UNIVERSITY OF CALIFORNIA SAN DIEGO

The Effects of Increased Exam Time on Performance and Test Anxiety

A Thesis submitted in partial satisfaction of the requirements for the degree Master of Science

in

Biology with a Specialization in Biology Education Research

by

Nicole Marcus

Committee in charge:

Professor James Cooke, Chair
Professor Liam O'Connor Mueller, Co-Chair
Professor Lisa McDonnell

2022

The thesis of Nicole Marcus is approved, and it is acceptable in quality and form for publication on microfilm and electronically.

University of California San Diego

2022

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ABSTRACT OF THE THESIS

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Educators who administer exams are often met with student desire for extended exam time. Thus far, it has been unclear whether giving students additional exam time serves to improve their exam performance or if this accommodation simply helps students feel more comfortable with taking exams due to inconsistent results. We hoped to design an experiment that would effectively measure the effects of increased exam time on students' exam performance and test anxiety levels. Because academic performance is negatively correlated with test anxiety, we hypothesized that giving students twice as much to complete an exam would improve their performance, primarily by decreasing their test anxiety levels. We studied two academic quarters of students taking the same undergraduate physiology course. We administered isomorphic exams, with one quarter of students taking the exam with the

standard amount of exam time and the other receiving double that amount of time. We compared midterm exam scores for both groups of students, as well as their test anxiety levels before and after the exams as measured via two surveys. We found that increasing exam time did not improve student performance or reduce their test anxiety levels. Increased exam time only reduced students' reported requests for additional exam time. The implications of our research are that increased exam time allows students to feel more comfortable with taking exams, and increases the likelihood that they will leave an exam feeling satisfied with their performance. Future research should account for demographic differences, as well as differences in academic ability and anxiety disorders, between experimental groups to accurately measure the relationship between increased exam time, performance, and test anxiety.

The Effects of Increased Exam Time on Performance and Test Anxiety

Introduction

Examinations, at every academic level, are paramount to evaluating students' understanding of class material and ensuring that students are internalizing the information they learn. Not all exams are weighted equally, but it is fair to state that most students find that taking exams generally induces stress. Students are often under the impression that, if given additional time to complete the exams they take in school, they will perform better. In many subjects, including science, exams may demand heavy writing from students in order for them to fully demonstrate that they understand the test material and are able to communicate their ability to connect important concepts. With this amount of writing, students may feel exhausted or restricted by time constraints on an exam, and therefore that they do not have enough time to convey their thoughts effectively.

While having no time limitation may seem ideal to guarantee that all students can comfortably complete an exam, time constraints are necessary to assign uniform testing conditions to all students and ensure fairness. It is unrealistic to administer an exam to students in the complete absence of time constraints, especially during school hours. However, giving too little time for completion of an exam can raise test anxiety levels in students, which can negatively affect their exam performance (Cassady & Johnson, 2002; DordiNejad et al., 2011; Holzer et al., 2009; Onwuegbuzie & Seaman, 2010). Several studies about making exams more equitable discuss the concept of "test speededness," describing that an exam is not a true measure of knowledge if it is "speeded" (Evans & Reilly, 1971; Munger & Loyd, 1991; Wright, 1984). An "unspeeded" exam is one that allows almost all test takers to reach 75% or more of the test items within the allotted testing time or that 80% or more of the test takers reach the last item on the exam (Swineford, 1956). In conjunction with the argument that an exam needs to be unspeeded to be fair, Walczyk et al. (1999) stated that mild time constraints are necessary to promote reading comprehension during an exam by increasing mindfulness and non-automatic metacognitive skills. Severe time

constraints, however, are destructive to students' cognitive skills such as "planning and monitoring" and can cloud their memories (Walczyk et al., 1999; Zimmerman et al., 1994). The time constraints being given to students on exams now may be too limiting, inducing testing anxiety and preventing students from performing to their fullest potential.

The relationship between test anxiety and exam performance

There is sufficient literature that provides insight into the inverse relationship between test anxiety levels and academic performance (Cassady & Johnson, 2002; DordiNejad et al., 2011). Separate from general anxiety, test anxiety specifically surfaces before, during, or after completing an assessment. Cognitive test anxiety may stem from comparison to other students, feelings of unpreparedness, and excessive worry about low performance and corresponding consequences (Cassady & Johnson, 2002). This test anxiety may result in anxious physiological responses and lack of concentration on the assessment due to intrusive thoughts, which may result in lowered performance (Sarason, 1978, as cited in DordiNejad et al., 2011). Worrying prevents students from thinking clearly and demonstrating their knowledge to their fullest potential on exams; this may explain why students who report having high test anxiety levels may perform more poorly than their peers who report lower levels. According to Veenman and Beishuizen (2004), mild time constraints on an exam allow students to exercise increased mindfulness while processing information, but greater time constraints may be destructive to performance by overworking memory and blocking the use of important metacognitive skills due to induced test anxiety.

