to be significantly correlated with internalized reasons for attaining goals and also with external reasons for goal avoidance (Dickson & Moberly, 2013). When taking less appealing coursework, students use a wide range of emotional strategies in order to engage in the learning process, including reframing and suppression tactics to help lower negative emotions (Ben-Eliyahu & Linnenbrink-Garcia, 2013). Salters-Pedneault and Diller (2013) reported greater negative affect, high levels of anxiety, and the tendency toward avoidance

predicted choosing a worse, but delayed, negative stimulus, as compared to an immediate, but less severe, negative stimulus.

Lastly, gender differences were found in several studies. In one study, females tended to report higher levels of test anxiety than did males (Goetz, Bieg, Lüdtke, Pekrun, & Hall, 2013; Nabi & Khan, 2015). More specifically, Nabi and Khan (2015) found female medical students reported lower grades and higher levels of test anxiety, suggesting test anxiety adversely affects a female student's academic performance. Eman, Dogar, Khalid, and Haider (2012) found female students may experience more anxiety when they are resolute in proving their academic worth is equal to their male counterparts. Eman et al. (2012) went on to suggest higher anxiety in female students was in line with both Freud's theories on threats to ego and existentialists' concept of threat to self-esteem.

Goetz et al. (2013) found female participants had higher levels of trait anxiety, but reported no gender differences for state anxiety. Devine, Fawcett, Szucs, and Dowker (2012) found anxiety levels could be increased because of an awareness of poor performance in the past. Building upon tenets of the cognitive deficit theory, Devine et al. (2012) concluded high anxiety levels tended to interfere with learned information, hence leading to poorer levels of performance.

Impacts on motivation and self-efficacy. Test anxiety negatively affects students' motivation as well as their self-efficacy (Bembenutty, 2009; Rajiah & Saravanan, 2014). In a recent study, test anxiety was shown to be positively correlated with amotivation, a term referring to the absence of motivation caused by a student who is experiencing feelings of helplessness and incompetence when faced with a

performance task (Rajiah & Saravanan, 2014). Ünal-Karagüven (2015) also found test anxiety was negatively correlated with perceived academic achievement as well as the lack of motivation. Since poor achievement and low motivation can lead to poor self-efficacy, it is not surprising that Bembenutty (2009), found self-efficacy to be the best negative predictor of test anxiety in students. Onyeizugbo (2010) also found trait anxiety had a positive correlation with test anxiety and an expected negative correlation with self-efficacy. Consequently, higher test anxiety scores were associated with persons with lower self-efficacy (Onyeizugbo, 2010).

Generally, persons who are highly anxious tend to be more self-preoccupied, and these self-focusing tendencies are most active during testing situations (Wine, 1971). Negative self-view was a significant predictor of severe anxiety (Wong, 2008). In Mami and Torabideh's (2014) study on self-efficacy, analysis of data revealed self-efficacy beliefs have a negative relationship with levels of test anxiety.

Self-efficacy can be the turning point for some individuals if only a partial lack of control is occurring (Pekrun, 2006). A student could experience hope if his or her focus is on a successful outcome; however, if a student focuses on failure, anxiety is liable to be induced (Pekrun, 2006). Also, the fear of receiving a poor assessment of a testing event was significantly related to high levels of test anxiety (Kandemir, 2013). Soucy Chartier et al. (2011) posited individuals with high levels of positive affect are more likely to successfully complete their education.

Physiological and behavioral theories of anxiety. Bradley et al. (2010) wanted to study anxiety not only through the use of a cognitive model, but also by considering the whole body. The mind in a panicked anxiety episode is unable to think well (Eisold,

2011). Andrews and Brown (2015) recognized students who do well are at times driven by some anxiety; however, data have shown a higher portion of students are hindered by their levels of test anxiety. Salend (2011) stated, "students with test anxiety experience high levels of stress, nervousness, and apprehension during testing and evaluative situations that significantly interfere with their performance, emotional and behavioral wellbeing, and attitudes toward school" (p. 59).

In one study, McTeague and Lang (2012) found fear circuitry in the body could become dysregulated in subjects experiencing high levels of anxiety; however, some people deny the presence of anxiety despite the physiological signs (Baddeley, 2013). When an individual experiences anxiety symptoms, those could include elevated pulse and respiratory rates (Prato & Yucha, 2013), and Baddeley (2013) stated physiological signs such as heart rate changes co-occur with episodes of anxiety. Many performers report having experienced the sensations of dry mouth, tingling sensations, nausea, and sweaty palms during an episode of performance anxiety (Allen, 2013). Also, blood volume is transferred from the digestive system and skin to the larger muscles, which in turn causes a lowered skin temperature (Prato & Yucha, 2013). Hammel et al. (2011) also reported worry is associated with increased sympathetic activity, responsible for the fight or flight response; decreased parasympathetic influence, responsible for heart rate and gastrointestinal activity; and decreased vagal activity, responsible for unconscious body processes. According to Judah et al. (2013), some of the physical symptoms of anxiety include muscle tension and feeling on edge.

All of these neurological responses occur in order to activate the fight or flight response to the stress (Jellesma, 2013). In normal functioning persons, this series of

events are short lived, and the body soon returns to a calmer state (Jellesma, 2013). If stress is prolonged, the body remains in the fight or flight response for a longer period of time, which puts the person at a greater risk for serious medical conditions such as cardiac events (Jellesma, 2013). Impaired fear extinction, the inability to voluntarily decrease fear responses, has been found in patients with anxiety disorders (Duits, Cath, Heitland, & Baas, 2016), so they would be more at risk.

MacNamara, Ferri, and Hajcak (2011) studied an electrocortical component of cognitive functioning, which indicated a variable amplitude called late positive potential. MacNamara et al. (2011) found state anxiety was associated with reduced modulation of the late positive potential by working memory load. MacNamara et al. (2011) concluded there was a competition for attention between cognition and emotion.

In response to stressful events, the amygdala, a portion of the brain, first recognizes the stressful situation, notifies the hippocampal region, which in turn activates the adrenal cortex to secrete several glucocorticoid hormones, including cortisol (Jellesma, 2013). The hippocampus activates the adrenal medulla, as well, through the use of the adrenaline hormone (Jellesma, 2013). Because the amygdala plays a pivotal role in the efficient encoding of emotionally charged memories, it can become over-used during times of severe stress (Roozendaal, McEwen, & Chattarji, 2009). Young, Wu, and Menon's (2012) found elevations in activity within a specific connection between the amygdala and the prefrontal cortex, which both regulate and process negative emotions.

Within the central portion of the amygdala, there are molecules responsible for binding the body's opioid receptors, which assist in mediating emotions of fear and anxiety (Poulin, Bérubé, Laforest, & Drolet, 2013). Young et al. (2012) found

hyperactivity in regions of the amygdala, which process negative emotions, was associated with math anxiety. Other researchers found targeting the prefrontal cortex portion of the brain may help treat patients with anxiety disorders who have difficulties in emotional processing (Etkin, Prater, Hoeft, Menon, & Schatzberg, 2010).

McHugh, Behar, Gutner, Geem, & Otto (2010) documented an association between cortisol, a hormonal indicator of stress, and attentional bias. Cortisol levels are also considered a factor in impaired working memory function (Mattarella-Micke et al., 2011). Thus, if one wanted to monitor attentional bias or impaired working memory, which arises from anxiety, one method would be to determine serum cortisol levels to assess anxiety levels (Bahrami et al., 2013). The hormone cortisol increases to the highest level upon awakening and then gradually decreases throughout the day (Bahrami et al., 2013). If high levels of cortisol are present throughout the day, a patient is likely suffering a disorder such as anxiety (Bahrami et al., 2013).

McHugh et al. (2010) also found an association between change in attentional bias toward threat and acute change in cortisol hormone levels. It is theorized corticosteroid hormones produced during a stressful event can target the most vulnerable neurons in the hippocampus, which is responsible for consolidating short term memory into long term memory (Klemm, 2007). Thus, effective cortisol reduction is an important part of anxiety treatment (Rosnick et al., 2016).

Jensen (2010) stated there are three chemicals or hormones within the brain which assist in optimal performance during a testing event. These three hormones are dopamine, norepinephrine, and glucose (Jensen, 2010). Dopamine assists in memory functioning, specifically helping working memory (Jensen, 2010). Norepinephrine

promotes alertness, attention, and overall improved memory function (Jensen, 2010). Glucose also assists in memory functioning, but primarily provides short term energy (Jensen, 2010). Each of these hormones can be enhanced by light exercise for dopamine, engaging in an exciting task for norepinephrine, and complex carbohydrate consumption for glucose (Jensen, 2010).

Choi, Padmala, and Pessoa (2012) also reported finding individual differences in state anxiety in the anterior insula, a structure of the brain which is vital to the interaction between emotion and cognition. Mikheenko et al. (2015) found high-anxiety caused reduced amygdala serotonin levels and a reduction in brain volume in the dorsal anterior cingulate cortex of the prefrontal region of the brain. Krug and Carter (2012) found higher levels of trait anxiety were associated with decreased accuracy and lower response time in the brain, specifically reduced activity in the prefrontal cortex.

The act of worrying was most indicative of autonomic dysfunction (Hammel et al., 2011). Emotional stimuli tend to hold attention to a larger extent than non-emotional stimuli (Piech et al., 2011). L. Visu-Petra, Miclea, and G. Visu-Petra (2013) found significant relationships between negative priming and the ability to shift attention. Negative priming is a term referring to the influence of previous negative memories on new exposures to the same memory forming stimulus (L. Visu-Petra, Miclea, & G. Visu-Petra, 2013). Brown et al. (2011) stated behavioral disturbances such as fidgeting, looking for easier tasks, and test avoidance are all components of test anxiety.

Subject specific anxieties. Mathematics anxiety can manifest as a negative emotional response to mathematics or the prospect of doing mathematical problem solving (Beilock, Gunderson, Ramirez, Levine, & Smith, 2010). Math anxiety seems to

primarily originate from feelings of inadequacy and fear of failure (Perry, 2004). Young et al. (2012), who used functional MRIs in a study, was able to emphasize similarities with other anxiety disorders and validate math anxiety as a bona fide type of situation-specific anxiety (Young et al., 2012). Math anxiety can be caused by skill-related fears; however, more often, it is the experience of the anxiety itself which is feared and math students would prefer to avoid those anxious feelings if possible (Andrews & Brown, 2015).

Suárez-Pellicioni, Núñez-Peña, and Colomé (2014) found math anxiety affects cognitive control in the higher-order functions making distractions, both external and internal, more intrusive for students with high math anxiety. According to Pletzer, Wood, Scherndl, Kerschbaum, and Nuerk (2016), "mathematics anxiety involves feelings of tension, discomfort, high arousal, and physiological reactivity interfering with number manipulation and mathematical problem solving" (p. 1). Negative reactions to foundational mathematical concepts in younger children may be when mathematics anxiety first emerges (Harari, Vukovic, & Bailey, 2013).

In Liew, Lench, Kao, Yeh, and Kwok's (2014) study, avoidance temperament was linked to low standardized math test scores and evaluative threat. Andrews and Brown (2015) reported showing a small negative relationship between standardized test scores and math anxiety. The higher the level of math anxiety, the lower the level subjects reported their ability in mathematics (Geist, 2015). Watts (2011) predicted lower levels of performance would occur in students with high levels of math anxiety and mathematics self-efficacy. By compromising activity in the working memory, math anxiety can disrupt efficient cognitive processing (Ashcraft, 2002). Students with high

math anxiety had lower short-term memory capacity and difficulty in blocking irrelevant information (Passolunghi et al., 2016). Individuals with limited working memory resources may have a diminished ability to successfully perform mathematical computations (Passolunghi et al., 2016).

Low confidence in one's mathematics ability can contribute to a student's math test anxiety and lead to poor mathematics test performance (Roykenes et al., 2014). Mathematics anxiety and a negative attitude towards mathematics were reported in students who tended to avoid mathematics courses (Adeyemi, 2015). Past experiences in mathematics often influence students' current attitude in mathematics (Vaughn, 2012). Lyons and Beilock (2012a) suggested interventions which emphasize control of negative emotions surrounding math stimuli would be the most effective method of developing mathematically competent students.

Chemistry anxiety can also be linked closely to a student's attitude surrounding chemistry calculations (Kurbanoğlu & Akin, 2012). Fletcher and Ershler (2014) found non-major chemistry students typically experienced a higher degree of anxiety. Chemistry anxiety can cause negative consequences such as avoiding chemistry classes and feelings of inadequacy even though sufficient skills are present (Kurbanoğlu & Akin, 2012).

Even the idea of test anxiety being similar to performance anxiety has been researched (Avery & Smillie, 2013). Performance-approach refers to an underlying motivation for students to perform better than his or her peers or improve a previous result (Avery & Smillie, 2013). Basically, the student's performance-approach to testing can heighten test anxiety symptoms, which, in turn, Avery and Smillie (2013) found to

have a "negative impact of anxiety on working memory performance as well as [these] performance-approach goals may elicit negative cognitions [such as] anxiety and worry" (p. 40). Thus Avery and Smillie (2013) concluded, this can impair effective use of the student's cognitive resources. Specifically, Nieuwenhuys and Oudejans (2012) studied perceptual-motor performance, that is, "describing information in terms of the behavioral possibilities of an environment" (p. 748). Nieuwenhuys and Oudejans (2012) explained if allowed enough time, a student may try to lower his or her feelings of anxiety, but if there is only a small amount of time, in terms of behavioral possibilities, students will turn to instinctual behaviors–both effective and ineffective.

Measuring Test Anxiety: Instrumentation

Anxiety is a psychological and physiological construct, thus making it a difficult concept to quantify (Cassady, 2010). Attempts to measure levels of anxiety have been made since the early 1950s (Anderson & Sauser, 1995; Sarason et al., 1958). Instruments were developed to measure general anxiety first but were quickly followed by test anxiety specific measures (Anderson & Sauser, 1995). Unidimensional measures were used in the early days of test anxiety measurement (Cassady & Finch, 2014).

The most common method of test anxiety measurement has been through self-report inventories (Anderson & Sauser, 1995). The first popular inventory, Test Anxiety Questionnaire, was developed by Mandler and Sarason in 1952 (Spielberger & Vagg, 1995); however, the Test Anxiety Questionnaire was inefficient, so in 1958, Sarason developed an easier-to-administer instrument called the Test Anxiety Scale (Spielberger & Vagg, 1995). The Test Anxiety Scale was used almost exclusively for 20 years until 1978 when Sarason added items in order to "increase the sensitivity and reliability of [the

Test Anxiety Scale]" (Spielberger & Vagg, 1995, p. 9). This instrument was developed to determine the extent emotionality and worry components affected test anxiety (Cassady, 2010). During the latter part of the 1960s, bi-dimensional models were also being explored as the understanding of test anxiety developed (Cassady & Finch, 2014). Spielberger and Vagg (1995) developed a widely accepted measure for test anxiety using their theories on state anxiety versus trait anxiety. The State-Trait Anxiety Inventory, is a 20-item, Likert-scaled measure designed to quantify the specific factors of state and trait anxiety (Anderson & Sauser, 1995). The State-Trait Anxiety Inventory has internal consistency coefficients between .86 and .95, reliability coefficients near .86, and was validated against other reliable anxiety measures using over 10,000 adults in the testing (Julian, 2011). Another assessment used is the Achievement Anxiety Test, which has separate scales for measuring both facilitating and debilitating effects of anxiety on test performance (Alpert & Haber, 1960). In 1980, Spielberger created the Test Anxiety Inventory in order to measure the individual differences in two other aspects of test anxiety: emotionality and worry (Spielberger & Vagg, 1995). The Test Anxiety Inventory has since then become the instrument of choice for test anxiety researchers (Anderson & Sauser, 1995).

Although both the Test Anxiety Inventory and the State-Trait Anxiety Inventory are still widely used in current research (Szafranski et al., 2012), Szafranski et al. (2012) found the Test Anxiety Inventory may no longer accurately measure test anxiety because of the difference in student populations. The original Test Anxiety Inventory was normed over 30 years prior, and Szafranski et al. (2012) concluded, current "studies

which base conclusions on out-of-date norms are at risk of reporting inaccurate findings" (p. 674).

More recently, Harpell and Andrews (2012) suggested test anxiety could best be measured using a multi-informant framework rather than the typical self-reported assessment alone. Harpell and Andrews (2012) showed a particular test anxiety factor, worry, would be best assessed using the multi-informant method. This method includes assessments and observations from teachers as well as parents and could be used at an early age (Harpell & Andrews, 2012). The continued development of new multi-dimensional, or multiple factor, measures for test anxiety has helped deepen the understanding of test anxiety (Cassady & Finch, 2014) and lead to the development of other instruments.

One example of such an instrument was developed by Cassady and Johnson (2002), called the Cognitive Test Anxiety Scale. It addresses several test anxiety factors, including worry, distractibility, and working memory functioning (Cassady & Johnson, 2002). In Singapore, a four-factor test anxiety scale is used to identify highly anxious students (Lowe, Ang, & Loke, 2011). The four-factors include the usual worry component, but also include social concerns, physiological arousal, and task irrelevant behavior (Lowe et al., 2011). In the United States, these factors could be compared to factors such as trait anxiety symptoms, state anxiety symptoms, and distractibility (Brooks et al., 2015).

