The Effect of Pre-Test Journaling on Student Test Anxiety

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Abstract

Education professionals, college admissions personnel, and employers all use students’ test scores to make crucial decisions that have significant long-term consequences for young people. This leaves educators with the responsibility of ensuring their assessments are valid, fairly representing their students’ understanding of the content. Students must believe their efforts will be reflected by their grades to be motivated to master the material. A serious concern for many students is the belief that their test scores do not accurately reflect their content mastery due to the debilitating effects of test anxiety. Many psychologists and educators believe anxiety interrupts students’ thought processes, inhibiting working memory. One proposed solution to the confounding effects of test anxiety is the practice of pre-test journaling immediately prior to a test. Participants in this study completed an anxiety inventory, wrote about the stress they experienced before quizzes and a final exam, and ranked their stress levels before and after a series of assessments with and without pre-test journaling. Like previous studies, this research suggests journaling immediately before assessments may help alleviate test anxiety and improve test scores, especially for individuals who report high test anxiety. This result supports a compelling argument for the implementation of pre-test journaling in every classroom.
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Chapter 1

Introduction

An effective education system requires appropriate methods of assessment. To stay motivated in the classroom, students must believe their effort will be recognized and rewarded in a meaningful manner. One of the most meaningful ways teachers can recognize student success is through grades, but arbitrarily high grades eliminate accountability for students to gain content mastery. Rewarding success while maintaining accountability requires valid assessments that accurately reflect students’ understanding of the content. Although all educators share this responsibility, high school science teachers must be especially diligent in their pursuit to maintain student motivation. Many students enter high school science courses with low self-efficacy toward science. This leaves students particularly susceptible to loss of motivation after only one poor test score.

Research suggests that deceivingly low test scores may be combated by allowing students to lower their test anxiety through pre-test journaling. Test anxiety has been shown to activate the amygdala, the emotion center of the brain. Working memory in the prefrontal cortex appears to suffer from over-stimulation by the amygdala, suggesting that anxiety inhibits working memory, the brain’s scratch pad. The practice of pre-test journaling may therefore allow student test scores to more accurately reflect students’ knowledge. This would motivate students to engage in science rather than focusing exclusively on activities with little value for their futures.

The number of stimuli vying for students’ attention is now greater than ever before, as technology provides more media and communication tools. While students now receive more information from non-academic sources, they are also expected to learn more information in
their science courses. As the global scientific community makes more discoveries about our universe, much of this information is incorporated into the curricula of high school science courses. Because scientific knowledge is cumulative, scientists who make discoveries advocate for the information learned in their research to be included in high school science classes around the world. This progression of information prepares each new corps of scientists more thoroughly than the last. However, it also places an ever-increasing burden on young adults to learn more information than the generation before them. This deepening of high school science curricula makes pivotal the validity of science assessments. To feel motivated in science courses, students must trust their teachers to provide them with the best opportunity to be successful. This opportunity requires assessments that fully reflect each student’s understanding.

Ensuring the validity of assessments in science courses is not an insignificant endeavor. One can easily imagine the impact of invalid science assessments on teachers and students. Inappropriate assessments lead to low student motivation and poor grades, which frustrate teachers. Students also feel the effects of classroom assessments outside the classroom. High school grades are used to determine student rankings, athletic eligibility, college admissions, scholarships, and employment. Without valid grades to identify the most successful students, colleges and employers risk extending admission, scholarship money, or employment to individuals less qualified and deserving than their peers.

More broadly, society as a whole suffers greatly from invalid high school science assessments. Current unemployment estimates suggest that around 7% of the American population is unemployed. This translates to over 20 million people out of work. However, the unemployment rate for technical careers is negative. Companies cannot find enough qualified people to fill technical positions. This discrepancy highlights the need for wide-scale technical
training, which relies on a solid background in science education. These unfilled technical positions also stifle the progression of technology. Mastery of science enables individuals to test new technologies, which make life more comfortable for everyone. Every modern technology was developed by individuals with a solid background in science. Society would not enjoy cell phones, computers, or the internet without individuals using science to make our lives easier. These individuals would not have the confidence or opportunity to pursue a career in science without valid means through which to demonstrate their content knowledge.