To understand why student test anxiety is potentially detrimental to college students' academic performance, we should first understand why their test anxiety levels may be so high. Test anxiety levels vary for an individual given the stakes of an exam. Especially at the college level, where exams are less frequent and are testing understanding of more material, the stakes of exams in general may be higher due to the weight they have on students' final grades. Putwain (2008) explains that exams with higher stakes may invoke higher test anxiety levels because students perceive them as more threatening than exams with lower stakes. Putwain explored this theory by studying high school students in the UK with some

level of reported test anxiety using three exams with different stakes, or levels of induced pressure for students to perform well. Contrary to their predictions, a slightly positive relationship was observed between anxiety level and test performance in the highest stakes exam condition. Students performed worst in the lowest stakes exam condition, where students took a mock test, and best in the medium stakes exam condition (Putwain, 2008). This offers supplemental support for the theory that there is an optimal amount of induced anxiety during an exam that encourages the student to stay concentrated and motivated, but not enough pressure to interfere with the student's cognitive skills. Increased, but not unlimited, exam time could reduce students' test anxiety while inducing a healthy amount of pressure. This would potentially improve students' exam performance.

Another study looking at how "statistics test anxiety," or test anxiety specifically related to the subject of statistics, affects test performance was performed by Onwuegbuzie and Seaman (2010). They sought to measure the effects of lifting time constraints completely from a statistics course's final exam. In alignment with their predictions, they found that there was a much stronger negative relationship between test anxiety and performance in their timed exam condition: with a time constraint, students with high anxiety performed significantly worse on the final exam than students with high anxiety in the unlimited exam time condition. This finding further supports the implementation of less constrictive time constraints for exams in order to make testing more equitable for students with high test anxiety levels and reduce students' overall feelings of test anxiety going into an exam.

How extended exam time can affect different groups of students

It is important to note that an exam can be "speeded" for some groups of students and not for others, so the true goal of educators administering exams should be to create exam conditions that are equitable for all students. Making an exam that is unspeeded for all students requires finding ways to accommodate students with different cultural backgrounds and learning abilities, and will help improve all students' demonstration of their understanding on an exam.

Past studies have demonstrated that certain demographic groups of students have benefitted more than others from the removal of time constraints from an exam. One demonstrated that, when given unlimited time to take an exam, Hispanic students spent more time on each test item than white students did (Llabre & Froman, 1987). Another showed that both fee-free and fee-paying LSAT takers improved their exam scores when given additional time on their exams, with fee-free students' score improvements being slightly higher (Evans & Reilly, 1971). These studies suggest that giving students additional time to take exams theoretically could account for cultural and perhaps linguistic differences that presently make exam administration inequitable.

Extending the amount of time given to complete an exam is also a common accommodation made for test takers with learning and/or physical disabilities. Additional time may allow students with different abilities to better communicate their knowledge on an exam by accounting for frequent distraction, slower writing, and negative thoughts that come with taking an exam. Students with disabilities are often given additional time on exams to account for their higher test anxiety and lower exhibition of test-taking strategies, both of which contribute to decreased exam performance (Holzer et al., 2009). Colker (2007) notes that students with learning disabilities, including students with ADD and ADHD, benefit from having extended time due to their slower processing of information. Colker references the "differential boost" theory which states that extended time is an accommodation that benefits some students more than others. This suggests that extended exam time benefits students with learning disabilities while having no significant effect on students without disabilities, who are theoretically fully capable of completing an exam without having extended time.

On the other hand, other researchers have shown that the extended time accommodation benefits students with and without disabilities to the same extent. For example, in their study, Munger and Lloyd (1991) wanted to answer the question of whether there is a difference in test speededness for language and math sections of the Iowa Test of Basic Skills between handicapped and nonhandicapped fifth grade students. They found that, for both exam sections, there were no significant differences in the proportion of handicapped versus nonhandicapped students that completed 90% of the exam, nor were there

significant differences in the number of test items attempted between the two groups. The effects of reducing the speededness of the exam by lifting all time constraints were about equivalent for both the handicapped and nonhandicapped students, likely because the exam was already equally speeded for both groups. In another similar study, Elliot and Marquart (2004) determined to find the effects of doubling the exam time for a standardized math test for students with disabilities, students who struggled academically in mathematics, and students without disabilities. None of the three groups scored significantly better with the extended time accommodation, nor did students with disabilities or learning difficulties improve their scores to a higher extent than students without disabilities. The implications of this study are, first, that extended time did not differentially affect students separated by their disability status, and second, that extended time did not serve to improve performance but instead to improve students' attitudes toward the exam. What is significant about these studies is that using extended time as a testing accommodation may benefit all students, regardless of their differences in demographics or abilities, equally. While this may not be through improving exam performance, extended time has proven to reduce anxiety and stress during an exam while improving students' perceptions of their performance.

