

3-17-2016

The influence of test anxiety on memory

James J. Malloy

Rowan University, malloy33@students.rowan.edu

Follow this and additional works at: <http://rdw.rowan.edu/etd>



Part of the [Psychology Commons](#)

Recommended Citation

Malloy, James J., "The influence of test anxiety on memory" (2016). *Theses and Dissertations*. 636.
<http://rdw.rowan.edu/etd/636>

This Thesis is brought to you for free and open access by Rowan Digital Works. It has been accepted for inclusion in Theses and Dissertations by an authorized administrator of Rowan Digital Works. For more information, please contact LibraryTheses@rowan.edu.

THE INFLUENCE OF TEST ANXIETY ON MEMORY

by
James J. Malloy Jr.

A Thesis

Submitted to the
Department of Psychology
College of Science and Mathematics
In partial fulfillment of the requirement
For the degree of
Master of Arts in School Psychology
At
Rowan University
December 18th, 2015

Thesis Chair: Roberta Dihoff, Ph.D.

© 2015 James J. Malloy

Dedication

I am dedicating this thesis to my Nana, Regina Mattia.

Acknowledgement

I'd like to acknowledge my thesis chair, Dr. Roberta Dihoff, for her constant support and assistance in the completion of this thesis.

Abstract

James Malloy

THE INFLUENCE OF TEST ANXIETY ON MEMORY

2015-2016

Roberta Dihoff, Ph.D.

Master of Arts in School Psychology

The purpose of this study was to investigate the relationship between test anxiety and memory among a college population (N = 42). Specifically, the goal was to ascertain whether text anxiety had a measurable effect on memory, which was represented by scores on the Nelson-Denny reading comprehension subtest. Participants were divided into a stressed group (N = 22) and a non-stressed group (N = 20) in order to compare scores from test-takers with anxiety to those who do not. It was hypothesized that (a) test anxiety would have a significant impact on test results, (b) the non-stressed group would score higher than the stressed group, and (c) the stressed-group's memory capabilities, and thus test performance, would be reduced as a result of the test anxiety created by the environment. Results indicated that the difference between the two groups were not significant.

Table of Contents

Abstract.....	v
List of Figures.....	ix
Chapter 1: Introduction.....	1
Need for Study.....	1
Purpose.....	3
Operational Definitions.....	3
Limitations.....	4
Assumptions.....	4
Summary.....	5
Hypotheses.....	7
Chapter 2: Literature Review.....	8
Causes of Stress Among College Students.....	8
Test Anxiety: Background Information.....	10
Effects of Stress on Memory.....	13
Test Anxiety Management and Treatment.....	17
Emotional Regulation.....	19

Table of Contents (Continued)

Situation Selection.....	20
Situation Modification.....	20
Attentional Deployment.....	20
Cognitive Change.....	21
Response Modulation.....	21
Interaction with Memory.....	21
Chapter 3: Methodology.....	23
Participants.....	23
Materials.....	23
Variables.....	24
Procedure.....	24
Chapter 4: Results.....	26
Data Analyses: Non-Stressed Group.....	26
Data Analyses: Stressed Group.....	28
Data Analyses: Combined Scores.....	29
Chapter 5: Discussion.....	31

Table of Contents (Continued)

Conclusions Regarding Sample Population.....31

Limitations.....32

Future Research.....32

References.....36

List of Figures

Figure	Page
Figure 1. Non-Stressed Group Test Scores.....	27
Figure 2. Stressed Group Test Scores.....	29
Figure 3. Stressed and Non-Stressed Mean Score Comparison.....	30

Chapter 1

Introduction

Need for Study

Tests serve a fundamental role in our education system. They primarily function to gauge the progress students have made, highlighting any strengths or weaknesses. In this way, tests allow instructors to focus on struggling students or content that seems to be problematic for the class. Furthermore, examinations often serve to divide students into separate learning tracks, so that students are paired with peers on a similar academic level. Last, test scores are often the largest contributor to a student's overall grade; as such, tests are considered extremely important from both the instructor's and the student's perspectives.

While it is excellent that examinations are treated with the severity they deserve, there are often negative consequences associated with them. For one, students feel pressured to succeed on these tests, be it from parental expectation, a requirement to pass the course, or internal desire to succeed and master the content. While the stereotypical stressed-out college student studying for finals week is overblown, there is a degree of truth behind the label. The pressure results in a great deal of stress for the student, which can ultimately motivate him or her to either prepare extensively for the upcoming test or prematurely accept a failing grade. This combination of expectations, requirements, and consequences can ultimately result in test anxiety, which is the focus of this study.

Test Anxiety refers to a combination of physiological over-arousal, tension and somatic symptoms, along with worry, dread, fear of failure, and catastrophizing, that occur before or during test situations. Test anxiety can cripple students, resulting in a

much poorer test score than they actually deserve. As previously mentioned, examinations and their scores are the cornerstone of our education system. If students are experiencing test anxiety, their test performance is compromised. Because of the extensive list of consequences associated with poor test performance, it is extremely important to discern how test anxiety affects students and which abilities are hindered most.

The purpose of this study is to investigate the potential connection between test anxiety and a student's decreased memory. Ultimately, the goal of a typical test is to assess a student's knowledge of the lesson. Because of this, a student's ability to recall information from their lectures, assignments, and studying is essential to succeed. Unfortunately, some researchers suggest that test anxiety actually reduces a person's ability to recall information. If test anxiety does have a negative influence on a test-takers memory abilities, how can a stressed-out student's scores be representative of their achievement?

Fortunately, research on the matter is split. Some studies conducted have shown that test anxiety can work as a motivating factor for students, ultimately resulting in increased study time and enhanced memory during the test. Others contrast greatly with this, stating that test anxiety actively works against a person's memory capabilities and has a profound negative impact on test performance. While the data on the subject is extensive, there remains a degree of grey area. Because of this, the primary goal of this study is to investigate whether test anxiety works to enhance or inhibit a test-takers memory.

Purpose

The purpose of this study is to two-fold. First, this study seeks to determine whether test anxiety has an observable impact on memory. Student test performance will be used to gauge this interaction. Second, this study seeks to determine which level of stress is most conducive to memory. In this case, there will be two separate testing environments: stressed, and non-stressed. By manipulating the stress levels of the two separate groups, it will be easier to see which environment allows participants' memory to work most clearly. Ideally, this will provide valuable information in terms of which testing environment is most beneficial for students, as well as how significant an impact test anxiety can have on a person's memory.

Operational Definitions

Nelson-Denny Test: The Nelson-Denny test is a reading and vocabulary test given to gauge performance levels in their respective areas. For the purposes of this study, scores on the reading portion of the test will be used to measure the effect of test anxiety on participant's memory abilities.

Stress: a state of mental or emotional strain or tension resulting from adverse or very demanding circumstances. For this study, stress will be represented as test anxiety.

Test Anxiety: a combination of physiological over-arousal, tension and somatic symptoms, along with worry, dread, fear of failure, and catastrophizing, that occur before or during test situations. For the purposes of this study, test anxiety will be manipulated to affect participant's scores on the sample test, thus representing their memory capabilities.

Working Memory: the part of short-term memory that is concerned with immediate conscious perceptual and linguistic processing. Students will be utilizing their working memory abilities in this study, as they will be tasked with comprehending the information of the passages and utilizing that information in a short period of time.

Limitations

This study utilized a reading comprehension assessment to gauge the effects of test anxiety on memory. As such, results may not prove accurate when applied to test anxiety in other fields, such as mathematics or science, as the skillset utilized in these subjects drastically differs.