**Research Question**

If an opportunity exists to increase the validity of high school science assessments, it must be pursued for the sake of students and society. Potential methods of increasing assessment validity must be investigated and optimized in order to maintain student motivation and develop a culture of scientific competence. Pre-test journaling has shown promise as a simple yet effective way to reach these goals. The purpose of this experiment is therefore to determine the answer to the question: Can the practice of pre-test journaling significantly improve test scores for students who suffer from test anxiety?
Chapter 2

Literature Review

Text anxiety research has increased dramatically over the past few decades, providing valuable insight into a complex issue. Education professionals, psychologists, and neuroscientists have collaborated to develop an ever-growing library of research results and subsequent theories. This research has taken place through true experimental design as well as through action research carried out in classrooms, with each method contributing its strengths to the comprehensive field.

A logical question to ask before investigating test anxiety is whether or not tests are a relevant focus. Are tests important enough to merit researchers’ time? As Salend (2011) discusses in his article Addressing Test Anxiety, test results are used to gauge students’ understanding of course content to appropriately adjust the pace of the course. This means that invalid tests can cause teachers to progress through content more slowly than necessary and risk incomplete coverage of later topics. Test scores are also used to make decisions with significant long-term consequences for students, including their education track, high school graduation, college admission, and employment.

In fact, some of these tests have been coined “high-stakes tests”, a term with which students are unfortunately familiar. As Sadker and Zittleman (2004) put it, “We know too well the alphabet soup of high-stakes tests - ITBS, SAT, ACT, and GRE. Our scores on some of these tests brand us for life, creating hopeful futures or lost opportunities” (p. 740). These tests undoubtedly induce strong feelings of anxiety in many students’ minds, because students know that their futures are significantly affected by their performances on these tests.
Some may argue that students who suffer from test anxiety should simply gain mastery over the content to alleviate their anxiety. Research suggests this solution is insufficient in many cases. Partin et al. (2011) argue that “students do not necessarily acquire positive attitudes toward science as they learn more science” (p. 88). This leaves educators with the responsibility of finding more creative ways to help students combat anxiety than simple content mastery. Test anxiety stems in part from low self-efficacy, which studies have shown to be malleable. Bandura described four ways to increase an individual’s self-efficacy. They include mastery experiences, vicarious experiences, verbal persuasion, and physiological/affective states. Mastery experiences are those in which an individual experiences the result of his or her acquired skill or knowledge. Vicarious experiences are those in which an individual observes another person demonstrating his or her mastery of a skill or content. Verbal persuasion is the use of constructive verbal feedback to build an individual’s confidence. Physiological/affective states refer to students’ interpretations of the physiological sensations they experience during stressful situations. “If students treat this response as a normal process rather than as a sign of inability, self-efficacy will increase” (Partin et al., 2011, p. 87). Addressing test anxiety directly can help students to fully demonstrate their understanding of course content during assessments.

Test anxiety will remain a hurdle for students as long as they view tests as a threat rather than an opportunity to demonstrate their knowledge. Bonaccio and Reeve (2010) found that although “students perceive test-related properties as most anxiety-inducing, self-perceptions appear to be more strongly empirically related to the level of test anxiety they experience” (p. 617). This result means that students are vulnerable to test anxiety even during less intimidating tests. It also supports the claim that focusing on anxiety directly holds more promise for mitigating student test anxiety. Students may not recognize how strongly their self-efficacy
influences their performances on assessments. Defense mechanisms lead students to blame external factors such as test parameters for their failures. It is the responsibility of educators to invest in the emotional development of their students, empowering them to conquer anxiety regardless of the environment.

When educators can control students’ testing environment, though, they must ensure that students are not disadvantaged by external factors. Research by Onwuegbuzie and Seaman (1995) suggests that anxiety’s effects can be mediated by eliminating time constraints.

Twenty-six graduate students who were enrolled in an intermediate-level statistics course were randomly assigned to the two examination groups, timed or untimed. Both low- and high-anxious students performed better on the final course examination under the untimed condition than under the timed condition. However, the benefit of the untimed examination was greater for high-anxious students than for low-anxious students.

(Onwuegbuzie & Seaman, 1995, p. 115)

This result provides a strong argument for the elimination of time constraints. All students benefited from a lack of time constraints, but the benefit to high-anxious students was more significant. This suggests that the exclusion of time constraints mitigated the detrimental effects of test anxiety.