Multi-dimensional measurements have been developed for overall test anxiety as well as for specific types of test anxiety such as mathematics, physics, chemistry, and nursing (Bai, Wang, Pan, & Frey, 2009; Berber, 2013; Cassady & Finch, 2014; Yang et

al., 2014). One example of a widely used mathematics test anxiety measure is the Mathematics Anxiety Scale-Revised, which is a bi-dimensional instrument measuring the factors of mathematics test anxiety and mathematics performance anxiety (Bai et al., 2009). The Mathematics Anxiety Scale-Revised has an internal consistency of .96 and reliability score of .90. More recently, the Abbreviated Math Anxiety Scale has become the standard instrument for the measurement of mathematics anxiety (Cipora, Szczygieł, Willmes, & Nuerk, 2015). The Abbreviated Math Anxiety Scale has a reliability score between .89 and .92, depending on the testing group (Cipora et al., 2015). In the nursing field, the Nursing Skills Test Anxiety Scale was created in order to measure three major sources of test anxiety: incorrect perception of exam content, lack of confidence, and insufficient preparation for the exam (Yang et al., 2014).

In 2015, Brooks et al. developed the Test and Examination Anxiety Measure. The purpose in developing this new instrument was to "address the shortcomings of previous scales and develop an assessment which more comprehensively measured the construct of [test anxiety]" (Brooks et al., 2015, p. 3). Prior assessments, such as the Test Anxiety Inventory and State-Trait Anxiety Inventory, do not account for the complexity of the test anxiety construct in that no one scale measures all of the components (Brooks et al., 2015), so the Test and Examination Anxiety Measure was developed to measure not only an overall level of test anxiety, but also five subscales related to factors of test anxiety: state anxiety, trait anxiety, distractibility, worry, and rumination (Brooks et al., 2015).

The Test and Examination Anxiety Measure was statistically compared to both the State-Trait Anxiety Inventory and the Test Anxiety Inventory and was found to be significantly correlated with both, thus making it useful for clinical applications (Brooks

et al., 2015). The Test and Examination Anxiety Measure has not only concurrent validity with other measures, but also a reliability coefficient of .90 (Brooks et al., 2015). A 26-item instrument, the Test and Examination Anxiety Measure is scored using a 5-point Likert scale (Brooks et al., 2015). During the calculation of the overall Test and Examination Anxiety Measure score, some items are reverse-scored (Brooks et al., 2015). Reverse-scoring of survey items has been shown to be beneficial in accommodating the reading ability of participants (Cassady & Finch, 2014).

Test Anxiety Interventions and Treatments

In light of all the documented problems with anxiety and the obvious negative impact it plays when students are taking tests, educators have tried for years to find a way to reduce its influence (Hembree, 1988; Salend, 2012). While most researchers addressed the issue linearly by suggesting the need to move from high anxiety to low anxiety, one theorist proposed neither high anxiety nor low anxiety was the goal (Csikszentmihalyi, 1997). Acknowledging that some anxiety can be helpful, the theorist proposed the secret to success is to strike a healthy balance between the two (Csikszentmihalyi, 1997). That model is discussed first. Subsequent sections present the many and varied intervention techniques and ends with final conclusions on the topic.

Goal of interventions: Flow model. In presenting his theory on balancing anxiety, Csikszentmihalyi (1997) defined the construct of flow as a state which occurs when skill level and challenge level are equally balanced, and performance anxiety occurs when the challenge level outweighs the skill level of the performer. In his well-known work on flow, Csikszentmihalyi (1997) illustrated the relationship between skill

and challenge levels (see Figure 1).

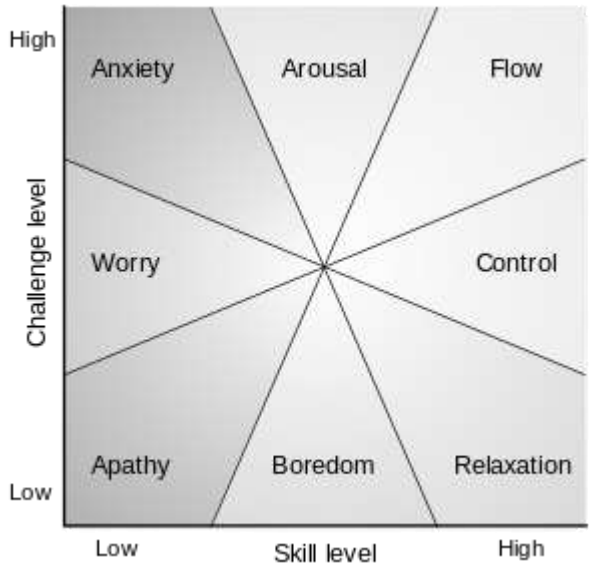


Figure 1. Flow Model. From Csikszentmihalyi (1997).

Dietrich, Stoll, and Bruya (2010), in their work on the physiology and cognitive anatomy of Csikszentmihalyi's (1997) flow, found a temporary break in some higher cognitive tasks, which tended to interfere in the automatic and more implicit cognitive processes indicative of flow. DeCaro, Thomas, Albert, and Beilock (2011) researched performance pressure, otherwise known as choking under pressure, and described this phenomenon as doing more poorly on a task than expected given a student's skill level.

In relation to attentional control theory, Fullagar, Knight, and Sovern (2013) stated the likelihood of anxiety is higher when a student is distracted from the task at hand, and this tended to occur when the challenge level and skill level were not equally matched. DeCaro et al. (2011) also explained the concept of choking under pressure as being related to distraction theories since attention needed to perform the task is taken over by worries and task-irrelevant thoughts.

Eisold (2011) stated a certain level of anxiety is useful; however, reducing anxiety to the point of nonexistence would be detrimental. Some types of anxiety can be helpful in providing mental alertness and increasing acuity (Eisold, 2011). When in a flow-like state and one's abilities are well matched to the challenge, anxiety is at an optimal level (Csikszentmihalyi, 1997). Csikszentmihalyi (1997) related optimal anxiety level to two players equally matched in a game where they are experiencing the fine line between anxiety and boredom. When challenges become greater than the skill level and abilities, frustration and anxiety appears (Csikszentmihalyi, 1997). Karatas et al. (2014) found experiencing some anxiety from time to time to be harmless, but excessive amounts of uncontrolled or continuous anxiety makes one weak and can cause a decline in academic performance and social isolation.

Procrastination is also an important factor in the challenge-skills balance of flow. Kim and Seo (2013) purported when students tend toward procrastination in their studies, they inadvertently cause an increase in the challenge level, which may be higher than their abilities are able to match (Kim & Seo, 2013). Dunn's (2014) study of statistics anxiety showed as anxiety increased so did tendencies toward procrastination.

Fullagar et al. (2013) went on to state there is evidence which implies a state of flow activates physiological systems, which can counteract the pathological effects associated with high stress and anxiety. Fullagar et al. (2013) stated:

> We would argue that flow and anxiety are not antipodal states (in that they are not the opposite ends of the same continuum), but that they are antithetical (in that they are negatively related) … Our findings indicate that flow and performance

> anxiety can exist simultaneously, but that the presence of one minimizes the magnitude of the other. (p. 251)

Thus, providing students with testing situations which generate a flow state may provide a practical way to reduce anxiety (Fullagar et al., 2013).

DeCaro et al. (2011) also theorized choking under pressure can occur when a student is hypervigilant to the details of a task in a manner which disrupts the execution of the task. This hypervigilance is related to perfectionistic tendencies (Eum & Rice, 2011). Eum and Rice (2011) found test anxiety to be inversely related to performance and positively associated with perfectionism. Eum and Rice (2011) also found the amount of importance a student associates with a task may be related to anxiety and maladaptive perfectionism.

Ogundokun (2011) reminded educators a certain amount of anxiety is necessary to complete an exam. Ogundokun's (2011) reminder follows Csikszentmihalyi's (1997) flow theory where a state of apathy can exist if skill level compared to challenge level is excessively high. While a complete state of flow is not necessary, a certain amount of anxiety can lead to beneficial effects such as excitement or enthusiasm (Ogundokun, 2011). Ogundokun (2011) went on to note educators should look for solutions geared toward alleviating distracting thoughts and worries and assist students in acclimating to beneficial levels of anxiety (Eum & Rice, 2011).

Intervention techniques. Researchers have developed and tested a multitude of treatments and intervention strategies designed to help students reduce their level of test anxiety (Cassady, 2010; Hembree, 1988; Huberty, 2009; Salend, 2011). Over the years, these strategies have included mental exercises, physical tasks, study skills enhancement,

and multiple combinations of these strategies (Huberty, 2009; Motevalli et al., 2013; Prato & Yucha, 2013; Salend, 2011). In a recent article aimed at educators and parents, Salend (2012) reiterated a multitude of anxiety reduction techniques. These included study skills enhancement and behavioral changes such as arriving right on time for an exam (Salend, 2012). In reviewing all of the suggested techniques, it is clear there is great overlap, and no technique falls clearly into one category. In the discussion which follows, the techniques are discussed according to the theme most dominant for that technique. Using these anxiety reduction strategies might reduce the degree of anxiety experienced; however, it must be noted that many students could still feel some anxiety (Knight, Dipper, & Cruice, 2013).

Modification of attitude (emotion). Brown et al. (2011) suggested, "approaching the testing situation with an accepting and nonjudgmental mindset that conserves resources and frees students to focus" (p. 46). Encouraging positive thinking improved student performance and decreased test anxiety levels (Brown et al., 2011). T. Ford, B. Ford, Boxer, and Armstrong (2012) even researched the benefits of laughing prior to examinations. The effects of humor on anxiety were found to be mediating and even prevented performance impairment (Ford et al., 2012).

In keeping with Hembree's (1988) findings, Lyons and Beilock (2012b) emphasized the control of negative thoughts relating to mathematical studies assisted in raising performance levels in the classroom. In Walkiewicz, Tartas, Majkowicz, and Budzinski's (2012) study on people choosing a career in the medical field, it was found medical students who experienced high levels of anxiety during their schooling were vulnerable to anxiety and depressive symptoms later in life and were at a greater risk for

burnout. However, Walkiewicz et al. (2012) also found the students who responded to surveys saying they were satisfied with life had lower anxiety experiences during medical training. Given the importance of a positive attitude, acceptance-based therapies can often assist students with high test anxiety (Brown et al., 2011; Glassman, 2014).

Salanova, Schaufeli, Martínez, and Bresó (2010) suggested a student's study engagement, which includes pride, enthusiasm, and the challenge of the performance, builds positive emotions associated with the work. Study engagement may broaden the student's habitual way of thinking and increases the likelihood of better performance in the future (Salanova et al., 2010). Similarly, Yu et al. (2015) found dispositional optimism, the state of having positive expectations for the future, had a negative correlation to anxiety, while rumination had a positive correlation. Academic buoyancy, a positive adaptive response to challenges in academic tasks, was inversely related to test anxiety (Putwain, Connors, Symes, & Douglas-Osborn, 2012). A sense of coherence is a personal resource which helps an individual cope with stressful encounters, buffers the negative effects of life stressors, and determines the effectiveness and the outcome of the coping methods (Cohen, Ben-Zur, & Rosenfeld, 2008). Higher test anxiety is inversely related to an individual's sense of coherence (Cohen et al., 2008). Both avoidance and emotional coping are positively related to test anxiety (Cohen et al., 2008).

Lachman and Agrigoroaei (2012) considered low levels of control beliefs to be a risk factor for poor cognitive functioning. Hence, in his studies, Lachman and Agrigoroaei (2012) found higher state anxiety was associated with lowered control beliefs. Spiritual beliefs also can be beneficial in lowering anxiety levels (Reutter, 2012; Salend, 2012). Reutter (2012) found daily spiritual practices did mediate stress and a

person's ability to cope with stressful situations. Moeini, Taleghani, Mehrabi, and Musarezaie (2014) also found spiritual care practices assisted in decreasing anxiety levels. H. Afzal, S. Afzal, Siddique, and Naqvi (2012) discovered 28.3% of the participants in his study reported using prayer as a method of reducing test anxiety.

Englert, Bertrams, Hagger, and Hepler (2015) found attention regulation or emotional regulation could assist in reducing anxiety. Specifically, Baumeister, Bratslavsky, Muraven, and Tice (1998) shared a strength model which defined self-control as a process in which an individual can chose to override impulses in order to achieve a certain goal. Englert et al. (2015) went on to say all self-control acts such as persistence or emotion regulation are subject to a limited, metaphorical resource within an individual and can become depleted. In a high stress situation, an individual's self-control to attend to a task can be drained, causing more attention to be paid to worrisome, distracting thoughts and thus precipitating poor test performance (Englert et al., 2015). Englert et al. (2015) went on to posit when a student's self-control strength is high, then efficient attention regulation can be obtained and performance heightened.

Cognitive approaches. Nadinloyi, Sadeghi, Garamaleki, Rostami, and Hatami (2013) found traditional cognitive therapy was effective in reducing the effects of test anxiety. Specifically, cognitive therapy was more beneficial to the students who identify themselves as introverts (Nadinloyi et al., 2013). Other researchers have found cognitive therapy to be efficacious for non-introverts as well (Ergene, 2003).

Stoeber and Janssen (2011) found positive reframing as a coping strategy could be helpful in handling failure in people with high perfectionistic outlooks. Findings have also shown retraining attentional engagement away from negative information was

successful in the reduction of the worry component of anxiety (Burgess, Cabeleira, Cabrera, Bucks, & MacLeod 2014). Choi et al. (2012) found threat monitoring influenced participants' ability to overcome cognitive interference. Patients with anxiety disorders may have significant deficits in the regulation of emotional processing (Etkin et al., 2010). Depression becomes an issue when suppression of the feelings of anxiety go unreported (Baddeley, 2013).

Rosnick et al. (2016) studied the augmentation of selective serotonin reuptake inhibitors treatments with cognitive behavioral therapy and found "reduced peak cortisol levels" (p. 1). A variation of cognitive behavioral therapy, called psychodynamic therapy, was researched by Monti, Tonetti, and Ricci Bitti (2014), which involves very sophisticated and carefully timed contributions by the therapist during a treatment session. Monti et al. (2014) found psychodynamic therapy to be just as effective as cognitive behavioral therapy in anxiety reduction.

Ogundokun's (2011) research also showed psychological skills training such as relaxation techniques, imagery, and centering could help both athletes and students learn to control negative thought production, focus of attention, and lower anxiety. Ogundokun (2011) stated the pressure to perform a task produces more distracting and worrisome thoughts than skill-focused attention. Thus, "preventive measures for choking should be directed at reducing worries and enforcing positive monitoring" (Ogundokun, 2011, p. 70).

One style of cognitive behavioral therapy is exposure therapy (Hunter, Westwick, & Haleta, 2014; Kriegshauser, 2014). Exposure therapy for test anxiety involves exposing a student to an anxiety producing situation within the parameters of a safe

environment (Ciccarelli & White, 2011). Cognitive behavioral therapies can be both low and high in intensity (Miles, Ellis, & Sheeran, 2012). In cases where there is mild impairment due to anxiety, then low intensity cognitive behavioral therapy strategies can be implemented (Miles et al., 2012). Low intensity strategies for cognitive behavioral therapy might include group therapy sessions or mild exposure therapy (Miles et al., 2012). Higher intensity strategies would be used when a person is experiencing significant impairment due to anxiety (Miles et al., 2012).

In a meta-analysis by Opris et al. (2012), virtual reality exposure therapy, a specific cognitive-behavioral treatment, was found to be quite effective in the reduction of test anxiety. Virtual reality exposure therapy is a tool used for conducting traditional exposure therapy "with the help of a computer-generated virtual environment, allowing for the systematic exposure to the feared stimuli within a contextually relevant setting" (Opris et al., 2012, p. 86). Alsina-Jurnet, Carvallo-Beciu, and Gutiérrez-Maldonado (2007) validated virtual reality as an effective method for evoking emotional responses related to anxiety.

Salend (2012) also suggested students learn relaxation techniques such as smelling fragrances, deep breathing, or engaging in positive self-talk, meditation, or prayer. The list also included suggestions that students use guided imagery, calming music, visualize positive and relaxing images and experiences, and finally various forms of exercise including yoga (Salend, 2012). Fish (2014) even studied the efficacy of students playing casual video games prior to their test to reduce anxiety symptoms.

Bar-Haim et al. (2011) suggested using attention bias modification as a treatment for anxiety. Using attention bias modification, a student is taught to disengage from the

threat by performing a relaxing activity, which in turn lowers state anxiety levels (Bar-Haim et al. (2011). Wine (1974) found training students in task-attending, that is, training students to ignore distracting thoughts, helped lower students' anxiety levels. Task-attending lowered test anxiety whether or not students were also trained in relaxation techniques (Wine, 1974).

Even simple techniques such as progressive muscle relaxation can quickly relieve anxiety symptoms (Zargarzadeh & Shirazi, 2014). Active relaxation or progressive muscle relaxation is a technique where participants contract a specific muscle group and then release the muscle completely bringing about a more relaxed bearing (Zargarzadeh & Shirazi, 2014). Research has shown progressive muscle relaxation to be a powerful treatment because the body discharges poisons and toxins through the production of natural chemicals during the relaxation phase (Shahroozi, 2011; Zargarzadeh, 2014). In addition, this relaxed bearing results in an increase in self-confidence, feelings of control, and empowerment enhancing performance in all areas (Shahroozi, 2011; Zargarzadeh & Shirazi, 2014). von der Embse and Hasson (2012) suggested instructors use guided relaxation techniques immediately prior to examinations. The guided relaxation techniques could include deep breathing exercises and positive thought reinforcement (von der Embse & Hasson, 2012).