Participants were also strictly college students, so conclusions may not apply to the interaction between anxiety and memory among all populations, specifically school-aged children under the age of 18.

Last, medical and mental health histories were not requested or documented. Thus, it is unknown if participants in either the stressed or non-stressed group are pre-disposed to anxiety symptoms.

Assumptions

It is assumed that each participant actively tried to complete this study's activity. Active participation includes beginning the Nelson-Denny assessment when asked, as opposed to before or after the designated time period, diligently working on the test throughout the time period, and completion of the test when notified to do so. Participants will be expected to put forth their best efforts on this test.

It can also be assumed that participants had no prior knowledge of the information on test given. The Nelson-Denny utilizes passages with widely varied information. While students may find some areas familiar due to schooling, it is assumed that participants had no prior knowledge as to which categories will be present on this assessment prior to completion.

Similarly, it can be assumed that participants will not be providing information concerning the test to future potential study participants. All information presented by the Nelson-Denny must be as new as possible to accurately represent the interactions between working memory and test anxiety in a real-world scenario. Participants will be asked to keep the content of this study to themselves until completion of data collection.

Moreover, it is assumed that each participant only completed the activity once. Due to the method of obtaining participants, students will only be limited to registering once for this study. Multiple test completions would dramatically skew scores and invalidate the test anxiety measures presented, as students would be operating on long term memory as opposed to short term memory.

Summary

This study was completed in the fall of 2015, and utilized the Rowan University student population as participants. Data was collected by having these students register for participation in the study, and then having them complete a short activity. Specifically, students were separated into two separate groups in order to complete the Nelson-Denny reading comprehension sub-test under different conditions. Completion of the Nelson-Denny test involved reading multiple passages and responding to a series of

multiple-choice questions assessing the student's reading comprehension and analytical abilities.

The first group was placed in a low-stress environment. Here, students were not given any additional directions beyond how to complete the test, and were then allowed to begin. Because students registered for participation in this study, they were aware of the 15-minute timeframe, but were not reminded of this prior to beginning the test period. Moreover, students were not informed of time remaining throughout the test. After test administration, student-administrator interaction was limited to answering any questions pertaining to test completion. Ultimately, the group was under much less pressure to complete and succeed on the test.

The second group was placed in a stressed environment while completing this assessment. The stressed environment features a restrictive time period of 10 minutes and urging from the test administrator. Specifically, members of this group were instructed to work as quickly as possible to complete the test while also being reminded of how short their time limit was. Moreover, students were frequently reminded of their time limitation, with prompts from the administrator such as "You only have 5 minutes left", "You only have 2 minutes left", and "You only have one-minute left, please finish working on your test". In this way, the members of this group were pressured to complete the test accurately and quickly.

Hypotheses

The prediction of this study is that participants in Group A (non-stressed), will score significantly higher on the worksheet than Group B (stressed). This is because Group A will complete the test in a relaxed environment, with few restrictions or requirements to generate stress. Conversely, Group B will score more poorly on the test due to the increased environmental, social, and academic pressure. This stressful environment will inhibit their ability to encode and retrieve the information, thus resulting in poorer scores.

Hypothesis 1: Test Anxiety will have a significant impact on scores on the Nelson-Denny reading comprehension subtest.

Hypothesis 2: Group B (Stressed) will experience reduced memory ability as a result of the administer-created test anxiety, thus reducing test scores.

Hypothesis 3: Scores from Group A (Relaxed) will be significantly higher than Group B (Stressed).

Chapter 2

Literature Review

Causes of Stress Among College Students

Research shows that test anxiety is correlated with significantly poorer academic performance (Zeidner 1998). This is concerning, as 25% of middle-and high-school aged American students have shown decreased performance in school due to test anxiety (Hill 1984). Put in perspective, this amounts to nearly 10 million school-aged children. Studies have also been conducted to examine the occurrence and consequences of test anxiety in college students. Chapell, Blanding, Silverstein, et al. (2005) split participants into groups based on the severity of their anxiety and the level of academics (undergraduate versus graduate). It was found that test anxiety made a significant effect on grade point averages among undergraduates, as those that scored high in test anxiety scored more poorly than those with low test anxiety. Specifically, the anxious students scored an average of a third of a letter grade lower, or a B- instead of a B, compared to their counterparts. Moreover, test anxiety was found to be more prevalent in and have more consequences for females than males, though this trend decreases as students age. In graduate students, test anxiety appeared to have minimal effect.

While test anxiety appears to decrease as grade level increases, daily stressors do not follow the same trend. Research shows that younger adults experience more daily stressors than older adults (Stawski 2008). Furthermore, these stressors elicit a stronger negative emotional response among younger adults than older. Daily stressors can include simple activates, such as social and moral obligations, household chores, or

traffic. Previous research also identifies that considerable daily stress, and in turn negative emotions, can lead to daily distress (Bolger). In this study, the youngest adults, who also experienced the most frequent and significant stressors, were college students.

Furthermore, students enrolled in college are exposed to a particular set of stressors. A study published in the *Journal of Rural Health* broke down college stressors into four groups: physical, financial, academic, and psychological (Calloway 2012). Students frequently suffered from lack of sleep and inability to relax when it came time to sleep. Incidentally, this lack of sleep is both the result and cause of further stress. Additionally, college students are removed from their usual support groups, as moving away from home is typically associated with entering college. This can greatly affect students' coping mechanisms, as they do not have their parents, siblings, or familiar social surroundings to sublimate stress. College students are also exposed to increased responsibility, such as paying rent, upkeep on a house or apartment, grocery shopping, and in some cases laundry. The stress created by these activities is closely linked with anxiety over becoming an adult. Academic stress is also hugely important, as students mentioned that they typically felt pressured to meet standards imposed by family, to attain high enough grades to graduate on time, secure an ideal job, or maintain a scholarship.

Research also shows that social responsibilities followed closely behind these other stressors (Ross, Niebling, Heckert 2008). It is not uncommon for college students to engage in multiple extracurricular activities, such as athletics, clubs, student government,

or an off-campus job. Time management was a frequently occurring issue, as students expressed difficulty maintaining their academic requirements with ongoing social and work responsibilities. The inability to fulfill their requirements in each given area represented a great deal of stress for students.

Test Anxiety: Background Information

Test anxiety refers to the various negative emotions a student may associate with taking an exam. In most cases, the student is worrying about the difficulty of the test and the consequences of failure (Ortner and Caspers 2015). These misconceptions generally result in poorer academic performance as a result of the physical and psychological influences test anxiety has, but also because the test-taker is dividing their focus between these negative thoughts and test completion. Moshe, McKeachie, and Lin (1981) state that the most significant effect of this anxiety is its ability to interfere with the students' test taking processes. Specifically, the student will engage in irrelevant responses as opposed to working on the actual content. These responses frequently feature inattention, which distracts the student's train of thought and wastes valuable test-taking time. This disruption has been associated with poorer performance in schools and negative thoughts and emotions (Diaz 2001). Moreover, performance pressure and the perceived difficulty of the assignment can greatly elevate anxiety levels (Hinze and Rapp 2011). In this case, the individual's anxiety will likely increase if the test is weighed as a heavy portion of their final grade, as performance pressure is dramatically increased. Moreover, the student's perception of the difficulty of the class is heavily personalized, as student

strengths are heavily differentiated. Because of this, test anxiety can vary greatly between subjects and across peers.