Complete elimination of test anxiety is not a feasible goal for all students, but this is not necessarily a misfortune. Pressure affects every individual differently, and it can be an asset to students. Mattarella-Micke, Foster, Beilock, Mateo, and Kozak (2011) studied how subjects’ salivary cortisol concentrations correlated to test performance. Cortisol is released during stressful situations, so it is a logical focal point for test anxiety research.
For higher working memory individuals high in math anxiety, the higher their concentration of salivary cortisol following the math task, the worse their performance. In contrast, for higher working memory individuals lower in math-anxiety, the higher their salivary cortisol concentrations, the better their performance. (Mattarella-Micke et al., 2011, p. 1000)

Only students who suffer from math-anxiety were negatively affected by stress-induced cortisol. Minimizing test anxiety appears to be the most appropriate goal, allowing students to benefit from the pressure of tests rather than floundering because of it.

In a similar study, researchers administered cortisol to participants directly rather than manipulating environmental factors to indirectly induce the production of cortisol. Researchers instructed participants to refrain from smoking, eating, or drinking anything other than water before sessions to preserve baseline cortisol levels. An independent measures design was then followed, with participants receiving either cortisol or placebo. “Memory retrieval of neutral and emotional information was impaired by a single dose of cortisol compared to placebo. The memory impairment due to cortisol remained, even after a washout period of 1 week” (Tollenaar et al., 2009, p. 23). This result supports the hypothesis that cortisol is responsible for memory impairment, which indirectly points to stress as a negative influence on student test performance.

Tollenaar et al. are not alone in their prescribed solution to this issue. Another research team compiled data that indicated that the extent of HMAs’ (individuals with high math anxiety) math deficits is associated with the ability to ramp up cognitive control resources in response to the prospect of doing math, which leads to a reorganization of task priorities, due at least in part to motivational factors. (Lyons & Beilock, 2011, p. 7)
Their results suggest that “emotional control processes that act early on the arousal of negative affective responses are more effective at mitigating these responses and limiting concomitant performance decrements than explicit suppression of these responses later in the affective process” (Lyons & Beilock, 2011, p. 8). Eliminating test anxiety entirely does not appear to be the most promising solution to its negative effects. Educators should rather address students’ feelings of anxiety prior to assessments and teach students how to utilize their emotions.

Another argument for creative solutions to test anxiety is the fact that although it affects every student differently, it affects all kinds of students. Whitaker-Sena, Lowe, and Lee (2007) analyzed the effects of test anxiety on students with and without learning disabilities. The results of the study “suggest that the factor structure of the Test Anxiety Inventory for Children and Adolescents across nominal groups of interest (i.e., students with and without learning disabilities) is similar” (Whitaker-Sena, Lowe, & Lee, 2007, p. 366). Students with learning disabilities in this study reported stronger feelings of worry regarding tests, however. This is a serious concern, because “as worry increases in test-anxious students, more effort and spare processing capacity are devoted to the solution of the anxiety problem associated with the test taking process, at the expense of solving the test problems” (Whitaker-Sena, Lowe, & Lee, 2007, p. 371). Students with learning disabilities may therefore be especially vulnerable to negative effects of test anxiety. In order to ensure that all students can be successful in an inclusive classroom, test anxiety must be addressed by educators.

Culture also plays a significant role in student test anxiety. Stankov (2006) investigated how Confucian culture contributes to the anxiety students experience. Multiple aspects of Confucian culture could contribute to high test anxiety. These include the tendency for individuals from Confucian Asian countries to be less forgiving than Europeans, for example.
The belief that effort rather than ability is the primary cause for success is another potential cause for high test anxiety. Whatever the reasons, Stankov (2006) found that

Confucian Asian students experience high anxiety and self-doubt compared to students in other parts of the world whose performance is only slightly lower. Despite their strong academic performance, the presence of higher mean anxiety/self-doubt should be of some concern to educators and to societies as a whole. (Stankov, 2006, p. 562)

Even when anxiety is not reflected in lower test scores, it can have dire consequences for the quality of life students experience.

One group of researchers delved deeper into the connection between anxiety and working memory in particular. They investigated how differences in individuals’ working memory capacity affected their susceptibility to the anxiety’s detrimental effect on memory. Participants in the study performed a highly demanding dual-task that consisted of a primary short-term memory task and a secondary tone discrimination task that served as a measure of spare capacity. Anxiety and working memory capacity interacted to affect performance on the auditory task so that those low in working memory capacity were particularly vulnerable to anxiety’s disruptive effect, whereas those high in working memory capacity were buffered against anxiety’s effect. (Johnson & Gronlund, 2008, p. 201)

These results provide strong evidence for the assertion that anxiety hinders working memory an important asset to students during assessments.

