

## **Exam Anxiety: Using Paired Adaptive Tests to Reduce Stress in Business Classes**

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### **Abstract**

*To reduce test-taking anxiety among businesses students, a Paired Adaptive Test (PAT) system was developed that allows students two chances to answer exam questions. In the study 46 students from three sections of Survey of International Business at Utah Valley University were given exams using the PAT. At the end of the semester, students were asked to complete a survey on test-taking anxiety for that class and other classes. The results indicated a twelve percent lower test-taking anxiety overall score for the PAT system and as much as 20.85% lower scores for questions key to taking specific exams. The implications of this research are that the PAT method could significantly reduce exam anxiety for students while providing a good assessment of their subject knowledge.*

**Key words:** *Exam anxiety; test-taking anxiety; Paired Adaptive Test.*

**JEL Classification:** M10

**PsycINFO Classification:** 3550

**FoR Code:** 1303; 1503

**ERA Journal ID#:** 35696

## **Introduction**

Test-taking is a common aspect of the higher education experience, and performance on tests can be a high stakes experience for a student, affecting not only advancement in a particular course but success in a major, and even the determination of whether or not a student stays enrolled and completes a degree. Both students and faculty members may question if tests are the best measure of a student's learning and if they have an impact on retention of knowledge.

High-stakes tests, frequently in the form of a standardized proficiency test, can impact an individual's future as well as an organization itself. For example, college entrance exams or exams that determine if one can enter a particular profession such as law or accounting are high stakes. Similarly, the overall test performance of a group of students, particularly in K-12, reflects on the effectiveness of an educational institution and may impact continued funding or level of funding. A substantial amount of literature has explored the legitimacy of this practice (The FairTest, 2017).

A comment frequently heard is, "His skill is better than that. He's really just not a good test-taker. His performance in class, and especially the comments he made in class discussions show that he really understands the material." How does one determine if this statement is accurate? On what basis should a faculty member determine if a student has truly grasped critical content and is ready to continue on in his studies or enter his chosen profession? What affects test-taking ability? Faculty members want to ensure that they are giving a fair assessment of what students learned and students deserve the opportunity to demonstrate their learning. Overall, performing well on tests is critical in a number of contexts.

Recently, educators have been turning to alternate measures of assessing student learning, sometimes called authentic assessment, such as e-portfolios (Eynon & Gambino, 2017; Watson & Babson, 2011). While these alternatives are attractive and much good work has been done in this area, the fact remains that most individuals will need to take and pass tests in their lives. This indicates the need to explore the role of test-taking anxiety on performance.

The current study seeks to consider if the exam design can reduce test-taking anxiety. A new type of exam, the Paired Adaptive Test, was used in a set of Survey of International Business classes to see if it reduced test anxiety.

## **Literature Review**

The literature on test anxiety is extensive and involves a range of variables, educational levels, and theories. We selected the most relevant literature to the current study, specifically undergraduate students in higher education and the impact of immediate feedback with the option to change responses on test anxiety. We also provide information to extend understanding of test anxiety in general and approaches for overcoming it.

### ***Test Anxiety Defined***

Test-taking anxiety, defined as "extreme levels of stress, nervousness, and apprehension during testing that drastically hinders [students'] ability to perform well and negatively affects their social-emotional and behavioral development and feelings about themselves and school" (Salend, 2012, p. 23), has been studied for at least 70 years. Initially focused on just the testing situation, it has expanded to include both test preparation and test performance (Cassady & Finch, 2014). Researchers generally agree that there are two main aspects to test-taking anxiety – emotionality and worry

(Cassidy & Johnson, 2002). Emotionality is manifest through physiological signs such as heart rate, dizziness, and nausea and the test-takers' awareness of these signs (Cassidy & Johnson, 2002). Worry, or cognitive test anxiety, includes behaviors such as comparing performance to others', having low self-confidence, feeling unprepared for a test, or lacking self-worth (Cassidy & Johnson, 2001),

This phenomenon is considered a type of state anxiety as it is focused on a specific situation, testing, rather than being a trait anxiety, a general form of anxiety which extends across a range of situations (Cassidy, 2010; Cizek & Burg, 2006). Cassidy (2010) describes the cycle of test anxiety. It may begin with poor test performance due to weak study habits or even a poorly written test. Low scores may result in criticism from family members and negative self-talk on the part of the student. This leads to lowered self-esteem and higher anxiety on subsequent tests.