In discussing test anxiety, it is important to note that there is a significant difference between trait anxiety and state anxiety. Zeidner (2007) states that trait anxiety is the person's likelihood to be stressed by any given situation. These people will become stressed at the thought of tests or difficult academic assignments without having to be in a situation where they are directly being tested. Trait anxiety is described as a person's method on handling all life situations, not just academics (Linnenbrink 2007). State anxiety, however, occurs incidentally, and is crucial to understand in-context. Those that have state test anxiety will experience this on an assignment they feel is particularly difficult, but may not in a subject that they perform well on. In the context of assessing applied test anxiety, both trait and state anxiety produce similar effects. It is important to note, however, that increased perceived difficulty and performance pressure will increase the likelihood of state anxiety to occur. This means that more important, difficult tests will create anxiety in students that typically do not suffer its effects, as the test will influence participants incidentally.

Anxiety can have significant effects on a students' performance. Research has shown that students who exhibit a high degree of anxiety typically have lower grade point averages and score lower on reading, intelligence, and aptitude tests (Deffenbacher 1980). The degree of anxiety is also a consideration. Research has shown that there are two typical reactions to test stress: ego-defensive and those focused on completion

(Sarason 1952). In small doses, test anxiety can actually improve performance by offering the individual increased motivation, thus resulting in more task-relevant actions. Higher amounts of anxiety, however, produce ego-defensive reactions. This results in irrelevant actions which interfere and disrupt task completion, generally leading to poorer scores on tests (Sperber 1961). For the purposes of this study, higher doses of test anxiety will provide more valuable feedback, as the intent is to determine if test anxiety can negatively impact memory, and thus scores. Irrelevant, disruptive behavior that results from higher levels of test anxiety reduces students' working memory capabilities, typically resulting in poorer performance. It is also important to note that these disruptions increase test-taking time, as more time is being spent on irrelevant behaviors.

This is significant, as time constraints on assessments are also a consideration when discussing test anxiety. The hypothesis is that when a challenging task is presented to an individual, their outlook on accomplishing it decreases. This occurs because of their concern to succeed at the assignment, and results in a stressed test-taker. In the case of timed test, the limited time represents a significant increase in difficulty. Previous research conducted at Vanderbilt University (Morris and Liebert 1969) has shown that the participants asked to complete a test on a strict timer exhibited significantly more anxiety than the participants that were not timed. This applied to participants that scored as both high and low on a worry scale, and highlights the increased pressure that a time restraint places.

The data provided by Hinze and Rappe (2011) on perceived difficulty and pressure is problematic when combined with Morris and Liebert's study (1970) on test anxiety and timed assessments. Many standardized tests, such as the SATs and GREs, are renowned for being difficult, closely monitored, timed, and predictive of future success. Moreover, there are severe consequences behind these test scores, as they may allow or deny access to a better college based on performance. Last, these tests feature manipulating new information in the reading comprehension and writing sections, which could prove difficult to anxious test takers as their working memory capabilities are reduced and disrupted by inattentive behavior and test anxiety's physical symptoms. Based on the studies' information, such tests likely prove difficult for students with trait anxiety, but will also result in state anxiety as the social and academic emphasis on success for these tests is so essential.

Effects of Stress on Memory

Test anxiety has a very significant impact on physical processes, which ultimately damage a person's memory. When stressed, the hypothalamic-pituitary-adrenal axis is activated, causing the release of Glucocorticoids, or Cortisol. This can affect several abilities, such as memory creation and retrieval (Beckner 2006). This is problematic, as a typical test is designed to assess a student's knowledge on the content, mandating appropriate memory retrieval. Moreover, Lupien (1998) has shown that chronic stress can have a significant negative affect on declarative memory, with mixed effects on smaller doses. Specifically, it can enhance the abilities of someone's memory if the stressor is emotionally arousing. The length of time after the stressor is introduced can negatively

affect glucocorticoids' ability to enhance emotionally arousing memory (Schonfeld, Ackermann, Schwabe 2014). In the context of testing emotional material and stress, a wait period between the encoding process and the retrieval will result in a less significant benefit of emotionally aroused memory processes.

The time in which stress is applied can also change the effect it has on memory. Research has shown that stress' effect changes based on the phase in memory formation in which it is initially applied. In situations where stress is maintained throughout the entirety of the learning process, including encoding, transfer to long-term memory, and recall, performance is dramatically decreased. Multiple studies have utilized this technique, providing participants with an unreasonable amount of information that will be shortly accessed, sometimes within 20 minutes. The results of these studies have generally shown very poor performance. It is theorized that this impairment in test performance is likely an issue with stress on retrieval, and not encoding (Roosendaal 2002). Because of this, studies have been completed to test the effect of stress over a prolonged learning experience, as opposed to providing material and assessment during the same period. Conrad, Lupien, and McEwan (1999) completed a study that exposed participants to stress during the learning phase, but then placed a 24-hour waiting period before retrieval would be necessary. In these tests, subjects actually showed improved test scores compared to the control group, which were not exposed to a stressful environment during encoding.

These findings are supported by several other studies. Ashcraft and Kirk (2007) conducted a study to examine the effects of stress on working memory, and its implication on mathematic ability. The researchers found the high-anxiety participants performed more poorly on the assessment than their counterparts, due to the fact that they were focusing their working memory on their anxiety, as opposed to the task at hand. It is important to note that the stress was applied to subjects throughout the entirety of the learning process, thus agreeing with Roozendaal's (2002) initial proposal that retrieval is the issue. Furthermore, these findings would likely apply more directly to females as opposed to males, as they tend to experience test anxiety in the field of mathematics much more frequently, decreasing with age (Ganley 2014). Similarly, a study was conducted to measure the differences in verbal aptitude test scores between high and low test anxious groups. In this study, the high-anxiety participants actually scored better than the low-anxiety group (Katahn 1966). Once again, the stressors were not in place during the encoding phase of memory creation.

Several researchers have explored potential treatments for test anxiety. Studies have been conducted to explore the possibility of repeated-testing to reduce its effect on test scores. Tse and Pu (2012) measured participants' working memory and test anxiety into high and low groups, and then divided them into two different testing formats. One group was given a repeated-testing session, while the other received repeated studying. Both groups were given a one-week wait period between encoding and retrieval. The results showed that the repeated testing group actually scored higher than the repeated

studying group. This proved to be true across the board, for both low and high working memory and test stress participants. This study also highlights the notion that a wait period between stress application and memory recall can prove beneficial.

As previously mentioned, emotional material can have a different interaction with anxiety as non-emotional material. It has been determined that test anxiety over emotionally arousing material can result in increased memory, as opposed to the inhibition anxiety typically causes. This is due to the fact that emotional memory is remembered much more clearly than other memories, as a result of the interaction between the amygdala and the hippocampus (Buchanan 2007). Moreover, it has also been found that stress hormones can influence human memory encoding, which are present during assessments in individuals with test anxiety (Cahill and Alkire 2003). This lends credence to the hypothesis that emotionally arousing information is more easily recalled because of the hormonal enhancement applied when stress occurs (Cahill 2003). Furthermore, the mere presence of emotion when learning material can have an effect on encoding (Laird 1982). Research has shown that students tasked with reading emotionally-neutral information will recall it more easily if they were assigned an emotion to associate it. In this case, certain students were asked to smile or frown as they read the articles. As a result, these same students scored higher when asked to recall the information presented to them.

Test Anxiety Management and Treatment

While test anxiety can have a significant impact on one's performance, there are methods of reducing its impact. A study conducted by Deffenbacher (1980) sought to compare the effectiveness of two respected techniques for minimizing anxiety: anxiety management training and self-control desensitization. Both strategies train individuals to detect the physical cues of anxiety arousal so that they can begin practicing self-relaxation techniques. Moreover, these programs also seek to allow participants to learn from their anxiety and manage future stressors. As such, their overall anxiety levels decrease as their time in the training program increases.