Working memory is not the only form of memory affected by test anxiety. As Putwain (2007) discovered through his research with British schoolchildren,
individuals high in test anxiety have more structured and pervasive ‘worry clusters’ in long-term memory, which include thoughts and images based on prior experiences of evaluative situations involving failure. These clusters predispose test anxious individuals to perceive assessment situations as more threatening and worry cognitions are more easily triggered. (p. 580)

Test-anxious students appear to be conditioned to fear assessments through the experience and recollection of negative testing situations. This recall of uncomfortable experiences in which students involuntarily engage triggers physiological arousal, which intensifies students’ discomfort when perceived as a sign of weakness. Teachers need to look for ways to minimize students’ recall of previous failures or train students to use their physiological arousal constructively.

Application of research often relies on a strong theoretical basis, but “a review of the most popular test anxiety models developed over the past 50 years shows that these paradigms differ in how they conceptualize test anxiety” (Lowe et al., 2008, p. 217). Even for the most experienced researchers, it is a daunting task to treat a condition for which the cause is not known. The multidimensional nature of test anxiety has led to many theories undergoing consistent revision. Lowe et al. (2008) argue that “more comprehensive models of test anxiety are needed that (a) define the test anxiety construct more broadly, (b) include many key components found in earlier models, and (c) incorporate current research” (p. 217). As the library of test anxiety research grows, scientists and educators are better able to refine current theories and combine the strengths of multiple theories.

Researchers at Miami University and the University of Chicago describe the negative effects of test anxiety as choking under pressure, which they describe as “performing more
poorly than expected, given one’s skill level, in situations where performance pressure is at a maximum” (DeCaro, Thomas, Albert, & Beilock, 2011, p. 390). This aligns with the belief that test anxiety’s negative effects are not a result of an inability to perform, but rather a confounding variable preventing students’ abilities from being displayed. Two schools of theory are discussed as potential methods by which performance is hindered. Distraction theories propose that anxiety-induced irrelevant thoughts distract individuals from the task at hand, making it difficult for students to focus on assessments. Explicit monitoring theories offer a radically different explanation. They propose that anxiety leads individuals to focus too intently on the task at hand, disrupting subconscious processes that assist in execution of a task. Explicit monitoring theories refer more strongly to kinesthetic tasks, but both areas of research provide concerns to address during assessments.

The contradictory theories regarding test anxiety speak to the issue’s complexity. Bruch, Juster, and Kaflowitz (1983) of the State University of New York at Albany discuss performance problems in 3 components: acquisition, organization/rehearsal, and retrieval/application. The most immediate concern of test anxiety is with retrieval or application, because it represents the inability to recall or apply one’s knowledge. However, this has consequences that reach beyond a single test. If a student underperforms on a test due to a problem with retrieval or application, he or she is likely to develop low self-efficacy. This can decrease motivation and lead to poor study habits. This is when organization and rehearsal are hindered, when a student neglects to prepare for a secondary assessment due to a lack of confidence. Finally, a refusal to prepare for assessments leads to a lower ability to acquire subsequent information. Test anxiety may begin with a short-term detriment, but it can easily lead to significant long-term problems.
If oppositional theories speak to test anxiety’s complexity, research that both supports and contradicts a single theory provides ample reason to delve deeply into test anxiety. Ng and Lee (2010) of the National Institute of Education in Singapore used processing efficiency theory as a theoretical framework for their investigation into the effects of test anxiety. Processing efficiency theory suggests that although anxiety hinders the efficiency with which students complete tasks, students’ overall effectiveness is not significantly affected. “Consistent with the PET, processing efficiency, but not performance effectiveness was detrimentally affected by test anxiety” (Ng & Lee, 2010, p. 1229). However, they “did not find support for the PET’s assumption that state anxiety mediates the test anxiety-task performance relationship” (Ng & Lee, 2010, p. 1229). Ng and Lee’s work demonstrates that more research is needed to determine the merit of processing efficiency theory as well as rival theories.