Two models, based on information processing, have been identified related to test anxiety. The interference model focuses on the difficulty students have retrieving material they have learned due to worry and distracting thoughts during a test (Birenbaum, 2007). The skill deficit model refers to the difficulties of test-anxious students in the learning process, or how they process and store information. In this case, poor preparation due to ineffective learning strategies results in test anxiety (Birenbaum, 2007). A third model, the integrated model, describes the co-existence of both models, but in different types of students—one that has effective learning strategies but difficulty with retrieval on a test, and the other who has ineffective learning strategies but difficulty on a test due to not having learned the material (Naveh-Benjamin, McKeachie, & Lin, 1987).

How do faculty members recognize if a student truly has test anxiety? It has "physical, behavioral, and affective warning signs" (Salend, 2012, p. 22). Physical symptoms include perspiration, headaches, stomachaches, nausea, shaking, dizziness, and difficult sleeping (Salend, 2011a). Behavioral symptoms are related to issues with "concentration, attention, and memory" (Salend, 2012, p. 22) as well as poor performance even when there is evidence that the student has grasped the material, or other behaviors such as asking for help, cheating, missing tests, or complaining. Affective signs are pessimism, apathy, negative self-talk, excuse-making, and avoidance (Salend, 2011a).

### ***Factors Impacting Test Anxiety***

Studies have examined a number of variables hypothesized to have an impact on test anxiety as well as the effects of test anxiety. Power (1999) found that participants' GRE scores were similar for paper-based and computer adaptive forms, and that of the two components of test anxiety, worry and emotionality, worry was higher on the paper-based sample than on the computer-adaptive test. In another study, immediate feedback on test responses reduced test anxiety (DiBattista & Gosse, 2006). Students with high levels of test anxiety or who performed poorly on the test were not disadvantaged by immediate feedback nor did they dislike it. In another study, receiving immediate feedback on multiple choice responses, reduced anxiety for undergraduate students (DiBattista & Gosse, 2006).

Similarly, giving students immediate feedback on their responses to open-ended questions and allowing them to revise their answers resulted in better scores and lower anxiety (Attali & Powers, 2010). Allowing item review and answer change on computer-adaptive and self-adaptive tests (ones in which students are allowed to select the level of difficulty) resulted in few answer changes, more wrong to right than right to wrong changes, and score improvement (Vispoel, 1998; Vispoel, Hendrickson, & Bleiler, 2000).

Other studies have shown that the type of feedback received during a test (e.g., answers after each item, answer until correct, and delayed feedback) is unrelated to test anxiety (Clark II, Fox, & Schneider, 1998). Worry, exhibited by irrelevant test thoughts during a test, was found to be a higher predictor of test performance than emotionality, exhibited by tension and physical symptoms (McIlroy, Bunting, & Adamson, 2000). Students with performance goals as opposed to mastery goals demonstrated lower self-efficacy and higher levels of test anxiety although these factors did not negatively impact performance (Dull, Schleifer, & McMillan, 2015). High-achieving students had high test anxiety and performance goals rather than mastery goals. Both performance and mastery goals were motivating factors and led to achievement. The researchers recommended that instructors, in this case accounting instructors, help students experience success early in the semester to positively impact motivation and higher self-expectations.

Another study, which examined the relationship of test anxiety and learning strategies on undergraduate students' assessment and instruction preferences, found support for the integrated model of test anxiety (e.g., that the interference and skill deficit models coexist in different types of students - those with effective learning strategies but difficulty with retrieval, and those with ineffective learning strategies but difficulty due to not having learned the material) (Birenbaum, 2007). Students with effective learning strategies had similar assessment preferences to low test-anxious students—tests with higher order thinking skill tasks, assessments that involved students, and instruction that emphasized self-regulation, while those with less effective learning strategies had low preferences for these methods and styles.