Another strategy found by Nemati and Habibi (2012) showed practicing pranayama, a yogic breathing technique, "could reduce and control test anxiety" (p. 2648). Zargarzadeh and Shirazi (2014) had positive results when participants used a progressive muscle relaxation technique before and during a testing event. Chen et al. (2012) found meditative type therapies can reduce anxiety. In their meta-analysis of over

200 studies on anxiety, Chen et al. (2012) concluded "meditation to be a potential intervention for anxiety… [and] may provide a useful alternative to existing pharmacotherapy and psychotherapy approaches to treat anxiety" (p. 559). Asmundson et al.'s (2013) research also showed combining cognitive behavioral therapy with tai chi movements or yoga sequences significantly reduced state anxiety symptoms.

Kim, Yang, and Schroeppel (2013) studied the effects of Kouk Sun Do practice on anxiety symptoms. Kouk Sun Do is a "traditional Korean mind-body practice" with similarities to yoga (Kim et al., 2013, p. 100). The findings from Kim et al.'s (2013) study were significant in showing a regular practice of Kouk Sun Do exercise three times per week was effective in reducing trait anxiety and depressive symptoms (Kim et al., 2013).

Meditation or mindfulness training has also been shown to be effective in treating all types of anxiety (Lang, 2013). According to Lang (2013), mindfulness is a "deliberate and nonjudgmental attention to the present moment" (p. 409). Lang (2013) further stated mindfulness leads to an easier discovery of an individual's ruminating thoughts, the worry component of test anxiety, which allows an individual to consciously control and change his or her thought process.

According to Karelaia and Reb (2014), mindfulness can be described as a state of being acutely aware and attentive to what is taking place in the present moment. Choi, Vickers, and Tassone (2014) found mindfulness methods improved anxiety sensitivity. Cunha and Paiva (2012) found students with high test anxiety levels also had high levels of negative self-criticism and low levels of acceptance and mindfulness. Foureur,

Besley, Burton, Yu, and Crisp (2013) concluded mindfulness methods could possibly increase resilience to stressful situations.

Karelaia and Reb (2014) stated mindfulness could allow a person to differentiate between irrelevant and relevant information, thus reducing distracting thoughts during any particular situation. Mindfulness, or being present, could also reduce procrastination tendencies, which in turn may reduce ones' overall stress levels (Karelaia & Reb, 2014). Park (2014) also posited mindfulness meditation may reduce anxiety levels as well as overall levels of stress. Park (2014) found mindfulness methods did assist nursing students in managing stress and anxiety. During a testing situation, being able to limit distracting thoughts, focusing only on the present could free cognitive resources (Karelaia & Reb, 2014).

Another view of anxiety involves considering a person's resilience (Foureur et al., 2013). The most current theories on resilience involve the assumption cognitive transformations occur when a person is under duress or experiencing anxiety (Foureur et al., 2013). Cognitive transformations are developed through holistic exercises including mindfulness meditation (Foureur et al., 2013). A common theme in mindfulness-based stress reduction studies and literature is the reduction of rumination, which decreases destructive thoughts and increases a person's health (Foureur et al., 2013).

Damer and Melendres (2011) found group therapy to be very beneficial to students suffering test anxiety symptoms. Hearing other students tell the group about their test anxiety experiences seemed to decrease feelings of shame and isolation (Berger 2013; Damer & Melendres, 2011). Batton (2010) stated gender specific group therapy showed females who interacted in groups were more likely to experience reduced test

anxiety symptoms. If more intensive cognitive behavioral therapy is required, a student could change from group therapy to individual therapy, increasing the frequency and number of sessions, or more intense exposure therapy (Miles et al., 2012).

Group therapy was found to help female participants more than their counterparts in a study on ways to reduce mathematics test anxiety (Batton, 2010). Lowering test anxiety levels for any student is desired. However, if anxiety levels are reduced, students may want to further pursue opportunities of study, specifically females in mathematics, which they may have avoided otherwise (Harding, 2015).

Behavioral interventions. Using visualization techniques prior to examinations could assist students in improved memory recollection (Grilli & McFarland, 2011). Self-imagination, the ability to imagine a scene from a personal perspective, has the possible benefit of assisting memory retrieval (Newport, 2012). By encouraging students to imagine themselves taking a test in a future context where they were relaxed and productive, encourages this lower anxious testing scenario in the future (Grilli & McFarland, 2011). Students may also find listening to guided imagery read by the instructor prior to an exam can promote positive thinking and lower anxiety levels (Salend, 2011). Shobe et al. (2005) conducted an experiment wherein a simple visualization was implemented immediately prior to a testing situation. Shobe et al. (2005) found this to be an effective method for reducing test anxiety symptoms in both easy and difficult testing settings.

Over the years, studies have been designed to determine if sound, smell, or visualizations have any mitigating effect on test anxiety (Dunnigan, 2013; Fenko & Loock, 2014; Grilli & McFarland, 2011; Johnson, 2014; Nyarko, Kwarteng, Akakpo,

Boateng, & Adjekum, 2013; Weiss, 2015). Music has been researched as a way to decrease anxiety prior to a testing event (Goldenberg, Floyd, & Moyer, 2013; Lilley, Oberle, & Thompson, 2014). In a study conducted by Jones, Bacon, and Williams-Schultz (2010), students in the study reported music helped them focus, relieved stress, and helped them ignore distractions in order to concentrate more fully. While the benefits of calm, relaxing music has been show to assist in anxiety levels, Lilley et al. (2014) found test performance was actually greater when listening to more up-beat music. In some instances, whether listening to music was efficacious or not depended upon whether the subjects had prior experience listening to music while working (Hars, Herrmann, Gold, Rizzoli, & Trombetti, 2014; Weiss, 2015). In particular, Weiss (2015) found background music during both testing events and everyday classes increased students' scores, but students who reported also listening to music while doing homework showed the most improvement in scores.

Another possible test anxiety prevention, where students write or sketch their thoughts, would occur immediately prior to a test (Blank-Spadoni, 2013; Rattine-Flaherty, 2014). Nelson and Knight (2010) found asking students to write positive thoughts just prior to a test was a very effective intervention. Students who incorporated personal experiences into the positive thoughts "exhibited a more optimistic outlook and less test anxiety" (Nelson & Knight, 2010, p. 732). Participants in Nelson and Knight's (2010) study demonstrated a likelihood to think of the test as a challenge instead of a distracting threat. Treatments, which include altering attention orienting away from threats or distractions, such as writing or sketching, help alleviate anxiety (Shechner et al., 2012). Rattine-Flaherty (2014) found having students sketch how they felt about their

upcoming speech assisted in alleviating some of the anxiety symptoms. Blank-Spadoni (2013) found a short expressive writing exercise immediately before an examination allowed students to overcome their anxieties. The study showed significant reduction in state anxiety (Blank-Spadoni, 2013). Park, Ramirez, and Beilock (2014) also found expressive writing to be effective in mathematics test taking, specifically. Simply writing about their worries immediately prior allowed students in one study to significantly improve their exam scores (Ramirez & Beilock, 2011).

A simple behavioral change was posited by Salend (2012), who suggested students should not arrive early on testing day because they may tend to discuss the upcoming exam, potentially asking anxiety provoking questions. Hembree (1988) concluded test anxiety seemed to be a behavioral construct and study skills training alone was not effective unless another treatment style was also present. Zeidner (1998) wrote "the synergistic effect of combining study-skills training and behavioral therapies may be due to the superiority of a two-pronged attack on the dual but interrelated problems of deficient preparation and test anxiety" (p. 383).

Another style of behavioral therapy was researched by Brown et al. (2011) called acceptance-based behavior therapy. In Brown et al.'s (2011) study, acceptance-based behavior therapy was compared to traditional cognitive behavioral therapy for treating test anxiety. Those participants receiving acceptance-based behavior therapy showed improvements in performance, and study results indicated acceptance-based behavior therapy may be more effective in lowering test anxiety than cognitive behavioral therapy (Brown et al., 2011).

In 2014, Fenko and Loock researched several environmental factors in anxiety producing situations. The use of scent alone, without accompanying music, was most effective in reducing participants' level of anxiety (Fenko & Loock, 2014). Dunnigan (2013) suggested the use of essential oils, specifically peppermint and rosemary, following proper aromatherapy practices could promote relaxation. However, Dunnigan (2013) found the effect of peppermint and rosemary scents only slightly decreased anxiety levels. Suggestions for future research which could produce more significant results included using other types of scents or combinations (Dunnigan, 2013). Johnson (2014) used diffused lemon essential oil in a study involving nursing students. Johnson (2014) found the scent had a positive effect on the students' levels of test anxiety. Jensen (2010) also used peppermint scents during basic skill practice tests. After completing the tests with and without the peppermint scent, Jensen (2010) found significant increases in performance when the scent was used. Jensen (2010) postulated the peppermint scent could possibly promote an attentional arousal; thus, increasing participants' ability to complete the tasks.

The instructor can have a very strong effect on the learning environment (Allen, 2013; Einbinder, 2014; Salend, 2011), specifically in relation to instructor feedback (Salend, 2011). Timely, individual teacher feedback reinforcing positive attributes helps to increase the occurrences of successful test performances (Salend, 2011). Faculty who illustrate and convey enthusiasm for both their field of study and student learning increase successful performances by students (Einbinder, 2014). DiLoreto and McDonough (2013) found a significant negative correlation between test anxiety and students' impression of instructor feedback. Students with positive impressions of

feedback had lower anxiety levels (DiLoreto & McDonough, 2013). The timing of feedback is also crucial in providing a low-anxiety environment (Williams, 2010). In his study, Williams (2010) found instructors who provided fast, timely feedback had a direct relation to decreasing the students' anxiety levels in the classroom.

The creation of a safe environment allowing for freedom of expression and non-judgmental practice has a significant impact on lowering feelings of anxiety in the classroom (Allen, 2013). Even the use of applause or other feedback from students for performances can reduce anxiety levels (Moridis & Economides, 2012). Also, work in small, cooperative groups could be beneficial in creating a low-anxiety classroom (Fletcher & Ershler, 2014; Harding, 2015). Just increasing individual interactions between instructors and students may also increase student success rates (Lee, 2011).

Anxiety can be associated with the environment in which the student is being tested (Nyer et al., 2013; Salanova et al., 2010; Stowell & Bennett, 2010). Nieuwenhuys and Oudejans (2012) proposed a student's increase in mental effort to mitigate negative effects of test anxiety are limited by the behavioral possibilities of the testing environment and the amount of time allowed to handle a specific stressor. In one study, students in online math courses reported a reduction in anxiety and frustration due to the flexible nature of online courses (Lee, 2011). Nyer et al. (2013) reported some students feeling less anxious about taking their tests via computer since students may feel more control in deciding where or when to take their online, computer-based test. However, it is possible a student who is required to use a computer may find an increase in his or her test anxiety if anxiety associated with computer use is also present (Nyer et al., 2013).

Nyer et al. (2013) also found students in math courses in particular who experienced high test anxiety felt online testing allowed them more control and thus reduced their anxiety symptoms. The control students felt may in part be due to feeling online testing provided an avenue to "escape the classroom cues that have been conditioned to elicit test anxiety in the past" (Stowell & Bennett, 2010, p. 169). In contrast, Salanova et al. (2010) suggested taking a test outside of familiar classroom surroundings might reduce the number of memory retrieval cues and cause a possible reduction in performance.

In a study specifically on statistics anxiety, Ciftci, Karadag, and Akdal (2014) showed the use of computer-based tools actually reduced students' anxiety and even positively affected their attitude toward the course and their success. Along with this idea, an instructor's choice in testing method has been shown to affect student's test anxiety levels (Geist, 2010). Geist (2010), referring specifically to mathematics, discovered the anxiety students experience is not related to the subject matter as much as in the presentation of the topics by the instructor.

Another eastern practice is treatment of ailments using acupuncture (Boucher, Griffith, Siepler, & Tilley, 2011). Boucher et al. (2011) found many medicinal treatments for anxiety caused negative side-effects in the body; however, the holistic practice of acupuncture has none of these side-effects. Boucher et al. (2011) showed a statistically significant result in reducing stress through the use of acupuncture.

Prato and Yucha (2013) studied nursing students and found a biofeedback-assisted relaxation technique decreases physical symptoms of test anxiety. Parker, Vagg and Papsdorf (1995) showed "substantial reductions" in test anxiety in a study on the

worry and emotionality factors (p. 192). The study showed biofeedback alone and cognitive therapy alone each reduced test anxiety; however, the combination of the treatments produced the most statistically significant results (Parker et al., 1995). Other researchers have also looked into using biofeedback techniques to relieve test anxiety symptoms (Ngin, 2014; Park, 2014; Wang et al., 2013). According to Wang et al. (2013), biofeedback, specifically electroencephalogram biofeedback, is "… an operant conditioning paradigm that participants learn in order to alter their brain activity by regulating specific parameters of the electroencephalogram" (p. 2).

Ngin (2014) found biofeedback was an effective alternative test anxiety treatment. Ngin (2014) stated biofeedback techniques also promoted the mind-body connection and promoted academic resilience. Park's (2014) study investigated the efficacy of both biofeedback and mindfulness meditation. Park (2014) found biofeedback techniques significantly reduced anxiety and eased stress levels. Similarly, Wang et al. (2013) used electroencephalogram biofeedback strategies in her research and found it effective in reducing test anxiety.

Even a unique strategy such as eye movement desensitization and reprocessing can be used to alleviate anxiety symptoms (Cook-Vienot & Taylor, 2012). The eye movement desensitization and reprocessing strategy involves the patient engaging in 24-second-long sets of rapid, rhythmic horizontal eye movements while focusing on a memory including all detailed aspects of thoughts, feelings, and emotions occurring within the memory (Cook-Vienot & Taylor, 2012). Through this technique, patients are able to desensitize and reprocess distressing memories (Cook-Vienot & Taylor, 2012).

Cook-Vienot and Taylor (2012) reported even test anxiety can be effectively treated using eye movement desensitization and reprocessing.

Singh, Suhas, Naveen, and Nagendra (2014) found a positive correlation between meditation practices with levels of mindfulness and acceptance. Consistent with this, Singh et al. (2014) also stated there was a negative correlation with overall anxiety levels as well as state anxiety levels. Biofeedback, meditation, mindfulness, and progressive muscle relaxation are all common methods of treating anxiety. While biofeedback requires the use of instrumentation to provide the biological feedback, the other techniques have no need for any equipment (Ngin, 2014; Singh et al., 2014).

In a study by Kennedy (2015), comparisons were made between exercise performed indoors and exercise performed outdoors. Kennedy (2015) hypothesized outdoor exercise would prove more effective in the reduction of anxiety sensitivity. Results showed reductions in anxiety; however, the difference in whether the exercise was performed indoors or outdoors was insignificant (Kennedy, 2015).

Paulus (2013) shared breathing is a fundamental physiological function under the control of the autonomic nervous system. Breathing rates can indicate levels of anxiety (Paulus, 2013). Deep breathing can increase the oxygen level in the blood and hence decrease symptoms of anxiety (Wong et al., 2014). High respiration rates are indicative of higher anxiety, while low respiratory rates indicate states of less anxiety and more relaxation (Paulus, 2013).

Jensen, Stevens, and Kenny (2012) found abdominal breathing indicated deeper, slower rates of respiration. Thoracic, or shallow, breathing was indicative of chaotic breathing and could even lead to hyperventilation during stressful situations (Jensen et

al., 2012). Prato and Yucha (2013) found diaphragmatic breathing combined with progressive muscle relaxation techniques to be most effective in producing a relaxation response and lowering anxiety levels. Wong et al. (2014) stated breathing relaxation exercises are effective and convenient in easing a person's level of anxiety. When someone experiences anxiety, they are often advised to take a deep breath (Wong et al., 2014). Reducing the respiratory rate and altering the breathing from shallow to deep will better oxygenate the blood and lower the heart rate, thus decreasing overall anxiety symptoms (Wong et al., 2014).

A common practice among many students is to reduce their hours of sleep in order to prepare for an exam (Fernández-Castillo, 2013). However, Fernández-Castillo (2013) found a "significant relationship between reduced sleep time and increased anxiety" (p. 78). Nyer et al. (2013) also found the presence of sleep disturbance characterizes a group of students who may experience more anxiety than other college student. Even students who already have depressive symptoms are better functioning than students who have confounding symptoms of sleep disturbance or deprivation (Nyer et al., 2013).

Choueiry et al. (2016) showed a statistically significant association with anxiety and insomnia. Choueiry et al. (2016) also showed an association with anxiety and poor quality of sleep and excessive daytime sleepiness. Any increase in the quality of sleep is likely to decrease overall levels of anxiety (Choueiry et al., 2016, Nyer et al., 2013). Even social functioning is affected by high levels of anxiety and poor sleep functioning (Cumba, 2014). Not only has anxiety been shown to increase due to poor sleep habits,

but even worry, anxiety, and negative emotions promote sleep-incompatible behaviors (Aho, Pickett, & Hamill, 2014).