Research by Powell (2004) demonstrates the scope of test anxiety’s influence. Powell investigated the effect of test anxiety on individuals who have demonstrated an impressive amount of knowledge and potential: medical students. Through systematic desensitization, behavioral rehearsal, and psychoeducational practices, Powell was able to help ninety-three percent of his students pass a test required for medical licensure, which is a significantly higher percentage than the national average for repeat test takers. Powell discusses a dual deficit of test anxiety in which students fail to prepare as well as perform. As he states, “because test anxiety can adversely affect study habits as well as test performance, the most successful therapeutic interventions are likely to be those that improve test taking skills as well as moderating tension” (Powell, 2004, p. 854) during the test itself. This provides a valuable scaffold on which educators can develop intervention practices.
The most central intervention practice to the current research is that of pre-test journaling, but this research is not the first study to investigate journaling’s potential benefits. Ramirez and Beilock (2011) of the University of Chicago conducted a similar study in which they “reasoned that, if worries lead to poor test performance and writing helps regulate these worries, then giving students the opportunity to express their thoughts and feelings about an impending examination would enhance test performance” (p. 211). Ramirez and Beilock compared test scores of students who journaled about their concerns before tests to scores of students who sat quietly or journaled about an unemotional past event. Students who engaged in expressive writing showed a less significant correlation between test anxiety and exam score than the control group. This study has inspired subsequent research, including the current investigation.
Chapter 3
Methods

Introduction

Although a growing library of research has suggested a connection between anxiety and test performance, the intricacies of this connection are not fully understood. Differences among individual test takers and assessment conditions demand comprehensive research into such a complicated phenomenon. This study continues the investigation into this connection, using anxiety inventories and assessments that ascend Bloom’s Taxonomy. Focusing on students’ test performances rather than neurochemical readings, this applied action research looks to add depth to the library of predominantly psychological and neuroscientific research studies on the subject.

Participants

Participants in this study included 8 College Preparatory Physics students, 7 Environmental Science students, and 25 College Preparatory Chemistry students. The participants included 28 juniors, 12 seniors, 15 males, and 25 females. All of the participants lived in a rural area with a low average household income. No selection process was necessary for this study, because the test data for students in all of my classes were analyzed. Participation in the journaling aspect of this study was optional to prevent confounding variables, but data from every student who chose to participate were analyzed to maximize the sample size.
**Instrumentation**

*Test Anxiety Inventory*

The first component of this experiment was a test anxiety inventory, which was designed to reveal each student’s susceptibility to test anxiety. To ensure the validity of the inventory, it was modeled after the Test Anxiety Inventory for Children and Adolescents. The TAICA is an inventory with a wealth of research supporting its validity, so it is a natural model for anxiety inventories. The inventory consisted of statements related to test anxiety with which respondents were asked to rate the extent to which they agreed with each statement. A Likert scale was utilized, because its value has been thoroughly supported. Students were asked to circle a number one through five, with one representing strong disagreement and five representing strong agreement. To control for acquiescence response bias, the inventory contained statements that suggested test anxiety as well as statements that suggested a lack of test anxiety. Social desirability bias was also prevented through an assurance that students’ responses would not be analyzed until after their grades were calculated.

*Journaling Prompt*

Before two quizzes and a final exam, students were given a paper with a prompt to write down whatever was on their mind. Students were encouraged through written and verbal means to write about stress they were experiencing. However, directions at the top of the paper were intentionally unrestricted. This left students with the opportunity to write about positive experiences or emotions, but it encouraged participation from hesitant students.
Assessments

The assessments used to analyze the effect of journaling included four quizzes and one final exam. Each quiz consisted of five questions worth a total of 15 points and followed a structure similar to the other quizzes. Difficulty was matched among quizzes as much as possible through the structural similarities and question types. This ensured that the format and weighting of each quiz would not complicate the results of the study. The final exam was considerably longer than each quiz, making it ideal to analyze for differences between pre-test anxiety and post-test anxiety. Quizzes as well as the final exam included prompts for students to rate their anxiety on a scale from 1 to 10 before and after each assessment.