In sum, computer-adaptive testing does not appear to increase test anxiety (Power; 1999) nor does receiving immediate feedback on test responses (DiBattista & Gosse, 2006). The latter may, in fact, lower anxiety (DiBattista & Gosse, 2006). Similarly, providing feedback and allowing students to change their answers to open-ended questions results in higher scores and lower anxiety (Attali & Powers, 2010). Allowing a review of answers on computer-adaptive and self-adaptive exams and the opportunity to change answers improves performance (Vispoel, 1998; Vispoel, Hendrickson, & Bleiler, 2000). The type of feedback provided during a test does not appear to impact anxiety (Clark II, Fox, & Schneider, 1998); worry has a more negative impact on test performance than emotionality (McIlroy, Bunting, & Adamson, 2000). Students with performance goals have higher test anxiety than those with mastery goals, but these factors do not affect performance (Dull, Schleifer, & McMillan, 2015). Effective learning strategies are associated with lower test anxiety and preferences for higher order thinking tests (Birenbaum, 2007).

### ***Strategies for Reducing Test Anxiety***

Faculty members want their students to do well on tests as much as students want to do well. This can be addressed through the creation of what has been described as student-friendly tests (Salend, 2009, 2011b, 2012). A number of strategies within the purview of a faculty member can be implemented to improve the validity of their tests, thereby decreasing test anxiety (Salend, 2012). These include ensuring test content is directly related to the concepts taught, aligning test questions to the instructional methods used to teach the content (e.g. objective questions for facts, essay questions for problem-solving or simulations), weighting test questions relevant to the amount of time spent on related content, and scheduling tests regularly to cover a reasonable amount of material. Additionally, faculty members can make tests more accessible through "format, readability, and legibility" (Salend, 2010, p. 23).

Other strategies for student-friendly tests include fostering motivation (connecting test items to the lives of students, providing choices, or allowing collaboration); providing clear directions and examples of responses as well as ensuring

that test questions are structured appropriately based on type of question (e.g., multiple choice, matching, completion, etc.), and helping students with strategies for reducing anxiety (e.g., relaxation techniques) as well as test-taking strategies (study guides, games, surveying the test, time use, etc.) (Salend, 2012). Finally, the use of technology can also provide students with options for the presentation of tests and methods of response (Salend, 2012).

When used in conjunction with other strategies, study guides, in particular, have been demonstrated to reduce anxiety and increase performance at the high school level (Huberty, 2009). The same is true in higher education. Students in an introduction to psychology class who were required to complete exercises in a study guide from the textbook performed significantly better than those in a control group on multiple choice exams, and indicated they would voluntarily use a study guide in the future (Dickson, Miller, & Devoley, 2009). Student-produced study guides, developed in collaboration with peers and the instructor to ensure accuracy is an effective technique for improving the performance underprepared students in college classes (Darden-Woody & Briant-Shanklin, 2018; Pilotti, Chodorow, & Petrov, 2009; Tincotti, 2010).

A technique found useful at the elementary school level was imagery training, which improved performance for both high and low test-anxious students (Cubberly, Weinstein, Cubberly, 1986). Imagery involves using a mental image of a word or concept, which the learner can later recall in a test-taking situation. In other cases, using a quick, simple, easy-to-administer anxiety scale prior to a test may be an effective way for teachers to address test anxiety issues prior to test administration. This was the case for nursing students who indicated a variety of concerns prior to their first skills test, particularly related to test atmosphere and the actions and attitudes of the teachers administering the test (Yang, Lu, Chung, & Chang, 2014).

### ***Measures of Test-Taking Anxiety***

Measures of test-taking anxiety have focused primarily on emotionality and cognitive test anxiety (worry), and in particular, attempts to identify factors related to the latter (Cassady & Johnson, 2002). Various measures have been identified and validated to accomplish this. These include the Cognitive Test Anxiety Scale (CTAS), a 27-item self-report measure of test anxiety that can be completed in 8-15 minutes and provides a “reliable, valid, and quick measure of anxiety” (Cassady & Johnson, 2002, p. 287) and has been determined to be valid across cultures (Cassady & Finch, 2014). A 17-item short version has also been proven to be effective (Cassady & Finch, 2014). This shortened version (with a single modification) was used in this study.