Furthermore, each of Deffenbacher's selected programs are particularly effective in different areas. Self-control desensitization has been shown to reduce test anxiety, speech anxiety, and social anxiety. This method may also be used to address targeted anxiety, or anxiety related to a specific area. Self-control desensitization is particularly relevant to the current study as a result of its effectiveness in treating test anxiety, and could serve as a potential recommendation to those suffering from its effects. That being said, anxiety management training proves itself as a potent treatment program as well, offering effective aid in the areas of math anxiety, text anxiety, and speech anxiety, as well as being noted as an excellent program for reducing non-targeted, or general, anxiety with increased involvement. An important note, however, is that neither treatment proved particularly effective immediately following the study, which is to say that regular training and follow-up appointments are necessary to accurately treat test anxiety using these methods.

Another study, conducted by Embse, Barterian, & Segool (2013), compared the effectiveness of multiple different treatment techniques when used on a sample population with prior history in anxiety. One of these programs utilized Cognitive-Behavior Therapy (CBT) techniques with varied degrees of relaxation training in order to assess the impact on test anxiety. The population, in this case, was ninth-graders in the New Orleans area following the Hurricane Katrina disaster who suffer from varying degrees of anxiety, test anxiety, and Post-Traumatic Stress Disorder. The population was divided into four groups: CBT with relaxation training, CBT without relaxation training, relaxation training alone, and attention control training alone. Teachers rated student's anxiety levels following participation in their assigned program. Results indicated that none of the four groups succeeded in reducing general test anxiety, but that the CBT with relaxation was successful in reducing math-based test anxiety. The exception to this, however, is the relaxation training only group. Here, participants were taught breathing exercises to combat their test anxiety symptoms. This group demonstrated reduced test anxiety across all subjects, including English, Math, Science, and Technology.

This same study utilized an additional nine other treatments with the intent of seeing which aspects of test anxiety treatment are most effective, or which specific program reduced symptoms the most. Their conclusion is that test anxiety treatment can be divided into five separate categories: behavioral, cognitive, cognitive-behavioral, study skills, and test-taking skills (Embse, Barterian, & Segool 2013). As previously mentioned, the cognitive, behavioral, and combined methods are frequently and effectively used to treat general anxiety disorder, and does benefit students based on the function of their test anxiety. The study skills and test-taking categories typically present

themselves as specific interventions used to treat the outcome of test anxiety, as opposed to addressing any occurring anxiety disorder. Most significantly, this study found that biofeedback, or focusing on the physiological effects of test anxiety, may prove to be particularly effective in combatting test anxiety's effects. This would offer students conscious control of the physical elements of test anxiety, which would allow them to employ their relaxation techniques on the onset of anxiety symptoms. There is a biofeedback software specifically used for test anxiety called "EmWave" which has proven successful in reducing test anxiety's impact on students, and may prove a valuable intervention option for educators dealing with test anxiety.

Emotional Regulation

As previously stated, test anxiety works to enhance negative emotions in students, which results in disruptive, inattentive behavior, as well as directly reducing performance. These negative emotions are the core of test anxiety, and can largely be addressed through emotional regulation. Emotional regulation is defined as the physiological, cognitive, and behavioral processes that enable individuals to control their experiences and emotions (Davis, DiStefano, and Shutz 2008). In the context of test anxiety, this refers to the test-takers ability to moderate negative thoughts, such as fear of failure, impending consequences, or inability to succeed on the given task. The ability, or lack thereof, to regulate emotions is predictive of whether someone will be susceptible to test anxiety or not. Davis, Distefano, and Shutz (2008) have also outlined five separate strategies of emotional regulation.

Situation Selection. Situation selection is an emotional regulation strategy whose basic premise is avoiding stressors. Specifically, individuals will seek out people, places, and situations that evoke positive emotions while avoiding those that play on or enhance their anxieties. Situation selection can be counter-productive to combatting test anxiety, as avoidance of the stressor is largely impossible.

Situation Modification. Unlike situation selection, situation modification focuses on the individual adapting the stressful situation to support their needs. The modifications are made to decrease anxiety-inducing stimuli and enhance positive emotions. Ultimately, this technique is not an option for students, as instructors have authority on the context of the test's administration.

Attentional Deployment. Attention deployment is the act of focusing on one topic or area and down-playing the importance of another. In the context of test anxiety, this is the strategy in which students complete the easier questions of the test first before considering the more difficult ones. Unlike the prior to methods, attentional deployment has actually been found to be a largely successful strategy. Davis, Shutz, and DeCuir (1999) found that students that frequently used this strategy demonstrated significantly lower test anxiety than peers. This is because attentional deployment allows individuals to reduce the perceived difficulty of the assessment by eliminating the quicker to answer, or easier, questions early on. By doing so, test-takers have fewer difficult questions to work on, which reduces negative emotions created by test anxiety. Moreover, this reduces disruptive, inattentive behavior, as test-takers have a clear idea as to which questions are left and how successful they have been on the test thus far. Last, this strategy features confidence building, as students are answering easier material first.

Decreased anxiety symptoms leads to reduced negative affect on memory, which increases their success on the more difficult questions saved for later.

Cognitive Change. Cognitive change is the act of re-evaluating the experience to create more positive emotions. Specifically, individuals will be presented with a stressor, in this case a test, and will create a positive meaning from their experience. A secondary potential effect of this strategy is rationalizing the importance of the assignment. While this will reduce test anxiety, it may not necessarily improve performance.

Response Modulation. Unlike the previous strategies, response modulation is not defined by the attempt to change the context of the stressor, their beliefs about the stressor, or the consequences causing their negative emotions. Rather, response modulation focuses on suppressing these emotions to focus on task completion instead. Response modulation is a coping strategy, in that its goal is to manage the psychological stress created by the stimulus (Lazarus 2001).

Interaction with Memory. Emotional regulation is extremely relevant when discussing the potential correlation between test anxiety and memory, as the quality of an individual's emotional regulation will greatly impact the effect of test anxiety. With strong emotional regulation skills, test anxiety's effects are greatly diminished, resulting in lesser impacts on memory and test performance. The opposite, unfortunately, is true as well; students with poor emotional regulation suffer amplified anxiety, and thus poorer negative effects. It is not quite so simple, however, as emotional regulation strategies can be categorized into two groups: task-focused and emotion-focused.

As previously mentioned, research conducted on anxiety's effect on memory is controversial, as some studies suggest heightened performance while others suggest the opposite. Davis, Distefano, and Shutz (2008) have analyzed data from multiple studies, ultimately coming to the conclusion that the orientation of one's emotional regulation strategy greatly impacts test anxiety's effects. Specifically, it was found that test-takers that focus more on task-oriented emotional regulation saw reduced negative effect on memory abilities, while those that focused on emotion-oriented regulation strategies had heavily reduced memory capabilities. Moreover, the task-oriented regulation strategies sometimes actually increased memory performance and test ability. These results may indicate that strategies such as attentional deployment and response modulation may prove particularly effective when used for test anxiety, as attentional deployment focuses on completing each task independently of the more difficult tasks and response modulation focuses on suppressing and coping with negative emotions.

Chapter 3

Methodology

Participants

The participants for this study is exclusively limited to college students at Rowan University. Participants will sign up through the SONA system, which allows students to complete studies for class credit. Participants will all be enrolled in an introduction to psychology course before completing this study. Completion and participation in this study is voluntary. Students under the age of 18 were not deemed eligible for study completion.