Data Collection

Data collection began with the test anxiety inventory, which was disseminated to students in Chemistry, Physics, and Environmental Science courses and collected immediately after completion. The inventory was completed by almost all participants on the same day to prevent communication among students from affecting responses. Journaling prompts were distributed prior to assessments and collected directly after students journaled to remove any potential distraction during assessments. Students were instructed to notify the teacher if they preferred not to have their work read and assured that the content of journals would have no bearing on their grades. Journal entries were seen only by the primary researcher. Quizzes and a final exam were all scored by the same individual to avoid inter-rater reliability concerns. Grading took place before any anxiety data was compiled.
Data Analysis

Test anxiety inventory responses, pre-test and post-test anxiety ratings, and assessment scores were compiled after course grades were recorded. Pre-test anxiety and assessment scores were separately contrasted between quizzes that followed journaling and quizzes that did not include journaling. Pre-test anxiety ratings before a final exam were also compared to post-test anxiety ratings. These comparisons were weighed against students’ test anxiety inventory responses. The effect of journaling on test-anxious individuals’ anxiety and performance was analyzed separately from the effect of journaling on individuals without test anxiety.
Chapter 4

Results

The test anxiety inventory developed for this experiment contained 13 statements with which students were asked to rank their level of agreement. Seven of these statements suggested test anxiety and six statements suggested a lack of test anxiety. A rating of three represented a neutral response to a statement. Therefore, if a student’s ratings of pro-anxiety statements added up to 21, that student would appear to be anxiety-neutral. Similarly, if a student’s ratings of anti-anxiety statements added up to 18, that student would appear to be anxiety-neutral. Ratings of agreement with pro-anxiety statements and anti-anxiety statements were separately added for each student. Twenty-one was subtracted from the sum of pro-anxiety agreement ratings, and 18 was subtracted from the sum of anti-anxiety ratings. This left each student a value for their agreement with pro-anxiety statements and a value for their agreement with anti-anxiety statements. To represent each student’s reported susceptibility to test anxiety with a single value, the anti-anxiety sum was subtracted from the pro-anxiety sum. Each student was left with a single value representing his or her level test anxiety. A greater number represented more severe test anxiety.

A test anxiety value was calculated for each student, and students’ responses were analyzed by gender and grade. Figure 1 reveals that females reported higher test anxiety than males. Females reported an average test anxiety value of 4.36, while males reported an average test anxiety value of 3.60.
Analysis by grade revealed another difference between groups. Juniors reported higher test anxiety than seniors. While juniors reported an average test anxiety value of 4.21, seniors reported an average test anxiety value of 3.75.
Students’ reports of pre-test anxiety were also analyzed between the conditions of quizzes following journaling and quizzes without journaling. This comparison was divided between the least test-anxious students and the most test-anxious students, according to their test anxiety inventory responses. As Figure 3 illustrates, the most test-anxious students reported an average anxiety rating of 6.00 before quizzes that did not include journaling. These students’ average anxiety rating was 5.83 before quizzes that followed a journaling session. The least test-anxious students reported an average anxiety rating of 4.50 before quizzes that did not include journaling. These students also reported a lower average anxiety rating of 4.00 before quizzes that followed a journaling session.

Figure 3:
The experiment’s most central data analysis involved the relationship between journaling and test scores. As with anxiety ratings, this data was divided between the least test-anxious students and the most test-anxious students. The least test-anxious students earned an average score of 9.83 out of 15 on quizzes that did not include journaling. These students earned an average score of 10.33 on quizzes that followed a journaling session. The most test-anxious students earned an average score of 8.67 out of 15 on quizzes that did not include journaling. On quizzes that followed a journaling session, these students earned an average score of 10.33.

Figure 4:
A final exam provided an opportunity to analyze the difference between students’ pre-test anxiety and post-test anxiety. Rather than dividing this analysis into groups based on anxiety susceptibility, the top three scorers on the final exam were analyzed separately from the bottom three scorers. The top three scorers showed an increase in their anxiety of 1.00 out of 10 from before the exam to afterward. The bottom three scorers’ anxiety increased during the exam by 2.33 out of 10.

Figure 5:
Chapter 5
Discussion

Responses to the test anxiety inventory were as one might expect. Females reported greater test anxiety than males, which could be a result of negative stereotypes regarding women in science. Despite being as well-equipped to comprehend scientific content as males, females may suffer from low self-efficacy because of gender stereotypes. This divide could also be due to the tendency for males to overestimate their knowledge of science. The stereotypes that cause women to underestimate their abilities also lead men to overestimate theirs.

Anxiety differences among grades may be explained by less troubling factors. Because this research was carried out in the last few months of the school year, seniors may not have been concerned about their grades. With seniors’ college admissions, cumulative grade point averages, and class rankings already determined before the final grading period, seniors had little reason to worry about the outcome of assessments. The disregard for academics commonly referred to as senioritis is a likely culprit for seniors’ lower reports of anxiety.