Conclusions on anxiety interventions. In Hembree's (1988) investigation of over 500 studies, test anxiety treatments were categorized as behavioral, cognitive, cognitive-behavioral, or study skills. Individually, the cognitive treatments and study skills training did not seem to reduce test anxiety (Hembree, 1988). Zeidner (1998) also found study skills training alone was not enough to significantly reduce the effects of test anxiety. Yet, Hembree (1988) found behavioral treatments, directed at the emotionality component, did result in reduced test anxiety levels. Hembree (1988) proposed, "Behavioral treatments act to reduce the levels of general and [trait] anxieties. Behavioral and cognitive-behavioral treatments each reduce the levels of [state] anxiety during testing" (p. 74). Even more recent studies corroborate Hembree's (1988) findings.

Through his comparisons of a multitude of studies, Hembree (1988) found purely behavioral treatments were considerably more effective in test anxiety reduction than purely cognitive treatments. Yet, ultimately, according to several studies, traditional cognitive behavioral therapies, as opposed to cognitive-only therapy, had the highest rate of effectiveness in alleviating anxiety (Aghaie, Abedi, & Paghale, 2012; Ergene, 2003; Monti, Tonetti, & Ricci Bitti, 2014; Urao et al., 2016)

Ergene (2003) found individuals who completed treatment were "seen as better off than 74 percent of those individuals who did not receive treatment" (p. 313). Depressive thinking and experience of failure can be important contributors to high stress levels, thus cognitive behavioral therapy, which addresses some depressive symptoms could help lower anxiety and stress levels (Augner, 2015). Evidence suggests cognitive

behavioral therapy may mediate threat-relevant attentional biases as well (Tobon et al., 2011).

Hunter et al. (2014) found a blend of exposure therapy, skills training, and cognitive behavioral therapy to be the most effective. A type of exposure therapy was used to assist students in alleviating their anxiety by being given opportunity to think realistically, that is, to acknowledge the existence of their anxiety, acknowledging the challenges to learning the anxiety may cause, and adopting a strengths-based view of those challenges (Hunter et al., 2014).

Chronically high cortisol can cause a range of injurious cognitive and health effects, and patients who engage in cognitive behavioral therapy can mitigate these effects by a reduction in cortisol levels (Rosnick et al., 2016). In particular, cognitive behavioral therapy interventions help reduce cortisol levels in patients with various anxiety disorders (Rosnick et al., 2016).

Research by Asmundson et al. (2013) showed cognitive behavioral therapy combined with exercise was the most effective. Results in a study where participants were asked to perform a home-based walking program in addition to their cognitive behavioral therapy showed significantly greater reductions in stress and anxiety than those in the study receiving only cognitive behavioral therapy (Asmundson et al., 2013). Even pamphlets produced by the Mayo Clinic suggest exercise as an effective treatment for stress and anxiety (Hall-Flavin, 2014). Mangles (2011) reported 87% of participants who used anxiety reduction strategies reported not freezing up during their exam.

Many interventions and treatments for reducing test anxiety have been researched, developed, and practiced. The most effective interventions include some component of

cognitive behavioral therapy (Hembree, 1988; Nadinloyi et al., 2013; Opris et al., 2012). Combining cognitive behavioral therapies with other test anxiety treatment strategies enhances the effectiveness of those treatments (Chen et al., 2012; Lang, 2013; Nelson & Knight, 2010).

Summary

Even though test anxiety has been studied for decades, researchers have yet to definitively define its nature, causes, or effects (Cassady, 2010; Salend, 2012). Not even a single style of effective treatment has been developed (Hembree, 1988; Salend, 2012). Despite the effusive nature of the test anxiety construct, cognitive interference and attentional control theories are considered to be prevailing current theories (Cassady, 2010; Coy et al., 2011; Owens et al., 2014; Salend, 2012).

In Chapter Three, the methodology used to examine the research questions in light of the previously discussed theories is discussed. The population and sample are described. The instrumentation used in answering the research questions is also thoroughly presented.

Chapter Three: Methodology

The intent of this research was to determine whether a relaxation technique, sensory activation, had a mitigating effect on a student's test anxiety response. In this chapter, a brief summary of the research problem and purpose of the study is provided. A quantitative research methodology was chosen for this research. Since a survey was used in data collection, Creswell (2013) stated a survey-designed method of research provides a numerical description of trends or opinions, and hence, is quantitative in nature. Also included in this chapter are the research questions. A discussion of the research design, population and sampling descriptions, and instrumentation used are followed by a presentation of the data collection and analysis processes.

Problem and Purpose Overview

In order to successfully complete a college degree, students must pass numerous exams. Test anxiety may inhibit optimal performance on exams (Hembree, 1988). A certain amount of test anxiety can help a student focus and perform at peak levels (Abuhamdeh & Csikszentmihalyi, 2012). However, high levels of test anxiety can negatively affect a student's academic progress (Hembree, 1988).

The purpose of this investigation was to determine if a relaxation technique, called sensory activation, was effective in reducing a student's level of test anxiety. This research was designed to identify any differences of perceived test anxiety before and after implementing the sensory activation relaxation technique. The purpose of this research study was to also identify any differences in specific factors of test anxiety: state anxiety, trait anxiety, distractibility, rumination, and worry, through the use of the Test and Examination Anxiety Measure (Brooks et al., 2015).

Research questions and hypotheses. The following research questions and hypotheses guided this study:

1. What difference, if any, exists in the mean level of perceived test anxiety as reported by students who completed the Test and Examination Anxiety Measure before and after implementation of the sensory activation relaxation technique?

$H1_0$: There is no measurable difference in mean level of perceived test anxiety as reported by students who completed the Test and Examination Anxiety Measure before and after implementation of the sensory activation relaxation technique.

$H1_a$: There is a measurable difference in mean level of perceived test anxiety as reported by students who completed the Test and Examination Anxiety Measure before and after implementation of the sensory activation relaxation technique.

2. How much difference, if any, exists in any of the Test and Examination Anxiety Measure mean composite subscale scores before and after implementation of the sensory activation relaxation technique?

$H2_0$: There is no measurable difference in any of the mean Test and Examination Anxiety Measure composite subscale scores before and after implementation of the sensory activation relaxation technique.

$H2_a$: There is a difference in at least one mean Test and Examination Anxiety Measure composite distractibility subscore before and after implementation of the sensory activation relaxation technique.

Research Design

Quantitative data analysis was used in this research study following a survey-designed methodology since the nature of the research questions and survey instrument

were both quantitative. The collected data included numerical, Likert scale values and categorical values. Fraenkel, Wallen, and Hyun (2011) stated, "Quantitative researchers seek to establish relationships between variables… and sometimes explain the causes of such relationships" (p. 15). A qualitative approach would have not been appropriate since a qualitative research methodology explores issues and strives to make sense of descriptive or non-numerical data (Fraenkel et al., 2011).

The variables within this research included an overall level of test anxiety as measured by the Test and Anxiety Examination Measure (Brooks et al., 2015), and five composite subscale scores, which measured the state anxiety, trait anxiety, distractibility, rumination, and worry factors. The Test and Examination Anxiety Measure (Brooks et al., 2015) was used twice in this survey-designed investigation. The first round of surveys was termed pre-examination and the second round of surveys was called post-examination within this study.

Population and Sample

Both pre-examination and post-examination surveys were distributed to students attending a public Midwestern two-year college. This institution was comprised of approximately 14,000 students within three campuses and three education centers. The college offered a variety of two-year associate of arts degrees as well as certification in a multitude of allied health and technical fields.

For convenience of sampling (Creswell, 2014), the mathematics department was chosen to participate, with permission, in this study. In particular, the college's Basic Algebra course was selected for the study. At the participating college, all Basic Algebra courses were taught within computer lab styled classrooms and consisted of both a

lecture and computer aided study time component. Each class meeting was divided into two segments: a lecture-style instruction period followed by independent work on a computer using a web-based mathematical assessment tool named ALEKS (ALEKS, 2015).

A sample of convenience was taken from all sections of the participating institution's Basic Algebra course (Creswell, 2014). Eleven sections were chosen for their similarity in course schedules and pedagogy in order to ensure efficient and accurate data collection (Fink, 2012). All 11 sections were held in similar computer lab styled classrooms.

Instrumentation

For both the pre-examination and post-examination surveys, the Test and Examination Anxiety Measure developed by Brooks et al. (2015) was administered (see Appendix A). Brooks et al. (2015) developed the Test and Examination Anxiety Measure so the complex construct of test anxiety could be comprehensively measured in a more up-to-date population. In the journal, *Psi Chi*, Brooks et al. (2015) stated the Test and Examination Anxiety Measure was created in order to measure more aspects of test anxiety than other instruments by distinguishing specific types of test anxiety factors and to help "clinicians to discern between varying manifestations of [test anxiety]" (p. 3). Permission was obtained from Brooks et al. (2015) to use his Test and Examination Anxiety Measure for this investigation (see Appendix B).

According to Brooks et al. (2015), the Test and Examination Anxiety Measure has five subscales which measure five test anxiety factors. The subscales "discern which manifestations of [test anxiety] a student possesses" (Brooks et al., 2015, p. 4). The

current version of the Test and Examination Anxiety Measure consists of 26 Likert scaled prompts rated from 1 = “uncharacteristic of me” to 5 = “characteristic of me” (Brooks et al., 2015).

In order to develop the Test and Examination Anxiety Measure, Brooks et al. (2015) used a psychometric method of analysis termed Principal Component Analysis on an original 35 item inventory. This type of factor analysis is used by researchers when a number of variables are investigated in a single study and “allows a researcher to determine if many variables can be described by a few factors” (Fraenkel et al., 2011, p. 334). In Brooks et al.’s (2015) study, five factors were chosen and referred to as subscales. The factors, or subscales, with the highest loading factor on each prompt, similar to correlation coefficients in other types of analysis, were considered the most significant (Brooks et al., 2015). The final instrument consisted of just 26 of the 35 prompts on the original inventory (Brooks et al., 2015).

While the actual loading factor values for all 26 of Brooks et al.’s (2015) Test and Examination Anxiety Measure prompts were not relevant to this inquiry, it should be noted these load values significantly influenced Brooks et al.’s (2015) choice of which factor, or subscale, to assign to each prompt. Out of the 26 prompts, Brooks et al. (2015) found two prompts in particular, numbered 18 and 19 (see Appendix C), had significantly high loading factors for both the worry and trait anxiety factors. Therefore, in calculating the composite subscale score for worry and trait anxiety, responses from both prompts were used. Three of the 26 prompts were not included in any of the five composite subscales, but were only considered in the overall Test and Examination Anxiety

Measure score (Brooks et al., 2015). Prompts 5, 6, and 23 were reverse scored (Brooks et al., 2015).

Besides providing an updated test anxiety scale, Brooks et al.'s (2015) other purpose in developing the Test and Examination Anxiety Measure was to explore the underlying factors of the ubiquitous test anxiety domain. Using the Test and Examination Anxiety Measure (Brooks et al., 2015) in this inquiry assisted in determining if the sensory activation relaxation technique made any difference not only with overall test anxiety levels experienced by participating students, but also if the sensory activation relaxation technique made any difference in any of the five subscales or factors of the test anxiety response. Specifically, did the sensory activation relaxation technique mitigate only overall test anxiety or did it have more effect on one or more of the five test anxiety factors: state anxiety, trait anxiety, distractibility, rumination, or worry (Brooks et al., 2015)?

Validity and reliability. The Test and Examination Anxiety Measure was used for both the pre-examination and post-examination survey (Brooks et al., 2015). According to Brooks et al. (2015), the Cronbach alpha calculated for the Test and Examination Anxiety Measure had a reliability coefficient, alpha, of .90. The Cronbach alpha is an internal consistency measurement (Fraenkel et al., 2011) and the Test and Examination Anxiety Measure's alpha level was consistent with preferred alpha levels in clinical assessments (Brooks et al., 2015).

Pearson's correlation coefficients were calculated for the Test and Examination Anxiety Measure against other well-known and well-established test anxiety measures (Brooks et al., 2015). In particular, the Test and Examination Anxiety Measure (Brooks

et al., 2015) was compared to the State-Trait Anxiety Inventory, developed by psychologists Spielberger and Vagg, and has been used in psychological research for decades (Sarason, 1980). Brooks et al.'s Test and Examination Anxiety Measure was also compared to the Trait Anxiety Inventory, again developed by Spielberger in the late 1980s "to measure individual differences in test anxiety as a situation-specific trait" (Brooks et al., 2015). Specifically, the Test and Examination Anxiety Measure correlated significantly ($p < .001$) with both the previously validated State-Trait Anxiety Inventory and Trait Anxiety Inventory (Brooks et al., 2015). Therefore, even though relatively new, Brooks et al. (2015) found the Test and Examination Anxiety Measure "shows true potential of being a [test anxiety] measure that clinicians and educational counseling centers may use" (p. 8).

Data Collection

The data collection process commenced with approval from both Lindenwood University's Institutional Review Board (see Appendix D) and the participating two-year college's Institutional Review Board (see Appendix E). Simultaneous to these requests, a letter was sent to the Provost of the participating institution informing the Provost of the upcoming survey distribution and asked for his endorsement (see Appendix F).

At the participating college, all Basic Algebra courses are taught within computer lab styled classrooms and consist of both a lecture and computer aided study component. A sample of convenience, consisting of 11 sections of the Basic Algebra course, were selected to participate in the study. Instructors for each of the 11 sections were invited to participate in the study (see Appendix G). Participating instructors were provided

specific instructions, including a script to follow when providing students the opportunity to participate in the study.

At least one class day prior to the first test of the spring 2016 semester, during the independent computer study time, instructors in the participating sections provided students a hypertext link to the pre-examination survey accessed through the SurveyMonkey.com website. After accessing the pre-examination survey, students were required to provide his or her informed consent (see Appendix H) before being allowed to proceed. After providing consent, students were asked three demographic questions followed by the 26 prompts of Brooks et al.'s (2015) Test and Examination Anxiety Measure.

After allowing sufficient time to complete the pre-examination survey, instructors showed the class a screen-capture video, created by the researcher, explaining how to use the sensory activation relaxation technique during their next testing event (see Appendix I). The researcher developed the sensory activation relaxation technique by incorporating several proven test anxiety interventions into one activity. In particular, deep breathing has been shown to lower anxiety levels in multiple studies (Nemati & Habibi, 2012; Prato & Yucha, 2013; Wong et al., 2014). Including creative, multi-dimensional or sensory aspects into the technique was designed to interrupt the fight/flight response and assist in memory retrieval. Multiple studies, discussed in detail within Chapter Two, have provided an abundance of data showing the benefits of those multi-dimensional aspects (Blank-Spadoni, 2013; Dunnigan, 2013; Nelson & Knight, 2010; Salend, 2012).

Specifically, the sensory activation relaxation technique employs the following processes. Prior to a testing event, students develop a personal, detailed, calm, and happy

place in their minds. This happy place must include sensory details of not only sight, but also sounds, smells, textures, and flavors. During a testing event, when a student begins to feel anxious, they are to close his or her eyes, begin breathing deeply, and imagine himself or herself within his or her previously created happy place. Students are encouraged to perform positive self-talk while imagining their scene and breathing deeply. After a very brief time, students should begin to feel less anxious and ready to continue with their test.

Following the completion of the testing event, all participating instructors provided another hypertext link to the post-examination survey hosted on the SurveyMonkey.com website. Instructors also reminded students who opted to participate in the study to complete the post-examination survey. Prior to the Test and Examination Anxiety Measure prompts, (Brooks et al., 2015), students were asked one demographic question relating to whether he or she implemented the sensory activation relaxation technique during the prior testing event. Data were collected analyzed using both descriptive and inferential statistical methods.

Data Analysis

The pre-examination and post-examination surveys contained both demographic data as well as scaled data. The Test and Examination Anxiety Measure (Brooks et al., 2015) prompts were Likert scaled from a value of one to five. All of the demographic data collected were categorical in nature and was analyzed using descriptive statistical methods (Fink, 2012).

In general, Likert scaled data are ordinal or even categorical (Fink, 2012). However, this is not a requirement (Fink, 2012). Within this research study, the data

derived from the Likert scaled Test and Examination Anxiety Measure (Brooks et al., 2015) prompt responses were regarded as continuous data, hence allowing for meaningful statistical analysis (Fink, 2012).

The research questions and corresponding six hypotheses were analyzed and answered using a *t*-test (Fraenkel et al., 2011). The *t*-test for correlated means is used "to compare the mean scores of the same group before and after a treatment…is given, to see if any observed gain is significant" (Fraenkel et al., 2011, p. 236). According to Fink (2012), using a *t*-test allows the comparison of the means of two groups to determine "the probability that any differences between them are real and not due to chance" (p. 128). Microsoft Excel was used to calculate all statistical values.

Ethical Considerations

Anonymity and student privacy were seriously considered in this inquiry. There were no data collected which could specifically identify any participant. Any analysis of survey results by the researcher were calculated using only anonymous encoding; thus, further protecting student confidentiality (Fraenkel et al., 2011). Data downloaded from the SurveyMonkey.com website contained only a computer generated code for each response. To ensure absolutely no identifying information was kept, even this SurveyMonkey generated code was deleted from the data set.