The Nelson-Denny tests were administered in academic classrooms at Rowan University during pre-set timeframes. Test administration was done in groups; the largest group contained 22 students, while the smallest group had only 3. 42 Nelson-Denny tests were completed and used for data analysis.

Materials

The test used for this study is the Nelson-Denny reading comprehension test. Traditionally, the test is administered in two segments: one for a vocabulary section, and another for the reading. For the purposes of this study, only the reading will be used. The reading comprehension test tasks students with reading short passages and responding to a variety of questions. The Nelson-Denny test is a timed reading assessment. Students' performance on this test will be used as the data to gauge the effects of test anxiety on memory.

Paper copies of the Nelson-Denny test were administered to the students. Participants had access to the test and an answer sheet. The Nelson-Denny

Administration and Scoring guide is necessary in order to properly conduct this study and score participants' scores.

The Nelson-Denny's reading comprehension subtest includes seven separate passages with associating multiple-choice questions. These questions were used to assess a multitude of reading-based abilities, and as such features great variety in question style. Specifically, the multiple choice questions can range from a simple memory-based "What was said in the first paragraph?" to "What was the purpose of this passage?". The test tasks students with remembering or seeking information, defining themes or main ideas, or indicating contextual definitions of words. This reading test can be effectively used for this study as the content covered in the passages are largely obscure, and as such prior education and long-term memory are less significant.

Variables

The independent variables include the duration of the test and administrator-created stressors, such as emphasis placed on completion and score. The dependent variable is the participants' scores on the Nelson-Denny reading segment. The experimental design will be an independent T-test.

Procedure

In order to complete this study, two separate procedures were followed: one for non-stressed test-taking, and one for stressed test-taking. The first procedure is followed for the group that will not be receiving stimuli fostering elevated levels of anxiety. Once participants had all arrived, students were given a set of directions. They were asked to only complete the reading comprehension portion of the Nelson-Denny and that they will have plenty of time to complete the assignment. Students were not informed of their time

restriction (15 minutes), and were allowed to begin following those brief instructions. After 15 minutes, students were asked to stop working on their tests.

For the stressed group, there were some alterations in the procedure. Students were still informed of their requirement to complete only the reading comprehension portion of the test, but they were also informed that they only had 10 minutes to work on it. Moreover, students were asked to work as quickly and accurately as they can and work toward completing the test to the best of their ability. 10 minutes after beginning the test, students were asked to stop working and turn in their answer sheets.

Due to the emphasis on completion time, this study is particularly sensitive to late attendance. In these cases, students were requested to stay until their respective time requirement was met, or asked to reschedule otherwise. No participant received additional or reduced time to complete the reading comprehension test.

Chapter 4

Results

Before presenting results, it is important to understand how participant test scores were obtained. First, all tests were scored by hand using the Nelson-Denny Administration and Scoring Guide, which comes with the test itself. Next, all tests were scored based on questions attempted, as opposed to completion. For instance, a participant that reached question 22 will be scored from 1-22, while a participant that reached question 25 will be scored out of 25. This measure was taken to account for the time difference between the two groups, as the focus should be on accuracy of response instead of time available to complete the test. Without this measure, group A would have an advantage on the test outside of test anxiety levels, which would skew results.

Data Analyses: Non-Stressed Group

The non-stressed group, or group A, was the section that received 15 minutes to complete the Nelson-Denny reading comprehension assessment. Moreover, this group was not reminded of their time limitations prior to completing the test. The non-stressed group contained 20 participants, roughly half of the total sample collected. Results in Table 1 display group A's scores on the test. To summarize, the mean score for the non-stressed group was 83.35 (SD = 10.45).

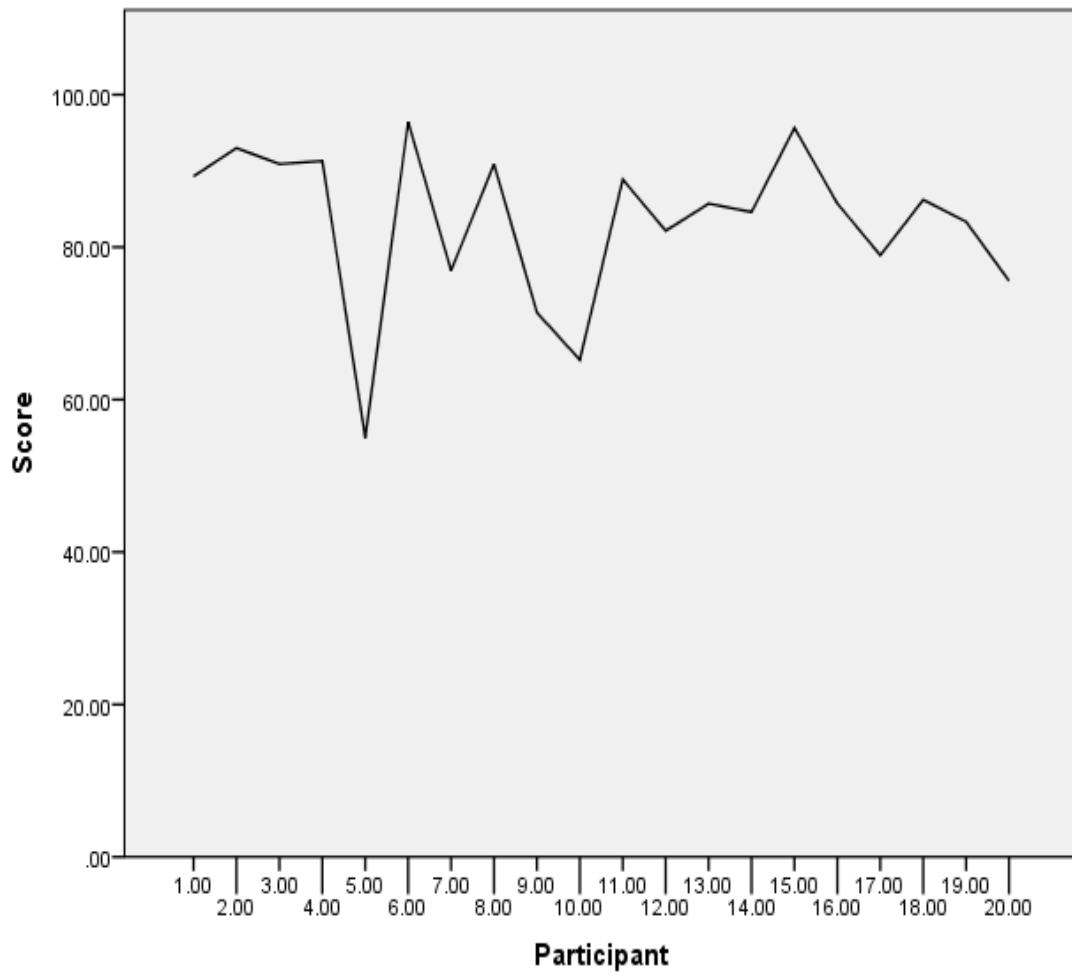


Figure 1. Non-Stressed Group Test Scores.

Data Analyses: Stressed Group

The stressed group, also referred to as group B, was the section that was limited to 10 minutes to complete the Nelson-Denny reading comprehension test. This group was specifically informed of this time restraint, was reminded at time intervals (5-minutes remaining, 2-minutes remaining, and 1-minute remaining), and urged to work as quickly and accurately as possible. The stressed group was comprised of 22 participants, roughly half of the total sample population. Results in Table 2 are statistics related to group B's performance on the Nelson-Denny. Specifically, their overall mean score was 81.40 (SD = 10.09).