The effect of journaling on pre-test anxiety is one central component of this research. In order to claim that data supports or opposes the hypothesis that pre-test journaling increases test scores through the mitigation of test anxiety, the correlation between journaling conditions and test anxiety must be analyzed. As the hypothesis would suggest, students with high test anxiety and students with low test anxiety reported less severe anxiety after journaling than without a journaling session. This supports the assertion that journaling allows students to address their stress and diminish their focus on that stress.
Contrary to the logic of the hypothesis, however, the least test-anxious students reported a more significant decrease in anxiety than the most test-anxious students. If journaling alleviates test anxiety, one would expect the most test-anxious students to report a more significant mitigation of anxiety than students who experience less severe anxiety in the first place. One explanation for this discrepancy is participant variables. Each student is unique, so comparisons between groups of students will always have confounding variables. One student may perceive an anxiety rating of six to be severe, while another may view that rating to be a typical experience. Another component is the personal nature of journaling. As student journals revealed, some students enjoyed and appreciated journaling, while others failed to see its value. This difference of opinion did not align with students’ reports of test anxiety, so some students without test anxiety benefited from journaling more significantly than some test-anxious students. Although journaling did not mitigate every student’s test anxiety equally, the effect of journaling was universally beneficial.

The central goal of this research is to determine if journaling before assessments improves test scores. For that reason, the most crucial relationship in this study is between journaling conditions and test scores. Data analysis revealed a promising occurrence for journaling’s potential as a tool to bolster assessment validity. On quizzes without pre-test journaling, the least test-anxious students outperformed their more test-anxious classmates. While the most test-anxious students earned an average score of 8.67 out of 15, the least test-anxious students earned an average score of 9.83 out of 15. This discrepancy was eliminated with the implementation of pre-test journaling. Both groups of students earned an average score of 10.33 out of 15. This is an improvement for both groups of students, but a more significant
improvement for the most test-anxious students. This strongly supports the hypothesis that pre-test journaling alleviates test anxiety and subsequently increases test scores.

If test anxiety is a cause for the discrepancy among students’ test scores without pre-test journaling, one would expect the most test-anxious students to benefit more significantly from the addition of journaling than the least test-anxious students. This is precisely what data analysis revealed. The argument that test anxiety is preventing select students from displaying their knowledge on assessments would be supported by evidence suggesting that without test anxiety, any group of randomly-selected students would perform similarly to any other group. With the group of the most test-anxious students earning the same average score on assessments following journaling as the least test-anxious students, this research was carried out in such a condition. This gives credibility to the assertion that it was the mitigation of anxiety that raised test scores rather than an unrelated factor.

A secondary investigation carried out during the experiment involved student perception of their success during a final exam. This was done through a comparison of each student’s pre-test anxiety and post-test anxiety. The students with the top three final exam scores reported an anxiety increase of 1.00 out of 10 during the exam, while the students with the bottom three final exam scores reported an increase of 2.33 out of 10 during the exam. This may reflect students’ perception of how successful they were with the exam. Students often know when they are underperforming on an assessment, and this awareness may lead to higher anxiety.

This anxiety increase may have two negative consequences. First, students may fall victim to a self-fulfilling prophecy during the test. If anxiety clouds students’ memories, encountering a question to which a student does not know the answer may lower their confidence
and cause anxiety to hinder their performance. The second consequence is students’ failure to prepare for subsequent assessments due to the memory of their past struggle. If students lack confidence in their ability to be successful on future assessments, they may lose motivation to study. This may lead to a cycle of failure to perform and subsequent failure to prepare for future assessments (Powell, 2004).

The results of this experiment align with those of Beilock (2011) and others in their support of the effectiveness of pre-test journaling as a practice to alleviate test anxiety. Immediate implementation of pre-test journaling in classrooms is therefore a natural recommendation. Student journaling provides educators with a means to increase the validity of their assessments while learning more about their students. Implementation requires little compromise by educators in terms of lesson planning, as journaling takes only a few minutes prior to each assessment. Introducing a protocol of pre-test journaling also requires no financial investment from teachers. Without any drawbacks, pre-test journaling is worth a trial in each classroom, because the potential benefits are significant.