Additionally, a computer-adaptive anxiety test (CAT-Anxiety), with items drawn from an item bank based on well-established questionnaires, has also been shown to be effective. In this case, results correlated highly with the State Trait Anxiety Inventory (STAI) (Walter, Becker, Bjorner, Fliege, Klapp, & Rose, 2007), another well-known measure. Items for the CAT-Anxiety instrument were selected based on the definition of state anxiety— “an emotional state characterized by strain, solicitude, nervousness, inner discomposure and fear of future occasions” (Walter et al., 2007, p. 144). Results indicated that the measure captured the construct in similar ways as established test anxiety questionnaires. Computer-adaptive testing is efficient in that fewer items need to be answered in order to measure the construct, which reduces the burden for test-takers; however, the costs of developing such instruments is high (Walter et al., 2007).

Yang, Lu, Chung, and Chang (2014) developed a 6-item anxiety test for nursing students, which could be adapted to other disciplines, and provides “an effective, rapid, and simple skills test anxiety scale” that allows teachers “to provide immediate assistance” (p. 588). For example, questions ask test-takers to indicate their level of certainty about passing standards, their level of worry about the non-verbal behaviors

and attitudes of teachers monitoring the test, and their confidence in their skills. Knowing this information in advance helps instructors address relevant issues and also refer students to sources of help.

Some have observed that test anxiety tends to be measured with standardized self-report instruments, which are practical and allow for generalization; however, alternate measures might be used to explore causality and provide new insights (Putwain, 2007). For example, interviews of students at different levels of study, in specific schools and classrooms, and during actual test-taking can provide greater understanding of students' experiences, and are no more subjective than standardized self-report measures. An additional issue with text anxiety measures is the lack of distinction between academic stress and exam stress, and also the use of terminology that appears similar, such as stress, anxiety, and worry, but may have differing meanings (Putwain, 2007).

In sum, a variety of options exist for measuring text anxiety. Measures must be appropriate to the research questions under investigation, and consideration should be given to the benefits of qualitative methodologies where appropriate. Administrative factors such as efficiency, particularly the amount of time needed for participants to complete a given measure, and the ability of the measure to help students make adjustments and lower their test-taking anxiety are also important factors to consider.

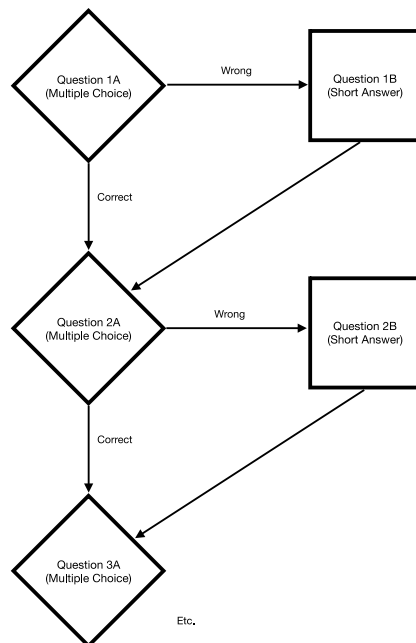
## **Summary**

Text anxiety is a serious concern in higher education. Faculty need to measure learning accurately and students need to demonstrate what they have mastered. Assessments are also important to identify learning gaps. As such, researchers have explored text anxiety from a number of different perspectives. These include identifying contributing factors and types of text anxiety, examining the impact of test formats (paper and pencil, computer-adaptive, self-adaptive), and studying how response feedback during a test (answering until correct, indicating that answers are right or wrong, allowing answer changes on open-ended questions, time to go back and review answers on computer-adaptive tests, etc.) can decrease anxiety and improve performance. Researchers have also investigated the role of learning strategies and intelligence mindset on text anxiety and performance. Additionally, well-designed tests and learner preparation strategies also have potential for anxiety reduction. Finally, measures of text anxiety are important for identifying students' levels of anxiety and the effectiveness of strategies to reduce it.