Further ethical considerations include the responsibility of the researcher to protect the participants from any psychological or physical harm (Fraenkel et al., 2011). Toward that end, students were not required to participate nor was any incentive to participate provided. At the start of the pre-examination survey, students were fully informed of the research study process and asked for their formal consent. Only students

providing informed consent were allowed to participate in the research study (Creswell, 2014).

A conflict of interest could arise where "two or more competing interests create the perception, or the reality, of an increased risk of bias or poor judgment" (Conflicts of Interest, 2013, para. 1). Since the researcher was an instructor at the participating institution and was teaching one of the included courses, a conflict of interest could occur. However, a conflict of interest was avoided by carefully choosing course sections not being taught by the researcher.

Summary

In Chapter Three, the research methodology for this study was discussed. The newly developed Test and Examination Anxiety Measure was utilized in order to determine the efficacy of the sensory activation relaxation technique as a method of reducing test anxiety levels experienced by students (Brooks et al., 2015). Participants were selected from several sections of Basic Algebra at the participating two-year college. The data analysis procedures used in the study were also discussed. In the following chapter, the results of statistical analysis upon the collected data are presented. Both descriptive and inferential statistics are provided.

Chapter Four: Analysis of Data

A student's ability to achieve academically can be hindered when he or she experiences test anxiety (May 2015; Onyeizugbo, 2010; Salend, 2012). A mild level of test anxiety can assist a student in focusing more clearly on assessments given in class (Abuhamdeh & Csikszentmihalyi, 2012). However, to satisfactorily progress academically, students need to be free from debilitating test anxiety responses (Davidson et al., 2006). Test anxiety can negatively affect both the educational and psychological well-being of students (Akanbi, 2013). A demonstrated need for educational institutions to find ways to reduce test anxiety has been determined through previous research (Akanbi, 2013). Specifically, Ogundokun (2011) found test anxiety levels are the strongest predictor of a student's success, thus also providing an impetus for change in education and counseling.

The primary focus of this study was to determine whether a sensory activation relaxation technique reduced the level of test anxiety experienced by students. Due to the type of the data collected via survey responses, a quantitative research approach was used to analyze the data (Creswell, 2013). In this chapter, the results of data collected are presented.

Procedures

In order to collect data for this study, the Test and Examination Anxiety Measure, developed by Brooks et al. (2015) was used. The Test and Examination Anxiety Measure is composed of 26 Likert scored questions, or prompts, as they are referred to by the developer. Besides being used to determine an overall test anxiety score, five subscale scores were also derived; state anxiety, trait anxiety, distractibility, rumination, and worry

(Brooks et al., 2015). The Test and Examination Anxiety Measure was converted to electronic form using software developed by SurveyMonkey.

Data collection began in the spring semester of 2016. Students who were enrolled in 11 sections of Basic Algebra were invited to participate in the study by their instructor. Each instructor was given a script to read to the students before beginning the survey process. Fraenkel, et al. (2011) described school-based surveys as having a higher response rate if a person in authority, the instructor, is provided the means to administer the survey within the classroom setting.

A pre-examination survey using Brook et al.'s (2015) measurement tool was developed for students to take prior to being instructed in the sensory activation technique and taking an exam. Similarly, a post-examination survey was created for students to complete after taking an exam. In the pre-examination survey, three demographic questions were inserted between the request for informed consent and the first Test and Examination Anxiety Measure prompt. In the post-examination survey, a question verifying participation in the sensory activation relaxation technique was inserted before the first prompt. Both the pre-examination and post-examinations were delivered to the participants via the SurveyMonkey.com website. The pre-examination survey was offered between February 10, 2016, and February 22, 2016. The post-examination survey was offered between February 21, 2016, and March 5, 2016.

The data from both online surveys were downloaded and organized using Microsoft Excel software. All data were anonymous and only included the random identifier generated by the SurveyMonkey software. The random identifier was discarded by the researcher to thoroughly ensure confidentiality and anonymity of

responses (Fink, 2012). The data were kept in a locked office cabinet at the researcher's current workplace, and electronic versions of the data were stored in a password protected folder.

Respondent Demographics

One hundred fifty-four students were invited to participate in the study. Each student was invited to participate in the study via the instructor for each selected section. Students were enrolled in one of 11 sections of a Basic Algebra mathematics course during the spring 2016 semester at a public Midwestern two-year community college.

All 11 sections of the Basic Algebra course were taught in computer lab classrooms. Students were given the opportunity to answer the survey questions during unstructured study time during the last portion of a class period. Students who declined to participate were able to continue working on coursework while participants completed the surveys.

In the 11 identified course sections, of the 154 students, 108, or 70%, agreed to participate in the pre-examination survey and 56, or 36%, completed the post-examination survey. According to Fink (2012), researchers always hope for 100% response rates; however, there is no particular standard response rate. Several measures were taken by the researcher to improve the response rate including emails to and personal conversations with instructors asking them to remind students to take survey during their class study time.

The first three questions of the pre-examination survey were demographic in nature. Gender data collected on the pre-examination survey revealed 45 participants responded "male," 63 participants responded "female," and one participant "preferred not

to say." Out of the 108 students who participated in the pre-examination survey, 37 were first semester, first-time Basic Algebra students. Thirty-seven students were second semester, first-time Basic Algebra students. Twelve participants responded as having had attended the college for four semesters or more with seven of those having taken Basic Algebra once before. The demographics of the classes are presented in Table 1.

Table 1

Comparison of Semesters to Course Enrollment

Number of semesters at college	Number of times taking Basic Algebra course	
	First time	Second time or more
1	37	1
2	37	3
3	9	9
4 or more	5	7

Note. $n = 108$.

The first question of the post-examination survey was used to determine participation in the sensory activation technique. Of the 56 students, 31 students answered yes to the question, "During my last math test, I did use the relaxation technique explained in the video." Twenty-two of the remaining participants answered "no" and three participants indicated they had no knowledge of an instructional video.

Analysis of Data

In this section, the pre- and post-examination data collected from the Test and Examination Anxiety Measure are presented. The Likert scale range used for each Test and Anxiety Examination Measure prompt response was 1 to 5. The Likert scale values ranged from 1 = "uncharacteristic of me" to 5 = "characteristic of me."

In the pre-examination survey, the Test and Examination Anxiety Measure prompts began with survey question four. However, since there were fewer demographic

questions at the beginning of the post-examination survey, the Test and Examination Anxiety Measure prompts began with survey question two.

The prompt numbers match the numbering found on the 26 Test and Examination Anxiety Measure. Each prompt, and the corresponding data analysis of each, is discussed individually. It should be noted, most of the following prompts belong to at least one of five subscale groups corresponding to the five factors of test anxiety designated in the Test and Examination Anxiety Measure (Brooks et al., 2015).

Descriptive statistics for each prompt is provided as well as the results of inferential statistical analysis. The data from each prompt were analyzed using a two-tail *t*-test with a confidence interval of 95%. The *t*-test was chosen since the population standard deviation is unknown and the sample size, *n*, is greater than 30 (Triola, 2014).

Results from prompt 1. *The thought of an exam makes me anxious.* Both descriptive and inferential statistics are detailed in Table 2. Brooks et al. (2015) assigned this prompt to the state anxiety subscale. The average response on the pre-examination survey was $M = 3.77$, while the average on the post-examination survey decreased by 0.75 to $M = 3.02$. The difference in means was highly statistically significant at the alpha level of $\alpha = .05$ level with a *p*-value < .001 (Bluman, 2013). Since the *p*-value was less than .001, there was an extremely low probability of a type I error occurring (Bluman, 2013).

Table 2

Statistical Results for Prompt 1

Measure	Pre-Examination	Post-Examination
Mean	3.77	3.02
Number	108	56
t-test *p*-value	< .001	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 2. *Doing poorly on an exam makes me feel dejected.* Both descriptive and inferential statistics are detailed in Table 3. Brooks et al. (2015) assigned this prompt to the worry subscale. The average response on the pre-examination survey was $M = 4.03$, while the average on the post-examination survey decreased by 0.42 to $M = 3.61$. The difference in means was statistically significant at the alpha level of $\alpha = .05$ level with a *p*-value of .019.

Table 3

Statistical Results for Prompt 2

Measure	Pre-Examination	Post-Examination
Mean	4.03	3.61
Number	108	56
t-test *p*-value	.019	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 3. *After an exam, I still continue to worry about how well I did on that exam until I find out for certain.* Both descriptive and inferential statistics are detailed in Table 4. Brooks et al. (2015) assigned this prompt to the worry subscale. The

average response on the pre-examination survey was $M = 4.05$, while the average on the post-examination survey decreased by 0.39 to $M = 3.66$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .059.

Table 4

Statistical Results for Prompt 3

Measure	Pre-Examination	Post-Examination
Mean	4.05	3.66
Number	108	56
t-test *p*-value	.059	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 4. *When someone finishes an exam when I am halfway done with an exam I become anxious.* Both descriptive and inferential statistics are detailed in Table 5. Brooks et al. (2015) did not assign this prompt to a subscale; instead, it was used only in determining the overall test anxiety score. The average response on the pre-examination survey was $M = 3.68$, while the average on the post-examination survey increased by 0.14 to $M = 3.82$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .484.

Table 5

Statistical Results for Prompt 4

Measure	Pre-Examination	Post-Examination
Mean	3.68	3.82
Number	108	55
t-test *p*-value	.484	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 5. *I have effective test taking skills.* Both descriptive and inferential statistics are detailed in Table 6. Brooks et al. (2015) did not assign this prompt to a subscale; instead, it was used only in determining the overall test anxiety score. This particular prompt was also reverse scored. The average response on the pre-examination survey was $M = 2.74$, while the average on the post-examination survey decreased by 0.04 to $M = 2.70$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .827.

Table 6

Statistical Results for Prompt 5

Measure	Pre-Examination	Post-Examination
Mean	2.74	2.70
Number	108	56
t-test *p*-value	.827	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 6. *I often feel relaxed and laid-back.* Both descriptive and inferential statistics are detailed in Table 7. Brooks et al. (2015) assigned this prompt to the state anxiety subscale. This particular prompt was also reverse scored. The average response on the pre-examination survey was $M = 2.97$, while the average on the post-examination survey increased by 0.03 to $M = 3.00$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .903.

Table 7

Statistical Results for Prompt 6

Measure	Pre-Examination	Post-Examination
Mean	2.97	3.00
Number	108	56
t-test *p*-value	.903	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 7. *I view exams as a negative part of the education system.* Both descriptive and inferential statistics are detailed in Table 8. Brooks et al. (2015) assigned this prompt to the rumination subscale. The average response on the pre-examination survey was $M = 2.79$, while the average on the post-examination survey decreased by 0.20 to $M = 2.59$. The difference in means was not statistically significant.

Table 8

Statistical Results for Prompt 7

Measure	Pre-Examination	Post-Examination
Mean	2.79	2.59
Number	107	56
t-test *p*-value	.337	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 8. *Worrying about my performance on an exam affects my performance on an exam.* Both descriptive and inferential statistics are detailed in Table 9. Brooks et al. (2015) assigned this prompt to the rumination subscale. The average

response on the pre-examination survey was $M = 3.58$, while the average on the post-examination survey decreased by 0.37 to $M = 3.21$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .08.

Table 9

Statistical Results for Prompt 8

Measure	Pre-Examination	Post-Examination
Mean	3.58	3.21
Number	108	56
t-test *p*-value	.08	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 9. *When presented with an exam, I begin to sense the physical symptoms of anxiety (sweating, increased heart rate, muscle tension, difficulty breathing).* Both descriptive and inferential statistics are detailed in Table 10. Brooks et al. (2015) did not assign this prompt to a subscale; instead, it was used only in determining the overall test anxiety score. The average response on the pre-examination survey was $M = 3.07$, while the average on the post-examination survey decreased by 0.45 to $M = 2.63$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .064.

Table 10

Statistical Results for Prompt 9

Measure	Pre-Examination	Post-Examination
Mean	3.07	2.63
Number	108	56
t-test *p*-value	.064	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 10. *During an exam I become flustered and my mind goes blank.* Both descriptive and inferential statistics are detailed in Table 11. Brooks et al. (2015) did not assign this prompt to a subscale; instead, it was used only in determining the overall test anxiety score. The average response on the pre-examination survey was $M = 3.73$, while the average on the post-examination survey decreased by 0.30 to $M = 3.43$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a *p*-value of .161.

Table 11

Statistical Results for Prompt 10

Measure	Pre-Examination	Post-Examination
Mean	3.73	3.43
Number	107	56
t-test *p*-value	.161	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 11. *When I am faced with an exam, I become anxious.* Both descriptive and inferential statistics are detailed in Table 12. Brooks et al. (2015) assigned this prompt to the state anxiety subscale. The average response on the pre-

examination survey was $M = 3.72$, while the average on the post-examination survey decreased by 0.54 to $M = 3.18$. The difference in means was highly statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .015 (Bluman, 2013).

Table 12

Statistical Results for Prompt 11

Measure	Pre-Examination	Post-Examination
Mean	3.72	3.18
Number	108	56
t-test *p*-value	.015	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 12. *Exams generally cause me more anxiety than other items in my life.* Both descriptive and inferential statistics are detailed in Table 13. Brooks et al. (2015) assigned this prompt to the state anxiety subscale. The average response on the pre-examination survey was $M = 3.25$, while the average on the post-examination survey decreased by 0.20 to $M = 3.05$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .385.

Results from prompt 13. *I am easily distracted during exams.* Both descriptive

Table 13

Statistical Results for Prompt 12

Measure	Pre-Examination	Post-Examination
Mean	3.25	3.05
Number	108	56
t-test *p*-value	.385	

Note. Confidence interval, $\alpha = .05$.

and inferential statistics are detailed in Table 14. Brooks et al. (2015) assigned this

prompt to the distractibility subscale. The average response on the pre-examination survey was $M = 3.26$, while the average on the post-examination survey increased by 0.09 to $M = 3.35$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .719.

Table 14

Statistical Results for Prompt 13

Measure	Pre-Examination	Post-Examination
Mean	3.26	3.35
Number	108	55
t-test *p*-value	.719	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 14. *I have a difficult time comprehending the instructions of exams.* Both descriptive and inferential statistics are detailed in Table 15. Brooks et al. (2015) assigned this prompt to the distractibility subscale. The average response on the pre-examination survey was $M = 2.94$, while the average on the post-examination survey decreased by 0.18 to $M = 2.76$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .401.

Table 15

Statistical Results for Prompt 14

Measure	Pre-Examination	Post-Examination
Mean	2.94	2.76
Number	108	55
t-test *p*-value	.401	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 15. *I have a difficult time comprehending the instructions of exams.* Both descriptive and inferential statistics are detailed in Table 16. Brooks et al. (2015) assigned this prompt to the state anxiety subscale. The average response on the pre-examination survey was $M = 3.34$, while the average on the post-examination survey decreased by 0.10 to $M = 3.24$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .668.

Table 16

Statistical Results for Prompt 15

Measure	Pre-Examination	Post-Examination
Mean	3.34	3.24
Number	108	55
t-test *p*-value	.668	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 16. *I feel anxious the majority of the time.* Both descriptive and inferential statistics are detailed in Table 17. Brooks et al. (2015) assigned this prompt to the trait anxiety subscale. The average response on the pre-examination survey was $M = 3.09$, while the average on the post-examination survey decreased by 0.17 to $M = 2.93$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .461.

Table 17

Statistical Results for Prompt 16

Measure	Pre-Examination	Post-Examination
Mean	3.09	2.93
Number	108	55
t-test *p*-value	.461	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 17. *I am hypercritical of myself usually.* Both descriptive and inferential statistics are detailed in Table 18. Brooks et al. (2015) assigned this prompt to the trait anxiety subscale. The average response on the pre-examination survey was $M = 3.79$, while the average on the post-examination survey increased by 0.07 to $M = 3.86$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a *p*-value of .712.

Table 18

Statistical Results for Prompt 17

Measure	Pre-Examination	Post-Examination
Mean	3.79	3.86
Number	108	56
t-test *p*-value	.712	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 18. *After I have performed poorly on an exam, I have a hard time with coping and moving on from that experience.* Both descriptive and inferential statistics are detailed in Table 19. Brooks et al. (2015) assigned this prompt to

both the trait anxiety and worry subscales. The average response on the pre-examination survey was $M = 3.16$, while the average on the post-examination survey decreased by 0.12 to $M = 3.04$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .595.

Table 19

Statistical Results for Prompt 18

Measure	Pre-Examination	Post-Examination
Mean	3.16	3.04
Number	108	56
t-test *p*-value	.595	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 19. *I worry about how others will view me if I do poorly on an exam.* Both descriptive and inferential statistics are detailed in Table 20. Brooks et al. (2015) assigned this prompt to both the trait anxiety and worry subscales. The average response on the pre-examination survey was $M = 2.92$, while the average on the post-examination survey decreased by 0.33 to $M = 2.59$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .159.

Table 20

Statistical Results for Prompt 19

Measure	Pre-Examination	Post-Examination
Mean	2.92	2.59
Number	108	56
t-test *p*-value	.159	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 20. *I worry about how an exam will affect my success in the future.* Both descriptive and inferential statistics are detailed in Table 21. Brooks et al. (2015) assigned this prompt to the worry subscale. The average response on the pre-examination survey was $M = 3.86$, while the average on the post-examination survey decreased by 0.13 to $M = 3.73$. The difference in means was not statistically significant.