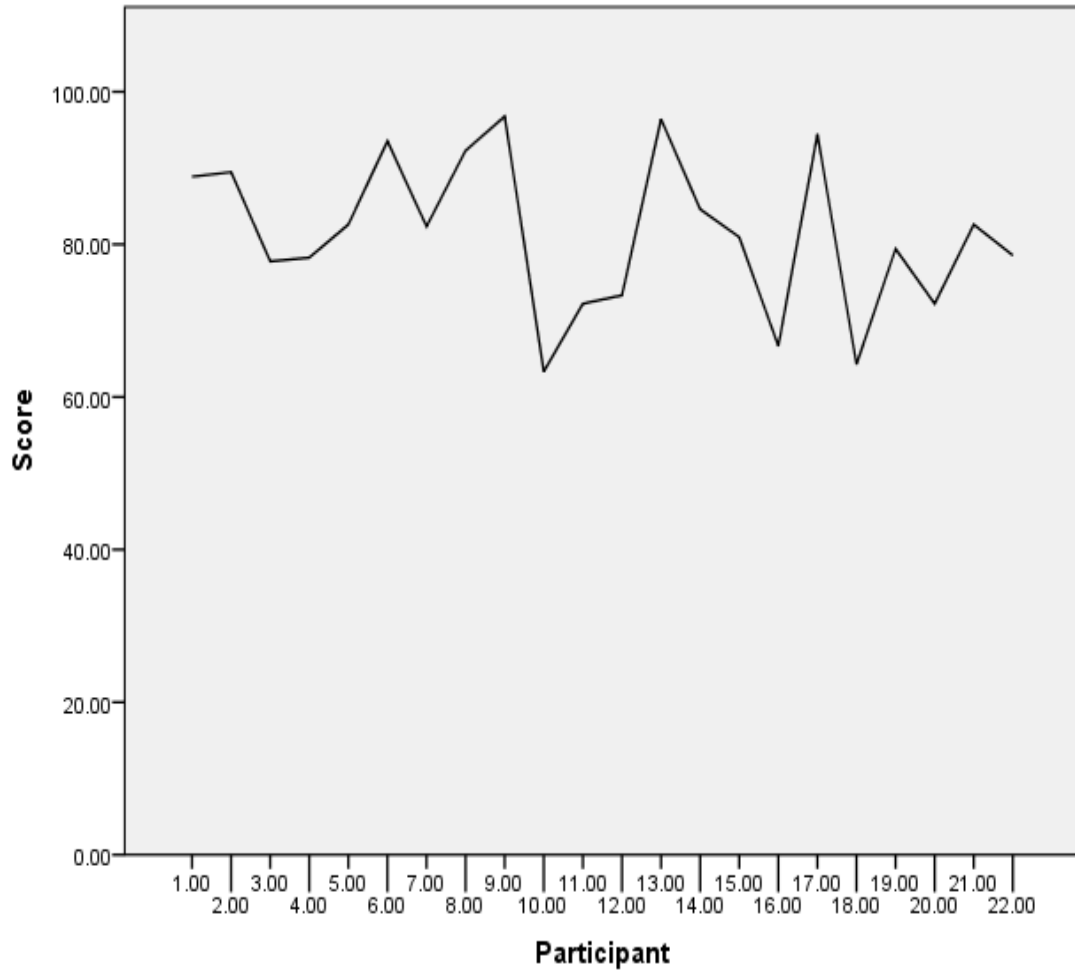


Figure 2. Stressed Group Test Scores.

Data Analyses: Combined Scores

In order to analyze the combined scores from group A and B, an independent samples t-test was conducted. Results from this statistic process can be seen in Table 3 below. Results have indicated that there was no significant difference between the non-stressed group's scores ($M = 83.35$, $SD = 10.45$) and the stressed group's scores ($M = 81.40$, $SD = 10.09$); $t(40) = .614$, $p = .543$ two-tailed. These results suggest that the

degree of anxiety that test-takers were subject to did not have a significant impact on their ability to take the Nelson-Denny test.

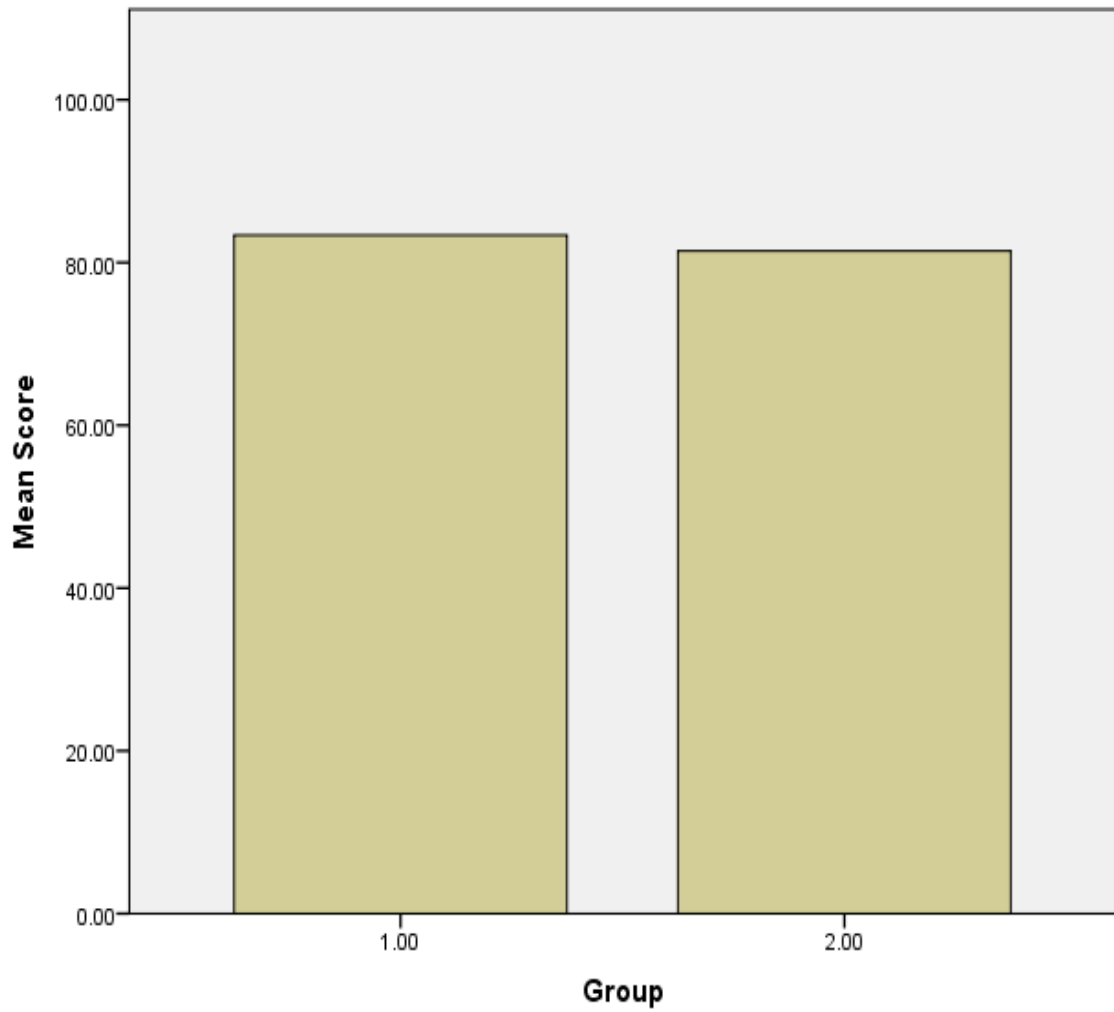


Figure 3. Stressed and Non-Stressed Mean Score Comparison.