Future research should discriminate between assessments that test working memory and assessments that test rote memorization. As Johnson and Gronlund (2008) reported, working memory may be especially vulnerable to the detrimental effects of test anxiety. Test-anxious individuals may therefore benefit more significantly from journaling before assessments that include problem-solving tasks. Journaling prompts should also be manipulated, encouraging students to journal about different subjects. In one condition, students may journal about whatever comes to mind. A second condition may have students journal about any stress they have experienced in recent memory. In a third condition, students should be instructed to write
about how they feel about the upcoming test. Analyzing conditions of different journal content would provide a clearer picture of how test anxiety affects students.

Research that adopted an independent measures experimental design would have advantages of which this experiment did not take advantage. An independent measures design would allow educators to investigate differences among students who journaled before a test and students who did not journal before the same test. Analyzing a single assessment with multiple groups would eliminate the confounding variable of inter-assessment differences. Challenges for an independent measures design include participant variables and grading complications. Each student is unique, so comparing students with various levels of content mastery presents a potential confound that must be addressed. An ethical concern would also need to be addressed in the grading of these assessments. If journaling is beneficial for students, those who did not journal before an assessment must be compensated in some way. These are important concerns that merit consideration.

Results of many research experiments, including this experiment, support the effectiveness of pre-test journaling as a method of mitigating student test anxiety. While researchers do not yet agree on the neural mechanisms responsible for journaling’s connection to test anxiety, few would argue against the merit of journaling before assessments. In fact, one participant in this study expressed sincere recognition of the power of journaling. She wrote during one journaling session, “Writing gives me hand cramps. Ew, hands are creepy. Okay, maybe writing stuff isn’t that bad. My nervousness is gone! OMG yay! So cool!” This evidence, although anecdotal, supports pre-test journaling in a manner data analysis cannot. From an international collection of research to an individual student’s candid report, the evidence supporting pre-test journaling as a means of alleviating student test anxiety is compelling.
References


Appendix A – Test Anxiety Inventory

Name __________________________

Please indicate how strongly you agree/disagree with the following statements by circling a number under each statement. Your responses will not affect your grade in any way. The only purpose of this survey is to help you, so please fill it out honestly.

1. During a test, I often find myself worrying about negative consequences for failing the test or missing a question.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Neither Agree Nor Disagree</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>

2. I usually go into most tests pretty confident.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
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<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Neither Agree Nor Disagree</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>

3. How well I do on tests is very closely related to how long I study.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Neither Agree Nor Disagree</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>
4. People will question my ability if I do poorly on a test.

1  2  3  4  5
Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

5. Tests do not affect how I physically feel.

1  2  3  4  5
Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

6. I mentally freeze up on important tests.

1  2  3  4  5
Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree

7. I get a hollow, uneasy feeling before tests.

1  2  3  4  5
Strongly Disagree Disagree Neither Agree Nor Disagree Agree Strongly Agree
8. Tests do not stress me out.
   1  2  3  4  5
   Strongly Disagree  Disagree  Neither Agree Nor Disagree  Agree  Strongly Agree

9. I often defeat myself with negative thoughts while taking a test.
   1  2  3  4  5
   Strongly Disagree  Disagree  Neither Agree Nor Disagree  Agree  Strongly Agree

10. If I do poorly on a test, people will understand that my performance is not necessarily a reflection of my ability.
    1  2  3  4  5
    Strongly Disagree  Disagree  Neither Agree Nor Disagree  Agree  Strongly Agree

11. After tests, I usually feel like I could have done better than I did.
    1  2  3  4  5
    Strongly Disagree  Disagree  Neither Agree Nor Disagree  Agree  Strongly Agree
12. Tests give us an accurate picture of how much students know.

1                    2                         3                          4                 5
Strongly Disagree    Disagree        Neither Agree Nor Disagree    Agree            Strongly Agree

13. During tests, I often forget things I really know.

1                    2                         3                          4                 5
Strongly Disagree    Disagree        Neither Agree Nor Disagree    Agree            Strongly Agree
Appendix B – Journaling Prompt

Write for a few minutes about whatever is on your mind. It does not need to relate to class. Write about what is stressing you out (relationship, parents, school, work, etc), something you’re excited about, or something funny that recently happened. Anything you want to write about is great.
17 issues found. Score: 65 of 100

Score: 65 of 100 (weak, needs revision)

- The text in this document is original

4 issues
- Spelling (3)
- Commonly confused words (1)
- Ignored words
- Unknown words

8 issues
- Comparing two or more things (1)
- Confusing modifiers (1)
- Sentence structure (1)
- Passive voice use (5)
- Use of articles
  Show all

2 issues
- Punctuation within a sentence (3)