Table 21

Statistical Results for Prompt 20

Measure	Pre-Examination	Post-Examination
Mean	3.86	3.73
Number	107	56
t-test *p*-value	.533	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 21. *I wish there were other ways to measure my knowledge of material other than exams.* Both descriptive and inferential statistics are detailed in Table 22. Brooks et al. (2015) assigned this prompt to the rumination subscale. The average response on the pre-examination survey was $M = 3.97$, while the average on the post-examination survey decreased by 0.20 to $M = 3.77$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a *p*-value of .315.

Table 22

Statistical Results for Prompt 21

Measure	Pre-Examination	Post-Examination
Mean	3.97	3.77
Number	108	56
t-test *p*-value	.315	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 22. *I do not put in effort when it comes to exams because I know I will fail.* Both descriptive and inferential statistics are detailed in Table 23. Brooks et al. (2015) assigned this prompt to the distractibility subscale. The average response on the pre-examination survey was $M = 1.69$, while the average on the post-examination survey increased by 0.02 to $M = 1.71$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a *p*-value of .911.

Table 23

Statistical Results for Prompt 22

Measure	Pre-Examination	Post-Examination
Mean	1.69	1.71
Number	108	56
t-test *p*-value	.911	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 23. *When presented with an exam, I do not sense any physical symptoms of anxiety (sweating, increased heart rate, muscle tension, difficulty breathing).* Both descriptive and inferential statistics are detailed in Table 24. Brooks et al. (2015) assigned this prompt to the state anxiety subscale. This particular prompt was

also reverse scored. The average response on the pre-examination survey was $M = 3.17$, while the average on the post-examination survey decreased by 0.19 to $M = 2.98$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .446.

Table 24

Statistical Results for Prompt 23

Measure	Pre-Examination	Post-Examination
Mean	3.17	2.98
Number	107	56
t-test *p*-value	.446	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 24. *Exams are a way for me to demonstrate my knowledge.* Both descriptive and inferential statistics are detailed in Table 25. Brooks et al. (2015) assigned this prompt to the rumination subscale. The average response on the pre-examination survey was $M = 3.33$, while the average on the post-examination survey increased by 0.09 to $M = 3.42$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a p-value of .69.

Table 25

Statistical Results for Prompt 24

Measure	Pre-Examination	Post-Examination
Mean	3.33	3.42
Number	108	55
t-test *p*-value	.69	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 25. *I avoid courses or professors that use a lot of exams.* Both descriptive and inferential statistics are detailed in Table 26. Brooks et al. (2015) assigned this prompt to the distractibility subscale. The average response on the pre-examination survey was $M = 2.70$, while the average on the post-examination survey decreased by 0.16 to $M = 2.54$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a *p*-value of .447.

Table 26

Statistical Results for Prompt 25

Measure	Pre-Examination	Post-Examination
Mean	2.70	2.54
Number	103	54
t-test *p*-value	.447	

Note. Confidence interval, $\alpha = .05$.

Results from prompt 26. *Exams do not cause me more anxiety than other things in my life.* Both descriptive and inferential statistics are detailed in Table 27. Brooks et al. (2015) assigned this prompt to the state anxiety subscale. This particular prompt was

also reverse scored. The average response on the pre-examination survey was $M = 2.99$, while the average on the post-examination survey decreased by 0.25 to $M = 2.74$. The difference in means was not statistically significant at the alpha level of $\alpha = .05$ level with a *p*-value of .299.

Table 27

Statistical Results for Prompt 26

Measure	Pre-Examination	Post-Examination
Mean	2.99	2.74
Number	104	54
t-test *p*-value	.299	

Note. Confidence interval, $\alpha = .05$.

Summary of prompt analysis. Of the 26 individual prompts, only three had a statistically significant difference in mean scores. The three prompts were number 1: "*The thought of an exam makes me anxious.*"; number 2: "*Doing poorly on an exam makes me feel dejected.*"; and number 11: "*When I am faced with an exam, I become anxious.*" Prompts 1 and 11 were both in the subscale group for state anxiety; while number 2 was in the worry subscale group. The following paragraphs detail the findings related to the research questions which guided this study.

Findings from research question 1. *What difference, if any, exists in the mean level of perceived test anxiety as reported by students through the Test and Examination Anxiety Measure before and after implementation of the sensory activation relaxation technique?* According to the scoring guidelines for the Test and Examination Anxiety Measure, to calculate the overall test anxiety score, all 26 Likert scaled prompt responses

are averaged for each participant (Brooks et al., 2015). Prompts 5, 6, 23, and 26 were reverse scored. Descriptive statistics are detailed in Table 28.

Table 28

Descriptive Statistics for the Overall Score

Measure	Pre-Examination	Post-Examination
Mean	3.29	3.10
Number	108	56

The average response on the pre-examination survey for the 26 Test and Examination Anxiety Measure prompts was $M = 3.29$ while the average on the post-examination survey decreased by 0.20 to $M = 3.09$. As shown in Table 29, a two-tailed *t*-test was calculated on the data resulting in a *p*-value less than .001. At the 95% confidence level, $\alpha = .05$, $p < .001$ was considered extremely statistically significant (Bluman, 2013). With a *p*-value of less than .001, there was an extremely low probability of a type I error occurring (Bluman, 2013). Therefore, the H_0 was rejected and the claim there was a statistically significant difference in mean levels of perceived test anxiety was supported.

Table 29

T-test Results for the Overall Score

Measure	Pre-Examination	Post-Examination
Mean	3.29	3.10
Variance	1.96	1.93
Observations	2788	1446
t Stat	4.22	
P(T<=t) two-tail	< .001	
t Critical two-tail	1.96	

Note. Confidence interval, $\alpha = .05$.

Findings from research question 2. *How much difference, if any, exists in any of the Test and Examination Anxiety Measure mean composite subscale scores before and after implementation of the sensory activation relaxation technique?* Besides obtaining an overall test anxiety score from the Test and Examination Anxiety Measure, five subscale scores may also be obtained. Brooks et al. (2015) arranged the 26 prompts into groups according to the test anxiety factor being measured. It should be noted the results for prompts 18 and 19 were used in both the trait anxiety and worry subscale scores. Also, prompts 4, 5, 9, and 10 were not included in any subgroup and were used only in the calculation of the overall test anxiety score.

Results from the state anxiety subscale. According to Brooks et al. (2015), seven of the 26 prompts are used in calculating the state anxiety subscale score. State anxiety is a type of anxiety felt during a specific time or event (Salend, 2012). For the state anxiety subscale score, the responses for prompts 1, 6, 11, 12, 15, 23, and 26 were used. Note, prompts 6, 23, and 26 were reverse scored. Descriptive statistics are detailed in Table 30.

Table 30

Descriptive Statistics for the State Anxiety Subscale

Measure	Pre-Examination	Post-Examination
Mean	3.32	3.03
Number	108	56

As shown in Table 31, a two-tailed, two-sample, unequal variance *t*-test calculated on the data, is presented. At the 95% confidence level, $\alpha = .05$, $p = .001$ was statistically significant (Bluman, 2013). Therefore, the H_0 was rejected for the state

anxiety subscale, and the claim there was a statistically significant difference in mean levels of the state anxiety subscale scores was supported.

Table 31

T-test Results for the State Anxiety Subscale

Measure	Pre-Examination	Post-Examination
Mean	3.32	3.03
Variance	1.99	1.97
Observations	751	389
t Stat	3.27	
P(T<=t) two-tail	.001	
t Critical two-tail	1.96	

Note. Confidence interval, α = .05.

Results from the trait anxiety subscale. According to Brooks et al. (2015), four of the 26 prompts are used in calculating the trait anxiety subscale score. Trait anxiety is experienced by a person on a regular basis due to his or her personality (Brooks et al., 2015). For the trait anxiety subscale score, the responses for prompts 16, 17, 18, and 19 were used. Descriptive statistics are detailed in Table 32.

Table 32

Descriptive Statistics for the Trait Anxiety Subscale

Measure	Pre-Examination	Post-Examination
Mean	3.24	3.10
Number	108	56

As shown in Table 33, a two-tailed, two-sample, unequal variance *t*-test, calculated on the data, is presented. At the 95% confidence level, $\alpha = .05$, $p = .239$ was not statistically significant. Therefore, the H_0 was not rejected for the trait anxiety

subscale, and the claim there was a statistically significant difference in mean levels of the trait anxiety subscale scores was not supported.

Table 33

T-test Results for the Trait Anxiety Subscale

Measure	Pre-Examination	Post-Examination
Mean	3.24	3.10
Variance	1.95	1.90
Observations	432	223
t Stat	1.18	
P(T<=t) two-tail	.239	
t Critical two-tail	1.96	

Note. Confidence interval, α = .05.

Results from the distractibility subscale. According to Brooks et al. (2015), four of the 26 prompts are used in calculating the distractibility subscale score. Distractibility can be described as the ease of which attention can be diverted from a task (Brooks et al., 2015). For the distractibility subscale score, the responses for prompts 13, 14, 22, and 25 were used. Descriptive statistics are detailed in Table 34.

Table 34

Descriptive Statistics for the Distractibility Subscale

Measure	Pre-Examination	Post-Examination
Mean	2.65	2.59
Number	107	55

As shown in Table 35, a two-tailed, two-sample, unequal variance *t*-test calculated on the data, is presented. At the 95% confidence level, $\alpha = .05$, $p = .592$ was not statistically significant. Therefore, the H_0 was not rejected for the distractibility

subscale, and the claim there was a statistically significant difference in mean levels of the distractibility subscale scores was not supported.

Table 35

T-test Results for the Distractibility Subscale

Measure	Pre-Examination	Post-Examination
Mean	2.65	2.59
Variance	1.97	1.95
Observations	427	220
t Stat	.54	
P(T<=t) two-tail	.592	
t Critical two-tail	1.96	

Note. Confidence interval, α = .05.

Results from the rumination subscale. According to Brooks et al. (2015), four of the 26 prompts are used in calculating the rumination subscale score. Brooks et al. (2015) defined rumination as repetitive, self-defeating thoughts. For the rumination subscale score, the responses for prompts 7, 8, 21, and 24 were used. Descriptive statistics are detailed in Table 36.

Table 36

Descriptive Statistics for the Rumination Subscale

Measure	Pre-Examination	Post-Examination
Mean	3.42	3.25
Number	108	56

As shown in Table 37, a two-tailed, two-sample, unequal variance *t*-test calculated on the data, is presented. At the 95% confidence level, $\alpha = .05$, $p = .112$ was

not statistically significant. Therefore, the H_0 was not rejected for the rumination subscale, and the claim there was a statistically significant difference in mean levels of the rumination subscale scores was not supported.

Table 37

T-test Results for the Rumination Subscale

Measure	Pre-Examination	Post-Examination
Mean	3.42	3.25
Variance	1.75	1.73
Observations	431	223
t Stat	1.59	
P(T<=t) two-tail	.112	
t Critical two-tail	1.96	

Note. Confidence interval, α = .05.

Results from the worry subscale. According to Brooks et al. (2015), five of the 26 prompts are used in calculating the worry subscale score. Worry is often referred to as concern about failure (Brooks et al., 2015). For the worry subscale score, the responses for prompts 7, 8, 21, and 24 were used. Descriptive statistics are detailed in Table 38.

Table 38

Descriptive Statistics for the Worry Subscale

Measure	Pre-Examination	Post-Examination
Mean	3.60	3.33
Number	108	56

As shown in Table 39, the results of a two-tailed, two-sample, unequal variance *t*-test calculated on the data, is presented. At the 95% confidence level, this score was statistically significant. Therefore, the H_0 was rejected for the worry subscale, and the

claim there was a statistically significant difference in mean levels of the worry subscale scores was supported. statistically significant. Therefore, the H_0 was rejected for the worry subscale, and the claim there was a statistically significant difference in mean levels of the worry subscale scores was supported.

Table 39

T-test Results for the Worry Subscale

Measure	Pre-Examination	Post-Examination
Mean	3.60	3.33
Variance	1.82	1.79
Observations	539	280
t Stat	2.78	
P(T<=t) two-tail	.006	
t Critical two-tail	1.96	

Note. Confidence interval, α = .05.

Summary

The purpose of this study was to determine if the sensory activation relaxation technique could assist students in lowering their level of test anxiety. Through the use of Brook et al.'s (2015) Test and Examination Anxiety Measure, two research questions were tested. Students attending a Midwestern, two-year college were invited to participate in the study. The participants consisted of currently enrolled students in a Basic Algebra course. Of those students, 108 agreed to participate in the pre-examination survey, and 56 participated in the post-examination survey.

In this chapter, the survey results were reported and data analysis described. In particular, a two-sample *t*-test for differences in means with unequal variances was used to determine whether the null hypotheses would not be rejected or rejected for both research questions. The first research question was supported since the *t*-test *p*-value was

less than .001. Results showed a statistically significant positive difference in perceived mean levels of test anxiety.

The second research question referenced the five subscale scores of the Test and Examination Anxiety Measure: state anxiety, trait anxiety, distractibility, rumination, and worry. Of these five subscales, only the state anxiety and worry subscales showed a statistically significant positive difference in mean subscore levels between the pre-examination survey and post-examination survey.

In the final chapter, a summary of all results is presented. Findings, implications, and conclusions are discussed in detail. Also, recommendations for future research are discussed.

Chapter Five: Summary and Conclusions

Students who experience test anxiety can have significant deficits in their ability to perform at an optimal level (Huberty, 2009). Chapell et al. (2005) was able to show, through a large study of over 5,000 students, a small but significant inverse relationship between grade point average and test anxiety. Several other researchers have found test anxiety is negatively correlated with student success (Basol & Zabun, 2014; Farooqi et al., 2014; Talib & Sansgiry, 2012). According to Onyeizugbo (2010), students who experience test anxiety could be prevented from performing to their best academically.

Previous research has shown achievement is negatively correlated with test anxiety (May, 2015; Salend, 2012). Test anxiety responses need to be curtailed in order for students to progress academically without hindrance. This study focused on determining whether a sensory activation relaxation technique would help reduce students' test anxiety.

Within this chapter, the major points of this study are reviewed. The results from the statistical analysis of data completed in Chapter Four are briefly discussed. Following this, conclusions, supported by previous research mentioned in Chapter Two, are drawn. Also included in this chapter is a presentation of implications for education, as well as suggestions for future research.

Findings

In this section the findings are summarized. The results which were presented in detail in Chapter Four are summarized. The outcomes are presented by research question.

The first research question, "*What difference, if any, exists in the mean level of perceived test anxiety as reported by students through the Test and Examination Anxiety Measure before and after implementation of the sensory activation relaxation technique?"* was explored through both descriptive and inferential statistical analysis. The overall mean test anxiety score from the 26 Test and Examination Anxiety Measure prompts on the pre-examination survey was 3.29, while the post-examination overall mean score was 3.10. *T*-test results provided a *p*-value less than .001, which is statistically significant at the 95% confidence level. Therefore, according to resulting data, test anxiety levels decreased.

The second research question, "*How much difference, if any, exists in any of the Test and Examination Anxiety Measure mean composite subscale scores before and after implementation of the sensory activation relaxation technique?*" was explored through both descriptive and inferential statistics. Each of the five subscales were analyzed in detail within Chapter Four. Of the five test anxiety factor subscales, only state anxiety and worry subscale results had a statistically significant outcome. Both had *t*-test *p*-values less than .05 indicating the null hypotheses could be rejected and second research question for the subscale of state anxiety and worry was upheld.

Conclusions

Research findings in any study are minimalized when only viewed in isolation. It is imperative to view results holistically. In this section, the findings for the research questions are discussed within the parameters of the literature review conducted in Chapter Two of this study.

Research question one. *What difference, if any, exists in the mean level of perceived test anxiety as reported by students through the Test and Examination Anxiety Measure before and after implementation of the sensory activation relaxation technique?* Besides looking at the overall score from the survey data, the individual prompts were analyzed in Chapter Four. Of the 26 prompts, the pre-examination and post-examination mean scores were only statistically significant for three of the prompts. Prompts 1, 2, and 11 all had *t*-test *p*-scores less than .05.

Both prompt 1, "*The thought of an exam makes me anxious.*" and prompt 11, "*When I am faced with an exam, I become anxious*." had resulting scores which were statistically significant. The *p*-value for prompt 1 was less than .001 and for prompt 11, $p = .015$. At the 95% confidence level, *p*-values less than .05 are considered statistically significant (Triola, 2014).

Since prompts 1 and 11 of the Test and Examination Anxiety Measure were assigned to the state anxiety subscale, it is reasonable to expect a statistically significant positive result in this study (Brooks et al., 2015). State anxiety is transient and occurs in the presence of an anxiety producing or highly stressful event (Salend, 2012). The sensory activation relaxation technique was designed to assist students in lowering their test anxiety during an examination, hence, lowering their state anxiety. The sensory activation relaxation technique was not designed to lower levels of trait anxiety, a type of anxiety which is related to a person's personality and experienced by them on a regular basis (Brooks et al., 2015; Salend, 2012).