Chapter 5

Discussion

Conclusions Regarding Sample Population

The purpose of this study was to determine if test anxiety had a significant impact on memory. For this study, participant scores on the Nelson-Denny test was used to assess this interaction, with higher scores representing a reduced negative affect from anxiety. This study was conducted to decide if a test-taker's anxiety levels contributed to their performance.

The first hypothesis was that test anxiety would have a significant affect, either positive or negative, on participant memory, thus skewing test scores. The second hypothesis was that Group B, in the stressed environment, would have reduced memory abilities and thus score more poorly on the Nelson-Denny assessment. The third hypothesis was that group A, receiving little interference, would score higher than group B. Ultimately, none of these hypotheses were supported by this study's data. The difference in scores between group A and group B was not significant, $p = 0.543$.

These results indicate several potential conclusions. First, the data suggests that the anxiety level present among the participants was not a deciding factor in their performance on the reading test. Based on prior research and the study's design, this would also indicate that the anxiety-inducing measures did not negatively affect memory. Alternatively, it could be concluded that the difference in anxiety between the two groups was not significant enough to create an observable difference in test performance.

Limitations

There were several limitations for this study. First, the sample size was not particularly large (N = 42). This is further exacerbated as the total population was split into the non-stressed group A (N = 20) and the stressed group B (N = 22). This sample size was used due to reliance on student's selective participation in the study. Participants were not actively sought out, and instead recruited via Rowan University's SONA system for psychology students.

Another limitation this study faces is that its results may not be an accurate representation of the general population as all participants were college students above the age of 18. As such, data provided may not be indicative of test anxiety's effect on high school or middle school aged students' memories.

Additionally, background information concerning the student's medical history and mental health was not collected. As such, it is unknown if test-takers of either group currently experience an internalizing disorder or an anxiety disorder which could affect their test results, ultimately skewing data for that particular group. Similarly, information about student's academic performance, specifically in the areas of English, was not collected. As such, it is entirely possible that the reading comprehension ability of students was a confounding variable, offsetting some of the created test anxiety.

Future Research

Text anxiety is an extremely relevant factor among students; as such, there has been much research conducted on its antecedents, effects, and treatments. It can be expected that research in this area will continue to grow.

Future research should focus on different school subjects, to seek any correlation between the specific subject and test anxiety. This study focused entirely on reading comprehension, as it is a skill than spans multiple subjects, but it would prove beneficial to branch out to other areas. Mathematics is a commonly seen area for test anxiety, and may provide beneficial results in terms of assessing its affects. Furthermore, previous research has suggested that treatment strategies vary in effectiveness based on the school subject the student struggles with, making a comprehensive test anxiety study particularly beneficial for practical use.

Moreover, future research should employ differing techniques to foster test anxiety in participants. For this study, time limitations and reminders were used to create anxiety in students. There are a multitude of directions research could proceed in in terms of assessing which environmental influences trigger anxiety more profoundly. In the future, more concrete interventions, such as a reward or punishment, may also be necessary to generate sufficient anxiety to impact student's memory and thus, performance. Students ultimately experience test anxiety because they fear some consequence of performing poorly on the examination. Because of the way this study's recruitment functioned, participants were not at risk of receiving academic consequences. As such, basic anxiety stimuli and social stressors were used almost exclusively. Any future research should employ significant interventions to attempt to mimic real-world examples.

Additionally, the timing of this study's data collection occurred towards the middle of the participant's semester, beginning in October 2015 and ending November 2015. It may prove beneficial to compare data between test-takers at the beginning of the

semester in September with those at the end of the semester, in December. Finals week sparks a significant amount of anxiety in students and could have a profound effect on test results. A study analyzing test scores in this fashion could provide valuable information concerning how profoundly outside influences are on a participant's anxiety, and whether or not that effects their memory and performance on the assessment.

Furthermore, this study utilized the Nelson-Denny's reading comprehension sub-test due to its relatively short time requirement to complete and manageable difficulty level. Prior research has shown that students have a harder time encoding information when they are under stress; as such, the Nelson Denny's emphasis on new information expressed through the passages and answer accuracy based on reading comprehension proved a perfect fit. In the future, a longer, more difficult test may provide a completely different angle for research. Specifically, the area of frustration, which is a common byproduct of test anxiety, was not present in this study. A more rigorous sample test could glean insight as to how potent perceived difficulty's effects are on memory and performance.

The current study did not collect data as to prior mental health issues. That being said, collecting this data and screening those that indicate some prior form of anxiety or depressive disorder could provide information as to how those with an existing issue handles test anxiety. In such a study, the anxiety stimulants and test content could be adjusted to determine which combinations work to most significantly damage a test taker's memory, and which heightens them. Students that are already confirmed as having test anxiety are much more likely to respond to these administrator-created stimulants, and as such, correlations could more accurately be made.

Similarly, it could prove beneficial to reach out to students with poor working memory skills. Working memory refers to the ability to take in information, remember it, and then utilize it within a short period of time. Students with poor working memory might find a test such as the Nelson-Denny to be difficult, as it is timed and features the presentation of a wide variety of new information in a short period of time. Moreover, the test demands students to quickly comprehend and analyze data in order to use this information for the multiple-choice questions. This data could prove particularly useful, as it may provide insight as to which environments create the least and most test anxiety in participants. Moreover, it could allow researchers to determine which test anxiety measures resulted in higher test scores and which resulted in lower. Last, associating each measure to a particular subject, such as differentiating between a reading study and a math study, could also aid in determining anxiety's effects on memory.

References

- Ashcraft, M., & Kirk, E. (2007). The relationships among working memory, math anxiety, and performance. *Journal of Experimental Psychology: General*, 224-237.
- Beckner, V., Tucker, D., Delville, Y., & Mohr, D. (2006). Stress Facilitates Consolidation Of Verbal Memory For A Film But Does Not Affect Retrieval. *Behavioral Neuroscience*, 518-527.
- Bolger, N., DeLongis, A., Kessler, R. C., & Schilling, E. A. (1989). Effects of daily stress on negative mood. *Journal of Personality and Social Psychology*, 57, 808– 818.
- Buchanan, T. (2007). Retrieval Of Emotional Memories. *Psychological Bulletin*, 761-779.
- Cahill, L. (2003). Enhanced Human Memory Consolidation With Post-Learning Stress: Interaction With the Degree of Arousal at Encoding. *Learning & Memory*, 270-274.
- Cahill, L. and Alkire, M. (2003). Epinephrine enhancement of human memory consolidation: Interaction with arousal at encoding. *Neurobiol. Learn. Mem.* 79:194 –198.
- Calloway, S., Kelly, P., & Ward-Smith, P. (2012). Stressors and barriers to help seeking for psychological distress among students attending a rural university. *Journal of Rural Mental Health*, 3-10.
- Chapell, M., Blanding, Z., Silverstein, M., Takahashi, M., Newman, B., Gubi, A., & McCann, N. (2005). Test Anxiety And Academic Performance In Undergraduate And Graduate Students. *Journal of Educational Psychology*, 268-274.