## **Methods**

### ***The Paired Adaptive Test (PAT)***

The Paired Adaptive Test (PAT) is composed of two main components: a multiple-choice question and a short-answer question for each concept that is tested. The exam is taken on a computer and Qualtrics' survey software was used in this study. When students take the exam, they are first presented with a multiple-choice question on a given topic. If students answer the multiple-choice questions correctly, then they are given full points and the PAT then presents a multiple-choice question for the next concept. If students answer the multiple-choice question incorrectly, then they are presented with a short-answer question on the same topic. Students then type in their answer, which is later graded for full or partial credit. See Figure 1 for a flow chart of this process. Although each question can be worth the same number of points, in this study questions were assigned points between 2 and 10, depending on the complexity of the question. Qualtrics provides a spreadsheet with all of the students' answers, and it gives scores for correct multiple-choice answers. This spreadsheet is then used in grading the short answers.

**Figure 1: Flow Chart of the PAT System**

The intent of the PAT system is to reduce test-taking anxiety by allowing students two chances to answer each question. Since the short-answer question does not show unless the multiple-choice question was answered incorrectly, students receive immediate feedback on their answer to the multiple-choice question. Consistent with other research (DiBattista & Grosse, 2006; Attali & Powers, 2010) the immediate feedback should reduce exam anxiety.

Since the second chance question is a different type (short answer, rather than multiple choice, as in the first question), this allows students to take two different approaches to earning points for the same topic. These different types should also reduce anxiety by increasing the chances of finding a question type that a given student is comfortable with.

For this study, students were given study guides for each module in the class. The study guides consisted of the actual short-answer exam questions. Each of three exams had 40 to 46 questions (exam 1: 46, exam 2: 43, and exam 3: 40). One section did add student-written multiple-choice questions from in-class presentations for the third exam, which went beyond the 40 questions mentioned here. In an effort to reduce student anxiety, the students were clearly told at the beginning of the class how the PAT system works, that the study guide questions were on the exam, and that those questions were worded the same way.

### ***Methodology for PAT study***

During the spring semester of 2015 at Utah Valley University, 46 students in three sections of Survey of International Business were given exams based on the PAT system. This included two midterms and the final exam. Students were also given study guides for each chapter that consisted of the short-answer questions on the

exams. At the end of the final exam, students were given a survey about test taking anxiety. The methods of this study were approved by the University's institutional review board before conducting the research on the students.

The survey was based on the Cognitive Test Anxiety Scale or CTAS (Casidy & Johnson 2002). The original scale used 27 questions, but later research (Casidy & Finch 2014) found that only 17 of those questions were needed for the same explaining power. Question 15 is slightly modified to describe testing using a computer, rather than pencil and paper. The questions used in the survey are shown in Table 1

Subjects were first asked to answer these questions twice: once in reference to how they usually feel about taking exams at the university, and then again related to the exams in the current class, which used the PAT system.

The survey consisted of a Likert-like scale with four possible responses:

- A. Not at all typical of me
- B. Only somewhat typical of me
- C. Quite typical of me
- D. Very typical of me

The answers were scored as follows:

- A = 1 point
- B = 2 points
- C = 3 points
- D = 4 points

**Table 1:**  
*Test Anxiety Questions*

1. I lose sleep over worrying about examinations.
2. While taking an important examination, I find myself wondering whether the other students are doing better than I am.
3. I tend to freeze up on exams.
4. During tests, I find myself thinking of the consequences of failing.
5. At the beginning of a test, I am so nervous that I often can't think straight.
6. My mind goes blank when I am pressured for an answer on a test.
7. During tests, the thought frequently occurs to me that I may not be too bright.
8. During a course examination, I get so nervous that I forget facts I really know.
9. After taking a test, I feel I could have done better than I actually did.
10. I worry more about doing well on tests than I should.
11. During tests, I have the feeling that I am not doing well.
12. When I take a test that is difficult, I feel defeated before I even start.
13. I am a poor test taker in the sense that my performance on a test does not show how much I really know about a topic.
14. I am not good at taking tests.
15. When I get to the first screen of a test, it takes me a while to calm down to the point where I can begin to think straight.
16. I do not perform well on tests.
17. When I take a test, my nervousness causes me to make careless errors

Total scores of responses on these 17 questions were taken for each student related to their perspective on generally taking exams at the university, and for their perspective on taking exams in the classes under study.