Furthermore, analysis in Chapter Four showed prompt 2, "*Doing poorly on an exam makes me feel dejected.*" which was assigned to the worry subscale, had a

statistically significant *t*-test *p*-score of .019. Since the worry subscale results were statistically significant, it is not surprising there was one individual prompt which was also statistically significant.

Findings from this research show the sensory activation relaxation technique may assist students in lowering their test anxiety levels. The results indicated students who learn the sensory activation relaxation technique may perform at academically higher levels and experience less stress during a testing event, which is consistent with the findings of several researchers who also found value in anxiety-reducing techniques (Grilli & McFarland, 2011; Jensen et al., 2012; Prato & Yucha 2013; von der Embse & Hasson, 2012). Since the difference in means was shown to be statistically significant, it could be concluded the students were benefitted by using the sensory activation relaxation technique; however, it should be noted demographic data indicate this may not necessarily be the sole cause.

Unfortunately, only 56 of the original 154 invited participants responded to the post-examination survey. Thirty-one of the 56 positively responded to the single demographic question, "*During my last math test, I did use the relaxation technique explained in the video."* This disparity leaves the question of whether the resulting decrease in overall anxiety levels is due to reasons other than the use of the sensory activation relaxation technique.

It is possible students became more aware of their anxiety after participating in the pre-examination survey and/or watching the instructional video. There exists a well-known psychological phenomenon called the Hawthorne Effect (Fernald, Coombs, DeAlleaume, West, & Parnes, 2012). The Hawthorne Effect is often defined as a

behavioral change resulting from an awareness of being in an experiment (Ciccarelli & White, 2011). Students could have been made more aware of their anxiety through the process of responding to the Test and Examination Anxiety Measure prompts, thus curtailing any heretofore unnoticed symptoms without the specific use of the sensory activation relaxation technique (MacNeill, Foley, Quirk, & McCambridge, 2016).

On the other hand, the statistical significance of the finding for research question one was upheld by many of the theories and treatments reviewed in Chapter Two. In particular, cognitive behavioral therapies include treating thoughts, feelings, and behaviors together in order to affect a positive change in the person (Ciccarelli & White, 2011). In particular, the findings for research question one are upheld by Hembree's (1988) prior meta-analysis.

Research question two. *How much difference, if any, exists in any of the Test and Examination Anxiety Measure mean composite subscale scores before and after implementation of the sensory activation relaxation technique?* Considering the sensory activation relaxation technique was used during the examination period, it is reasonable to assume its effectiveness would be limited to lowering state anxiety levels rather than trait anxiety levels. Anderson and Sauser (1995) defined worry as thinking about the outcome of an event. Therefore, it is also reasonable for the sensory activation relaxation technique to assist in lowering the effects of worry during the testing event.

The other three subscale scores did not show statistically significant results. The trait anxiety subscale would likely not change through only the use of the sensory activation relaxation technique since trait anxiety refers to a person's usual level of anxiety in his or her everyday lives (Brooks et al., 2015; Salend, 2012). A relaxation

technique designed to assist at the time of the testing event would be unlikely to change a person's prevailing level of anxiety (Zargarzadeh & Shirazi, 2014). Rumination pertains to repetitive, on-going thoughts, which are often detrimental to self-esteem (Brooks et al., 2015). Therefore, it is plausible the sensory activation relaxation technique would be unlikely to affect the rumination subscale levels.

The one unexpected result was the rejection of the null hypothesis for the distractibility subscale. Brooks et al. (2015) used the term distractibility to describe the ease with which a student is distracted during a testing event. It should be noted, however, while the *t*-test statistic showed no statistical significance in the difference of mean subscale levels, it does not mean there is no information to be gained from the data (Bluman, 2013). The mean subscale scores, both for the pre-examination and post-examination surveys, were the lowest of the five subscale scores, indicating this particular sample population reported low symptoms of distractibility (Brooks et al., 2015). Also, the difference between pre-examination and post-examination mean scores was the smallest of the five subscales, implying there was very little difference between the distractibility levels before or after implementation of the sensory activation relaxation technique, and therefore, had little effect on the distractibility test anxiety factor.

Implications for Practice

Since the sensory activation relaxation technique includes components of deep breathing, mindfulness, and visualization, the findings from research question one also followed the findings of multiple researchers. Lang (2013) found meditation and mindfulness training to be effective in reducing test anxiety symptoms. Also, guided

relaxation techniques performed immediately prior to examinations, or even during, could increase positive thought reinforcement and lower anxiety levels (von der Embse & Hasson, 2012).

Instructors in fields with typically higher rates of test anxiety would be well served by following the results of this study. Studies have shown students do not perform as well when experiencing high levels of test anxiety (Owens et al., 2014). Some of the fields with the highest test anxiety levels are mathematics, nursing, and many of the physical sciences (Hembree, 1988; Johnson, 2014). In order to mitigate test anxiety symptoms, instructors could introduce the sensory activation relaxation technique to their students prior to the first testing event in the course, thus producing the desired outcomes of better test performance and less anxiety.

The results of the study showed an overall decrease in state anxiety levels. However, instructors should note the difference in trait anxiety levels measured by the Test and Examination Anxiety Measure was not statistically significant. The implication of this finding being, if a student has high levels of trait anxiety, just learning the sensory activation relaxation technique will not change his or her inherent level of anxiety.

A typical description of one anxiety symptom, anecdotally reported by students, is "going blank" (Tobias, 1990). Test and Examination Anxiety Measure prompt 10, "*During an exam I become flustered and my mind goes blank."* specifically mentioned this phenomenon. While the resulting *t*-test *p*-score for prompt 10 was not statistically significant, it is important to note there was a decrease in mean scores between the pre-examination and post-examination surveys. Therefore, it is suggested the sensory

activation relaxation technique could have served as a possible deterrent to the "going blank" problem.

Recommendations for Future Research

Several modifications could be made to this research study. In particular, the sample size could be larger and more random in nature (Navidi & Monk, 2012). Because of time limitations, a sample of convenience was chosen for this research study (Fraenkel et al., 2011). Ideally, future research on whether the sensory activation relaxation technique mitigates test anxiety would include random selections of students in a wide a demographic as possible. Participants could be selected from all currently attending students at another two-year college, as was used in this study, but students from other types of colleges such as four-year institutions and colleges from other parts of the country could be included.

Including only students in mathematics courses limited the type of student responding to the survey. While students in math courses often experience very high levels of test anxiety, there are other courses and subjects which could also have inherently high levels of test anxiety (Andrews & Brown, 2015; Owens et al., 2014). For example, future research could include students in the physical sciences and medical fields where levels of test anxiety are high (Johnson, 2014).

The Test and Anxiety Examination Measure was the instrument of choice for this study; however, there exist many test anxiety instruments which future researchers could employ in their study. Some instruments which are still in use and have been used for decades include the State-Trait Anxiety Inventory and Trait Anxiety Inventory (Hembree, 1988; Szafranski et al., 2012). Other possible instruments, which are subject specific,

include the Organic Chemistry Anxiety Scale and the Mathematics Anxiety Scale-Revised (Bai et al., 2009; Kurbanoğlu & Akin, 2012).

Another suggestion to future researchers would be to change the study design to what Fraenkel et al. (2011) calls the static group pretest-posttest design. This design includes the use of a control group, who does not receive the treatment, and allows for analysis of the increase or decrease of individual participants (Fraenkel et al., 2011). This design would allow future researchers to explore the effects of the sensory activation relaxation technique on the test anxiety levels for individual students.

Also, one of the worrisome aspects of the current study was the low positive response rate on the post-examination demographic question, "*During my last math test, I did use the relaxation technique explained in the video."* Only 30 students responded positively to this question out of the 108 who participated in the pre-examination survey. Future researchers could ensure all participants agree to use the sensory activation relaxation technique or only analyze the data from students who completed the entire experimental process.

Finally, future research should include not only quantitative data, but should also include qualitative data in a possible qualitative or mixed methods study. Participants could be asked questions concerning their symptoms of anxiety both prior to learning the sensory activation relaxation technique and after which could then be compared. Also, qualitative data from interviews or focus groups regarding subjective experiences of utilizing the sensory activation technique could be analyzed in order to increase the technique's effectiveness.

Summary

This survey-designed, quantitative research study was developed in order to investigate whether a sensory activation relaxation technique could lower students test anxiety. Two research questions were proposed and data were collected and analyzed. The first research question was supported by the data analysis. There was a statistically significant positive difference in mean level of perceived test anxiety as reported by students through the Test and Examination Anxiety Measure before and after the implementation of the sensory activation technique.

Parts of research question two were also supported. Two of the five subscales as defined in the Test and Examination Anxiety Measure were found to be statistically significant. Therefore, the second hypothesis was not rejected for the state anxiety and worry subscales. While not statistically significant, there did exist a decrease in the remaining three composite subscale scores of trait anxiety, distractibility, and rumination as measured by the Test and Anxiety Examination Measure.

Appendix A

Pre-Examination Survey

1. Gender: Male Female Prefer not to say

2. This is my _____ semester at [Institution Name].

   1st 2nd 3rd 4th or higher

3. This is the first time taking MTH 050 [Basic Algebra] Yes No

Please read each statement below and consider how characteristic it is of you. Rate each statement using the following scale and record your answer in the space provided.

1 = Uncharacteristic of me

2 = Somewhat uncharacteristic of me

3 = Neither uncharacteristic nor characteristic of me

4 = Somewhat characteristic of me

5 = Characteristic of me

4. The thought of an exam makes me anxious.
5. Doing poorly on an exam makes me feel dejected.
6. After an exam, I still continue to worry about how well did on that exam until I find out for certain.
7. When someone finishes an exam when I am halfway done with an exam, I become anxious.
8. I have effective test taking skills.
9. I often feel relaxed and laid-back.
10. I view exams as a negative part of the education system.

11. Worrying about my performance on an exam affects my performance on an exam.
12. When presented with an exam, I begin to sense the physical symptoms of anxiety (sweating, increased heart rate, muscle tension, difficulty breathing).
13. During an exam, I become flustered, and my mind goes blank.
14. When I am faced with an exam, I become anxious.
15. Exams generally cause me more anxiety than other items in my life.
16. I am easily distracted during exams.
17. I have a difficult time comprehending the instructions of exams.
18. When I am well-prepared for an exam, I do not feel anxious about it.
19. I feel anxious the majority of the time.
20. I am hypercritical of myself usually.
21. After I have performed poorly on an exam, I have a hard time with coping and moving on from that experience.
22. I worry about how others will view me if I do poorly on an exam.
23. I worry about how an exam will affect my success in the future.
24. I wish there were other ways to measure my knowledge of material other than exams.
25. I do not put in effort when it comes to exams because I know I will fail.
26. When presented with an exam, I do not sense any physical symptoms of anxiety (sweating, increased heart rate, muscle tension, difficulty breathing).
27. Exams are a way for me to demonstrate my knowledge.
28. I avoid courses or professors that use a lot of exams.
29. Exams do not cause me more anxiety than other things in my life.

Post-examination Survey

1. During my last math test, I did use the relaxation technique explained in the video.

Yes No

Please read each statement below and consider how characteristic it is of you. Rate each statement using the following scale and record your answer in the space provided.

1 = Uncharacteristic of me

2 = Somewhat uncharacteristic of me

3 = Neither uncharacteristic nor characteristic of me

4 = Somewhat characteristic of me

5 = Characteristic of me

2. The thought of an exam makes me anxious.

3. Doing poorly on an exam makes me feel dejected.

4. After an exam, I still continue to worry about how well did on that exam until I find out for certain.

5. When someone finishes an exam when I am halfway done with an exam, I become anxious.

6. I have effective test taking skills.

7. I often feel relaxed and laid-back.

8. I view exams as a negative part of the education system.

9. Worrying about my performance on an exam affects my performance on an exam.

10. When presented with an exam, I begin to sense the physical symptoms of anxiety (sweating, increased heart rate, muscle tension, difficulty breathing).

11. During an exam, I become flustered, and my mind goes blank.

12. When I am faced with an exam, I become anxious.
13. Exams generally cause me more anxiety than other items in my life.
14. I am easily distracted during exams.
15. I have a difficult time comprehending the instructions of exams.
16. When I am well-prepared for an exam, I do not feel anxious about it.
17. I feel anxious the majority of the time.
18. I am hypercritical of myself usually.
19. After I have performed poorly on an exam, I have a hard time with coping and moving on from that experience.
20. I worry about how others will view me if I do poorly on an exam.
21. I worry about how an exam will affect my success in the future.
22. I wish there were other ways to measure my knowledge of material other than exams.
23. I do not put in effort when it comes to exams because I know I will fail.
24. When presented with an exam, I do not sense any physical symptoms of anxiety (sweating, increased heart rate, muscle tension, difficulty breathing).
25. Exams are a way for me to demonstrate my knowledge.
26. I avoid courses or professors that use a lot of exams.
27. Exams do not cause me more anxiety than other things in my life.

Appendix B

Permission to use the Test and Examination Anxiety Measure from Author

April 15, 2015

Dear Mr. Brooks -

I am a graduate student working on my doctoral dissertation through Lindenwood University (St. Charles, MO). My dissertation research is in the area of test anxiety. I am studying the mitigating effects of a particular relaxation technique I have developed.

I recently found and read your article concerning the development of the Test and Examination Anxiety Measure (TEAM). I am thrilled to see your research!! One of the most disappointing items in all my research was the age of all of the test anxiety measures – and reading a fairly recent article by Derek D. Szafranski (2012), *Test Anxiety Inventory: 30 Years Later*, only served to exacerbate my frustration with meaningful measures.

I am still in the beginning stages of my dissertation process and have only just begun developing my own versions of a test anxiety survey. However, I believe I would like to incorporate your TEAM scale in my research.

Would you be willing to provide permission to use your TEAM scale within my doctoral research?

Please feel free to contact me using my information below, or call/text my cell number at [redacted] if you prefer, for any further information concerning my research and how I would like to implement your survey.

Thank you so much for your time & consideration.

Reply:

Hi Marylynne-

Your research sounds very interesting and I would love to hear about how your relaxation techniques decreases test anxiety as well as your test anxiety instrument. I felt the same frustration when I was looking for test anxiety measures when I began this research a couple of years ago. I have attached the TEAM which you are more than welcome to use. Feel free to contact me if you have any questions.

Good luck with your dissertation! Byron

Appendix C

TEAM Prompts

Scored on Likert Scale:

1 Uncharacteristic of me

2 Somewhat uncharacteristic of me

3 Neither characteristic nor uncharacteristic of me

4 Somewhat characteristic of me

5 Characteristic of me

Prompts SUBSCALE

#1 = The thought of an exam makes me anxious STATE ANXIETY Reverse scored

#2 = Doing poorly on an exam makes me feel dejected WORRY Reverse scored

#3 = After an exam, I still continue to worry about how well I did on that exam until I find out for certain WORRY

#4 = When someone finishes an exam when I am halfway done with an exam I become anxious

#5 = I have effective test taking skills

#6 = I often feel relaxed and laid-back STATE ANXIETY

#7 = I view exams as a negative part of the education system RUMINATION

#8 = Worrying about my performance on an exam affects my performance on an exam RUMINATION

#9 = When presented with an exam, I begin to sense the physical symptoms of anxiety (sweating, increased heart rate, muscle tension, difficulty breathing)

#10= During an exam I become flustered and my mind goes blank

#11= When I am faced with an exam, I become anxious STATE ANXIETY

#12= Exams generally cause me more anxiety than other items in my life STATE ANXIETY

#13= I am easily distracted during exams DISTRACTABILITY

#14= I have a difficult time comprehending the instructions of exams DISTRACTABILITY

#15= When I am well prepared for an exam, I do not feel anxious about it STATE ANXIETY

#16= I feel anxious the majority of the time TRAIT ANXIETY

#17= I am hypercritical of myself usually TRAIT ANXIETY

#18= After I have performed poorly on an exam, I have a hard time with coping and moving on from that experience TRAIT ANXIETY & WORRY

#19= I worry about how others will view me if I do poorly on an exam TRAIT ANXIETY & WORRY Reverse scored

#20= I worry about how an exam will affect my success in the future WORRY

#21= I wish there were other ways to measure my knowledge of material other than exams RUMINATION

#22= I do not put in effort when it comes to exams because I know I will fail DISTRACTABILITY Reverse scored

#23= When presented with an exam, I do not sense any physical symptoms of anxiety (sweating, increased heart rate, muscle tension, difficulty breathing) STATE ANXIETY

#24= Exams are a way for me to demonstrate my knowledge RUMINATION

#25= I avoid courses or professors that use a lot of exams DISTRACTABILITY

#26= Exams do not cause me more anxiety than other things in my life STATE ANXIETY

NOTE: If no subscale is present, then the prompt is used only in calculation of overall test anxiety score.

Appendix D

LINDENWOOD

LINDENWOOD UNIVERSITY ST. CHARLES, MISSOURI

DATE:	November 18, 2015
TO:	Marylynne Abbott
FROM:	Lindenwood University Institutional Review Board
STUDY TITLE:	[820425-1] Mitigating the Effects of Test Anxiety Through a Relaxation Technique called Sensory Activation
IRB REFERENCE #:	
SUBMISSION TYPE:	New Project
ACTION:	APPROVED
APPROVAL DATE:	November 18, 2015
EXPIRATION DATE:	November 18, 2016
REVIEW TYPE:	Expedited Review

Thank you for your submission of New Project materials for this research project. Lindenwood University Institutional Review Board has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to the IRB.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the completion/amendment form for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of November 18, 2016.