- Conrad, C. D., Lupien, S. J., & McEwen, B. S. (1999). Support for a bimodal role for Type II adrenal steroid receptors in spatial memory. *Neurobiology of Learning and Memory*, 72, 39–46.
- Davis, H., DiStefano, C., & Schutz, P. (2008). Identifying Patterns Of Appraising Tests In First-year College Students: Implications For Anxiety And Emotion Regulation During Test Taking. *Journal of Educational Psychology*, 942-960.
- Davis, H. A., Schutz, P. A., & DeCuir, J. T. (1999). “They can't tell me I'm stupid”: Undergraduate students coping with test anxiety. Paper presented at the annual meeting of the American Psychological Association, Boston, MA.
- Deffenbacher, J. (1978). Worry, emotionality, and task-generated interference in test anxiety: An empirical test of attentional theory. *Journal of Educational Psychology*, 248-254.
- Deffenbacher, J. L., Michaels, A. C., Michaels, T., & Daley, P. C. (1980). Comparison of anxiety management training and self-control desensitization. *Journal Of Counseling Psychology*, 27(3), 232-239.
- Díaz, R., Glass, C., Arnkoff, D., & Tanofsky-Kraff, M. (2001). Cognition, anxiety, and prediction of performance in 1st-year law students. *Journal of Educational Psychology*, 420-429.
- Ganley, C., & Vasilyeva, M. (2014). The role of anxiety and working memory in gender differences in mathematics. *Journal of Educational Psychology*, 105-120.
- Greenberg, R., Pearlman, C., Schwartz, W., & Grossman, H. (1983). Memory, Emotion, And REM Sleep. *Journal of Abnormal Psychology*, 378-381.
- Hayes, S., Hirsch, C., & Mathews, A. (2008). Restriction of working memory capacity during worry. *Journal of Abnormal Psychology*, 712-717.

- Hill, K. T., & Wigfield, A. (1984). Test anxiety: A major educational problem and what can be done about it. *Elementary School Journal*, 85, 105–126.
- Hinze, S. R., & Rapp, D. N. (2011). *How does test anxiety influence testing effects?* Paper presented at the Eighty-Third Annual Meeting of the Midwestern Psychological Association, Chicago, IL.
- Katahn, M. (1966). Interaction of anxiety and ability in complex learning situations. *Journal of Personality and Social Psychology*, 475-479.
- Kuhlmann, S. (2005). Impaired Memory Retrieval After Psychosocial Stress In Healthy Young Men. *Journal of Neuroscience*, 2977-2982.
- Laird, J., Wagener, J., Halal, M., & Szegda, M. (1982). Remembering what you feel: Effects of emotion on memory. *Journal of Personality and Social Psychology*, 646-657.
- Lazarus, R. S. (2001). Relational meanings and discrete emotions. In K. R. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion* (pp. 37–67). New York: Oxford University Press.
- Linnenbrink, L. A. (2007). The role of affect in student learning: A multi-dimensional approach to considering the interaction of affect, motivation, and engagement. In P. A. Schutz & R. Pekrun (Eds.), *Emotion in education* (pp. 13–36). Amsterdam: Elsevier.
- Luethi, M. (2008). Stress Effects On Working Memory, Explicit Memory, And Implicit Memory For Neutral And Emotional Stimuli In Healthy Men. *Frontiers in Behavioral Neuroscience*.
- Lupien, S. J., de Leon, M., de Santi, S., Convit, A., Tarshish, C., Nair, N. P., et al. (1998). Cortisol levels during human aging predict hippocampal atrophy and memory deficits. *Nature Neuroscience*, 1, 69–73.

- Lustman, P., Sowa, C., & O'hara, D. (1984). Factors influencing college student health: Development of the Psychological Distress Inventory. *Journal of Counseling Psychology*, 28-35.
- Maroun, M., & Akirav, I. (2008). Arousal and Stress Effects on Consolidation and Reconsolidation of Recognition Memory. *Neuropsychopharmacology*, 394-405.
- Merz, C., Wolf, O., & Hennig, J. (2010). Stress impairs retrieval of socially relevant information. *Behavioral Neuroscience*, 288-293.
- Mika, A., Mazur, G., Hoffman, A., Talboom, J., Bimonte-Nelson, H., Sanabria, F., & Conrad, C. (2012). Chronic stress impairs prefrontal cortex-dependent response inhibition and spatial working memory. *Behavioral Neuroscience*, 605-619.
- Morris, L., & Liebert, R. (1969). Effects of anxiety on timed and untimed intelligence tests: Another look. *Journal of Consulting and Clinical Psychology*, 240-244.
- Morris, L., & Liebert, R. (1970). Relationship Of Cognitive And Emotional Components Of Test Anxiety To Physiological Arousal And Academic Performance. *Journal of Consulting and Clinical Psychology*, 332-337.
- Moshe, Benjamin, M., Mckeachie, W., Lin, Y., & Holinger, D. (1981). Test anxiety: Deficits in information processing. *Journal of Educational Psychology*, 816-824.
- Murray, B., Muscatell, K., & Kensinger, E. (2011). Effects of emotion and age on performance during a think/no-think memory task. *Psychology and Aging*, 940-955.
- Ortner, T., & Caspers, J. (2015). Consequences of Test Anxiety on Adaptive Versus Fixed Item Testing. *European Journal of Psychological Assessment*, 157-163.
- Paulman, R., & Kennelly, K. (1984). Test anxiety and ineffective test taking: Different names, same construct? *Journal of Educational Psychology*, 279-288.

- Rickenbach, E., Almeida, D., David, S., & Lachman, T. (2014). Daily Stress Magnifies the Association Between Cognitive Decline and Everyday Memory Problems: An Integration of Longitudinal and Diary Methods. *American Psychological Association*.
- Roosendaal, B. (2002). Stress and memory: Opposing effects of glucocorticoids on memory consolidation and memory retrieval. *Neurobiology of Learning and Memory*, 78, 578– 595.
- Ross, S., Niebling, B., & Heckert, T. (2008). Sources of stress among college students. *College Student Journal*, 33(2), 312-318.
- Sarason, S., & Mandler, G. (1952). Some correlates of test anxiety. *The Journal of Abnormal and Social Psychology*, 810-817.
- Schönfeld, P., Ackermann, K., & Schwabe, L. (2014). Remembering under stress: Different roles of autonomic arousal and glucocorticoids in memory retrieval. *Psychoneuroendocrinology*, 249-256.
- Smith, R., Arnkoff, D., & Wright, T. (1990). Test anxiety and academic competence: A comparison of alternative models. *Journal of Counseling Psychology*, 313-321.
- Sperber, Z. (1961). Test Anxiety And Performance Under Stress. *Journal of Consulting Psychology*, 226-233.
- Stawski, R., Sliwinski, M., Almeida, D., & Smyth, J. (2008). Reported Exposure And Emotional Reactivity To Daily Stressors: The Roles Of Adult Age And Global Perceived Stress. *Psychology and Aging*, 52-61.
- Tse, C., & Pu, X. (2012). The effectiveness of test-enhanced learning depends on trait test anxiety and working-memory capacity. *Journal of Experimental Psychology: Applied*, 253-264.

von der Embse, N., Barterian, J., & Segool, N. (2013). Test anxiety interventions for children and adolescents: A systematic review of treatment studies from 2000–2010. *Psychology In The Schools, 50*(1), 57-71.

Zeidner, M. (1998). *Test anxiety: The state of the art*. New York: Plenum Press.

Zeidner, M. (2007). Test anxiety in educational contexts: Concepts, findings, and future directions. In P. A.Schutz & R.Pekrun (Eds.), *Emotion in education* (pp. 13– 36). Amsterdam: Elsevier.