## Results

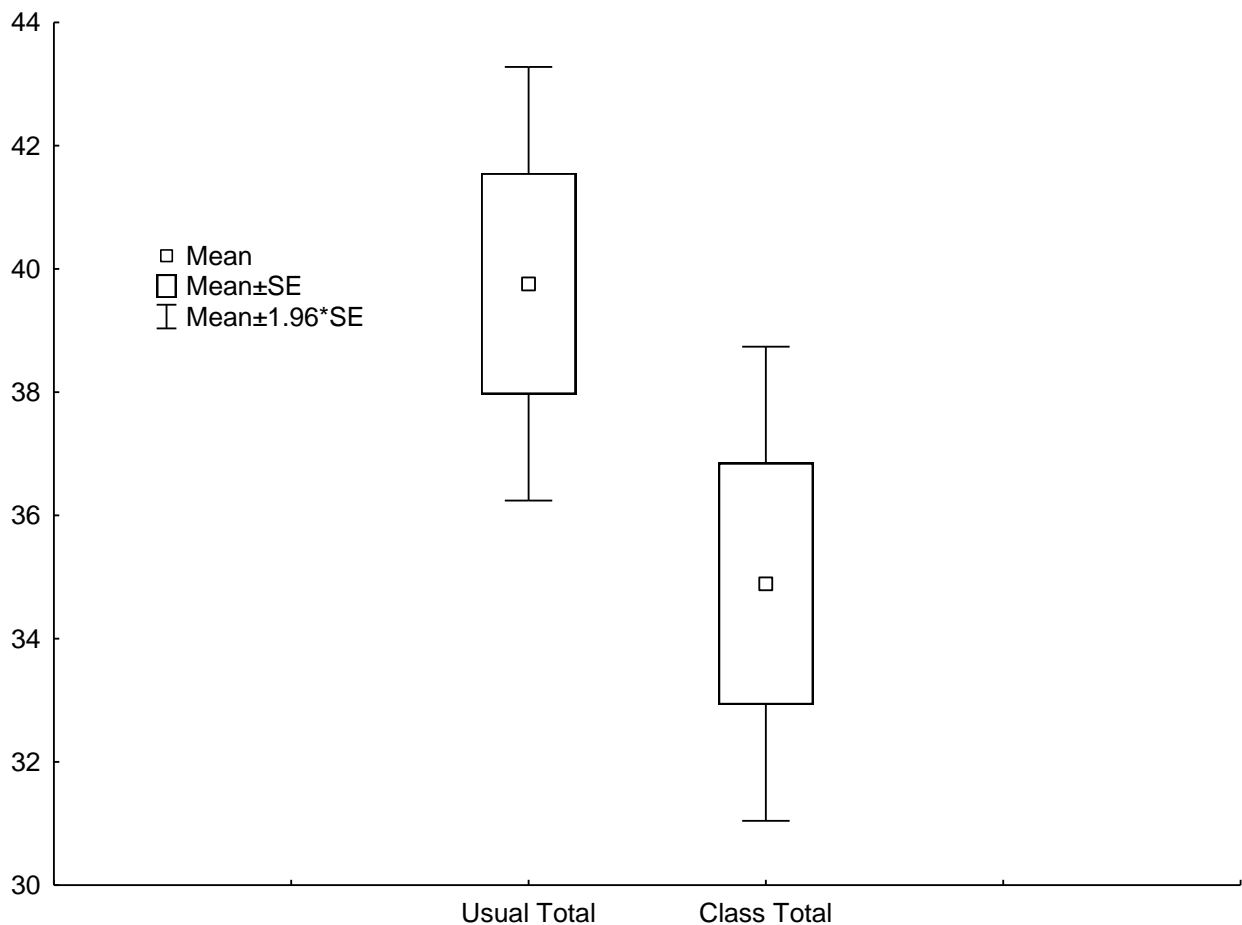
Average scores by question and the total of all questions are shown in Table 2.