Please note that all research records must be retained for a minimum of three years.

If you have any questions, please contact Megan Woods at (636) 485-9005 or mwoods1@lindenwood.edu. Please include your study title and reference number in all correspondence with this office.

If you have any questions, please send them to mwoods1@lindenwood.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Lindenwood University Institutional Review Board's records.

Appendix E

IRB Application

Project Personnel - Lead Investigator Name	Marylynne Abbott
Principal Investigator E-Mail Address	[redacted]
Division (if OTC employee)	General Education
Department (if OTC employee)	Mathematics
Project Title	Mitigating the Effects of Test Anxiety Through a Relaxation Technique called Sensory Activation
Funding Agency or Research Sponsor (if applicable)	Lindenwood University
Proposed Begin Date for Project	04/01/2016
Proposed End Date for Project	04/01/2017
Human Participants Training Certificate (must be in PDF form)	http://[redacted]/media/uploads/sites/4/ninja-forms/2015-12-01-primary-m_abbott_su14_protectinghumansubjectresearchparticipantscertificate.pdf

Project Description	http://[redacted]/uploads/sites/4/ninja-forms/otcirb-abbott-projectdescription.docx

Appendix F

October 14, 2015

Dear Dr. [redacted],

I am conducting a research study titled, *Mitigating the Effects of Test Anxiety Through a Relaxation Technique called Sensory Activation,* in partial fulfillment of the requirements for a doctoral degree at Lindenwood University.

The purpose of this study is to determine if a relaxation technique, sensory activation, designed to decrease test anxiety is effective in reducing perceived levels of test anxiety.

In addition to seeking both [redacted] and Lindenwood IRB approval, I am asking for your permission as the Principal Investigator in this study to contact students in fourteen sections of Basic Algebra during the fall 2015 semester. These sections will be randomly divided into two groups. Both groups will take a pre- and post-test survey before and after the third test via an online survey tool. One group will be shown a screen-capture video explaining the sensory activation relaxation technique, while the other group will be asked to implement any relaxation techniques with which they are already familiar.

Participation in this study is completely voluntary. The participants may decline to take the anonymous online survey without penalty and the identity of the participants and the institution will remain confidential and anonymous in the dissertation or any future publications of the study.

Please do not hesitate to contact me with any questions or concerns about participation in the study. A copy of this letter and your written consent should be retained by you for future reference.

Sincerely,

Marylynne Abbott

Appendix G

October 5, 2015

Hello Colleagues –

I'm writing to ask for your assistance in completing the data collection portion of my dissertation. I've selected 14 sections of MTH 050 [Basic Algebra] from this fall semester and all of you are the instructors for these sections. My research questions are focusing on whether a particular relaxation technique assists students in reducing their test anxiety.

Toward that end, I would need your sections of MTH 050 [Basic Algebra] (if you choose to participate) to take a pre- and post-test test anxiety survey. Ideally, the pre-test survey will occur a class day (or two) prior to Test 3 in November. Students may choose to participate in the study or not by taking the online survey during their ALEKS time. After the test, again during their ALEKS time, participating students can take the online post-test test anxiety survey. Also, half of the sections (randomly chosen) will be shown a 5-minute screen-cast video during the ALEKS time. If you choose to participate, I will provide detailed instructions and more information.

**** Until then, all I need to know is whether you would be willing to let your MTH 050 sections participate and if so, I need to know the date you are giving Test 3 in your MTH 050 sections. *****

Thank you all for your consideration in this matter & please let me know if you have any questions – Thanks! Marylynne Abbott

Appendix H

Informed consent letter

LINDENWOOD

INFORMED CONSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

"Mitigating the Effects of Test Anxiety Through a Relaxation Technique called Sensory Activation"

Principal Investigator _Marylynne Abbott__
Telephone: [redacted] E-mail: [redacted]

Participant_____ Contact info_____

1. You are invited to participate in a research study conducted by Marylynne Abbott under the guidance of Dr. Rhonda Bishop. The purpose of this research is to determine if a relaxation technique will help relieve test anxiety symptoms.

2. a) Your participation will involve
   - Completing a before testing survey.
   - Watching a 6-minute screencast video which explains and demonstrates a relaxation technique.
   - Completing an after testing survey.

   b) The amount of time involved in your participation will be approximately 10 minutes for each survey and 6 minutes to watch the video which is about 26 minutes of total time.

   Approximately 300 students will be involved in this research.

3. There are no anticipated risks associated with this research.

4. There are no direct benefits for you participating in this study. However, your participation will contribute to the knowledge about test anxiety and may help society.

5. Your participation is voluntary and you may choose not to participate in this research study or to withdraw your consent at any time. You may choose not to answer any questions that you do not want to answer. You will NOT be penalized in any way should you choose not to participate or to withdraw.

6. We will do everything we can to protect your privacy. As part of this effort, your identity will not be revealed in any publication or presentation that may result from this study and the information collected will remain in the possession of the investigator in a safe location.

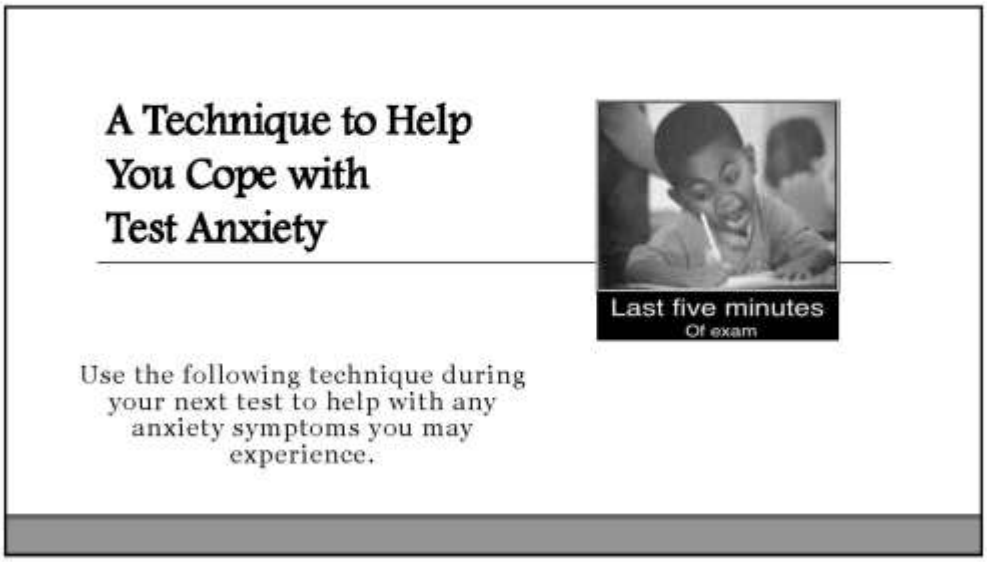
7. If you have any questions or concerns regarding this study, or if any problems arise, you may call the Investigator, Marylynne Abbott, [redacted] or the Supervising Faculty, Dr. Rhonda Bishop, [redacted]. You may also ask questions of or state concerns regarding your participation to the Lindenwood Institutional Review Board (IRB) through contacting Dr. Marilyn Abbott, Interim Provost at mabbott@lindenwood.edu or 636-949-4912.

I have read this consent form and have been given the opportunity to ask questions. I will also be given a copy of this consent form for my records. I consent to my participation in the research described above.

_____	_____
Participant's Signature Date	Participant's Printed Name
_____	_____
Signature of Investigator Date	Investigator Printed Name

Appendix I

Sensory Activation Instructional Video Screen shots:



The Sensory Activation Relaxation Technique

The power of this particular strategy is that it requires the brain to **use all the senses**.

You must use more than just a "picture" for this to really be effective.

The Sensory Activation Relaxation Technique

You will develop a scene in your imagination which you will use to help you relax whenever you feel anxious during a test.

Use all your senses.

The Sensory Activation Relaxation Technique

Where do you feel safe, the most relaxed, happy and at peace?

Example:

At the Mudhouse hanging out.

See: Lots of people; comfy furniture; tables and lamps; coffee

Hear: Quiet chatter; a bit of laughter; clicking sounds from various computer users; maybe dishes clanging or being washed.

Feel: Table I'm sitting at; my computer or book; or "if I'm lucky my hubby's hand in mine"

Smell: Coffee or maybe something sweet

Taste: "coffee with lots of creamer and maybe even some cheesecake, if I'm hungry"

The Sensory Activation Relaxation Technique

Where do you feel safe, the most relaxed and at peace?

- What does my peaceful place look like?



The Sensory Activation Relaxation Technique

Where do you feel safe, the most relaxed and at peace?

- What does my peaceful place look like?
- What does it sound like?


The Sensory Activation Relaxation Technique

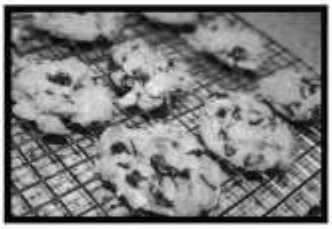
Where do you feel safe, the most relaxed and at peace?

- What does my peaceful place look like?
- What does it sound like?
- What would you feel or touch?

The Sensory Activation Relaxation Technique

Where do you feel safe, the most relaxed and at peace?

- What does my peaceful place look like?
- What does it sound like?
- What would you feel(touch)?
- What smells or scents are there?



The Sensory Activation Relaxation Technique

Where do you feel safe, the most relaxed and at peace?

- What does my peaceful place look like?
- What does it sound like?
- What would you feel if you were there? (touch)
- What smells or scents are there?
- What tastes would you experience?

The Sensory Activation Relaxation Technique

Where do you feel safe, the most relaxed and at peace?

- What does my peaceful place look like?
- What does it sound like?
- What would you feel if you were there? (touch)
- What smells or scents are there?
- What tastes would you experience?

Example:

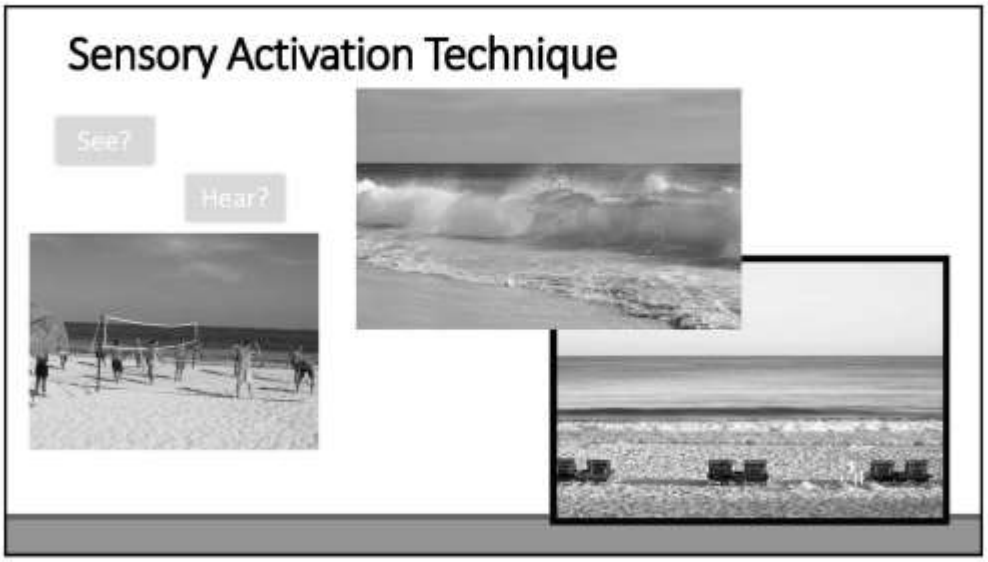
Sitting in the grandstand, watching as cars slide around the track.

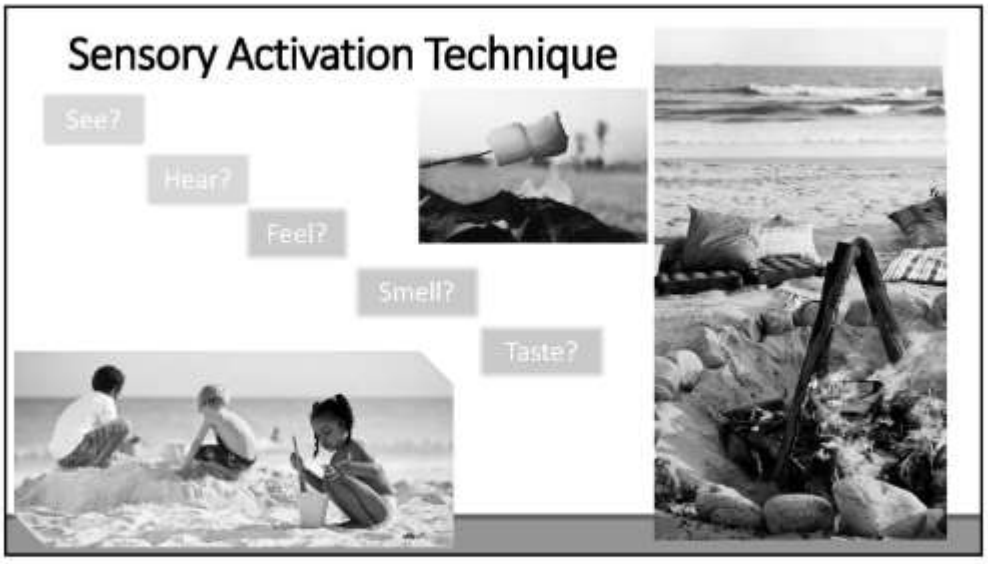
See: Cars on the track; Flagman waving flags; People cheering
Hear: Roar of engines; Announcers and people cheering
Feel: "Dirt hitting my skin & getting in my eyes." The bleachers; "the engines shaking through my body"
Smell: Gasoline; "Smoke mixed in with the smell of Burgers"
Taste: Cheeseburger I am eating; Mt. Dew I am drinking

The Sensory Activation Relaxation Technique

Where do you feel safe, the most relaxed and at peace?

- What does my peaceful place look like?
- What does it sound like?
- What would you feel if you were there? (touch)
- What smells or scents are there?
- What tastes would you experience?


Sensory Activation Technique
See?
Hear?


Sensory Activation Technique
See?
Hear?
Feel?
Smell?
Taste?

The Sensory Activation Relaxation Technique

- see?
- hear?
- feel?
- smell?
- taste?

Before your test:

Create your scene and practice "entering" your scene.

- Imagine experiencing all the things you put in the scene using <u>all your senses</u>
  - See (sight)
  - Hear
  - Touch
  - Smell
  - Taste

Before your test:

Create your scene and practice "entering" your scene.

- Imagine experiencing all the things you put in the scene using <u>all your senses</u>
  - **See (sight)**

Before your test:

Create your scene and practice "entering" your scene.

- Imagine experiencing all the things you put in the scene using <u>all your senses</u>
  - See (sight)
  - **Smell**

Before your test:

Create your scene and practice "entering" your scene.

- Imagine experiencing all the things you put in the scene using <u>all your senses</u>
  - See (sight)
  - Smell
  - **Hear**

Before your test:

Create your scene and practice "entering" your scene.

- Imagine experiencing all the things you put in the scene using <u>all your senses</u>
  - See (sight)
  - Smell
  - Hear
  - **Taste**

Before your test:

Create your scene and practice "entering" your scene.

- Imagine experiencing all the things you put in the scene using <u>all your senses</u>
  - See (sight)
  - Smell
  - Hear
  - Taste
  - **Touch**

The Sensory Activation Relaxation Technique

When you start feeling anxious during your test, close your eyes and imagine yourself in your scene.

Use all your senses.

Test Anxiety Relief:

- Close your eyes & take a deep, slow breath.
- Enter your "scene" and relax.
- Keep taking deep breaths for just a short time - even 30 seconds can be plenty of time
- Re-open your eyes and calmly begin working again.

The Sensory Activation Relaxation Technique

The Five Senses

- **Sight**
- **Hearing**
- **Smell**
- **Taste**
- **Touch**

The power of this particular strategy is that it requires the brain to **use all the senses**.

*Imagine **more** than just a "picture" for optimal effectiveness.*

Photos

http://www.californiabeaches.com/california-beach-bonfires/
http://www.thekitchn.com/how-to-make-really-good-pizza-at-home-cooking-lessons-from-the-kitchn-178384
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Vita

Marylynne Abbott was born in Springfield, Missouri. She has a passion for teaching and mathematics education. Marylynne earned her Bachelor of Science degree in mathematics education and her Master of Arts degree from Missouri State University. She was president of the mathematics honors society, Pi Mu Epsilon during her senior year.

The 2015-2016 school year marked Marylynne's thirtieth year of mathematics teaching. During her tenure as an educator, she taught students at the junior high, high school, and college levels. Marylynne also supervised mathematics tutors for her first eight years at Ozarks Technical Community College in Springfield, Missouri.

Over the years, Marylynne participated in multiple seminars, workshops, and organizations. She was a Math-Science Fellow at Brown University, a Missouri Community College Association board member, and co-director of the Missouri Great Teachers Seminar. Marylynne is currently a mathematics instructor at Ozarks Technical Community College and still resides in Springfield, Missouri.