**Table 2:**  
*Survey Averages by Question*

Question #	Regular Test Average Score	PAT Average Score
1	2.07	1.72
2	2.43	2.17
3	2.30	2.00
4	2.50	2.04
5	2.11	1.67
6	2.33	2.26
7	1.89	1.61
8	2.35	2.28
9	3.22	2.70
10	2.78	2.46
11	2.41	2.31
12	2.27	1.80
13	2.59	2.09
14	2.30	2.07
15	1.89	1.78
16	2.02	1.89
17	2.35	2.09
Average Total	39.76	34.89

A dependent t-test was run on the students' rating of their current (M=34.89, SD=13.31) versus usual (M=39.76, SD=12.17) class experience, with  $t(46)=4.87$ ,  $p<.001$ , Cohen's  $d=0.66$ , a medium effect.

**Figure 2:**  
*T-test Results*



Additionally, a repeated measures ANOVA was run on the questions asked for the current versus the usual class. This resulted in a 2 (Class: Usual / Current) X 17 (Questions) where the students answered the 17 questions addressing both the current and their usual class experiences. The results were that the main effect for Class,  $F(1,43)=19.56$ ,  $p<0.001$ , partial eta-squared=0.31, and the main effect for Questions,  $F(16,688)=11.74$ ,  $p<.001$ , partial eta-squared=0.21, as well as the overall interaction,  $F(16,688)=1.87$ ,  $p=0.02$ , partial eta-squared=0.04, were each statistically significant. Tukey post-hoc tests on the significant interaction showed that there were statistically significant differences for questions 4, 5, 9, 12, and 13.

## Discussion of Results

The results clearly indicate that the students in the survey found the new exam method less stressful. The mean went from 39.76 for their usual tests to 34.89 for the PAT, showing a 12.25 percent reduction in testing anxiety. This would seem to indicate that the second chance available for each question is a major contributor to this reduction.

When considering the responses for specific questions, the impact of the PAT seems even greater. In particular, questions 4, 5, 9, 12, and 13 showed significantly lower scores for students. These questions are repeated in Table 3 and the scores are repeated in Table 4 with the percentage differences. These five questions focus on the

students' interaction with the exams themselves, whereas many of the other questions are general to testing or refer to things that happen outside of the time of the test itself.

**Table 3:**  
*Key Questions*

Question #	Question
4	During tests, I find myself thinking of the consequences of failing.
5	At the beginning of a test, I am so nervous that I often can't think straight.
9	After taking a test, I feel I could have done better than I actually did.
12	When I take a test that is difficult, I feel defeated before I even start.
13	I am a poor test taker in the sense that my performance on a test does not show how much I really know about a topic.

**Table 4:**  
*Scores for Key Questions*

Question #	Regular Test Average Score	PAT Average Score	Percentage Difference
4	2.50	2.04	18.4%
5	2.11	1.67	20.85%
9	3.22	2.70	16.15%
12	2.27	1.80	20.70%
13	2.59	2.09	19.31%

### ***Limitations, and Future Research***

One of the key limitations of this study was that the same group of students were asked their impressions of their exam anxiety in other classes, which did not use the PAT, and the current class, which used the PAT. Students may have overstated the positive impact of the PAT to please the researchers and instructors. A similar study could be done in which different sections of the identical class consist of treatment and control groups. The treatment sections would have the PAT exams and the control groups would just have the multiple-choice questions found in the PAT.

A second limitation to the study relates to determining whether the second chance on a question or the immediate feedback was responsible for reducing exam anxiety. A future study could consider the immediate feedback without the short-answer questions to see if that reduced test-taking anxiety.

Another limitation relates to the use of the study guides. As used in the classes in this study, these guides consisted of the actual questions from the short-answer portion of the tests. Although the number of questions (40-46) made simple memorization difficult, the use of actual exam questions may have had a significant impact on reducing test-taking anxiety, rather than the possibility of taking two chances at an exam topic or immediate feedback.

This study does not separate the impact of three components. Future studies could test these elements separately to determine their individual impact.

## Conclusion

The PAT system proved to make a significant reduction in students' text anxiety. For many students, if not most, the anxiety of an exam is neither reflective of other coursework, nor their ultimate work in the field. Yet student knowledge on a particular subject must be assessed for a course. The focus on key elements of a course through a study guide has the potential to improve the focus of students on the most important topics, which can improve their performance more broadly. The PAT has the potential to reduce testing anxiety and improve students focus in study while still accomplishing the needs for student assessment.

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