The relationship between time taken to complete an exam and performance

When examining the effects of time constraints on test performance, many researchers have previously been interested in whether the order in which students complete a given exam correlates with exam performance. Thus far, there is no consistent relationship between time taken to complete an exam and performance. Paul and Rosenkoetter (1987) found no significant difference in the performance of university students on general psychology exams based on when they completed their exams, nor did Foos (1989) in a very similar study. Johnston (1977) found that the average scores for the groups finishing the exam first, in the middle, and last in the study were about equivalent. Landrum et al. (2009) predicted a negative linear relationship between time to complete an exam and performance, where students who scored higher on an exam would be among the first to finish due to increased confidence. This study was performed using an array of differently organized exams in terms of their ratio of multiple choice

questions to open-ended questions taken in undergraduate psychology statistics courses. Only in two of the three exams, both of which with higher multiple choice content than the third, was the negative relationship observed as predicted. I would speculate that this is due to the fact that multiple choice exams require less time and thought to reach "correct" answers; open-ended questions require a demonstration of true understanding, which may take more time to convey in addition to increased amount of time spent writing. It seems consistent that there is little to no relationship between time taken to complete an exam and performance, however the results may vary widely with each new study on this issue. With increased exam time, however, students' perceptions of their abilities may change, which may improve their exam performance.

Previous studies demonstrating the effects of increased exam time

As aforementioned, there are other clear benefits to being given extended time on an exam. Holzer et al. (2009) determined that students who learned and used distinguished test-taking strategies also used more of the extended time given to them on an exam, correlating with an increase in their exam performance from before they had learned these strategies. Elliot & Marquart (2004) showed that, while students' scores did not improve significantly from a timed condition of an exam to an untimed condition, having extended time helped increase students' motivation while taking the test and increased their self-reported confidence in their ability to perform well. This trend suggests that, even if increasing exam time does not always improve performance, it has strong potential to alleviate the emotional stress that comes with taking an exam. The clear solution is to give students more time on exams, but the undecided issue is determining how much additional time needs to be given to students to see the benefits of extended time and when additional time no longer benefits students.

Some existing literature finds no significant relationship between increased test timing and performance, with no sufficient evidence that having more time increases students' exam scores (Elliot & Marquart, 2004; Evans & Reilly, 1971; Munger & Loyd, 1991; Wild et al., 1982; Wright, 1984). Wright (1984) sought to determine if increasing the amount of time given to college sophomores on a

College-Level Academic Skills Test (CLAST) by five or ten minutes would improve their scores. While it was found that students in the treatment groups with five and ten extra minutes did perform better than those in the control group, the differences in students' scores were not statistically significant. The CLAST exam was determined to be an unspeeded measure of aptitude, meaning that giving students additional time on the assessment was predicted to have no notable effect on performance. A shortcoming of this study was that the amount of additional time given was so minimal that it was unlikely that a significant difference would have been observed. Increasing exam time is a common testing accommodation made for students with learning and physical disabilities. However, Elliot and Marquart (2004), as well as Munger and Loyd (2013), found no significant improvement in exam performance or exam completion for students with and without learning disabilities when in an untimed testing environment compared to a timed one.

Although the aforementioned experiments did not demonstrate a strong relationship between exam time and performance, some studies have recorded a significant difference in exam performance when students are given extended time. Onwuegbuzie and Seaman (2010) did see a significant improvement in exam performance with unlimited time given on the exam as compared to having a 90 minute time constraint. This improvement of nearly seven percentage points from the timed to untimed treatment is impressive, however this study had a small sample size of only 26 graduate students in one statistics course. It is notable, however, that they found a significant negative relationship between exam performance and "statistics test anxiety." They were able to prove that this relationship was stronger in the timed exam condition than in the untimed condition, showing that time constraints worsen the effects of test anxiety on exam performance. It is also important to clarify that the mean age of the participants in this study was about 41 years old, which may have significant effects on the students' test taking skills due to the amount of years since they had last taken a math course. While it is not practical to administer a final exam with no time constraint at a university, it is worth researching further whether giving students a sufficient amount of additional time on an exam would have different effects on their exam performance than have already been observed. One goal of the present experiment is to conduct a similar study to this

one on a larger scale; we will also use a measure of general test anxiety to compare the relationship between test anxiety and exam performance in two timing conditions rather than test anxiety specific to the course subject.

Present study

It is apparent that students who suffer from exam-related anxiety would benefit from their instructors' attempts to reduce test anxiety during an exam, especially given that test anxiety likely has negative effects on students' academic performance. One probable method of reducing anxiety during an exam, as mentioned, is to increase the amount of time students are given to complete an exam. Having more time to spend on an exam may allow students to feel more calm going into the exam, and more confident that they will have sufficient time to complete the exam to convey what they have learned to their fullest capacity.

While it is unknown from previous studies how much additional time given to students on their exams is sufficient to increase their performance or reduce their test anxiety, in this study we have chosen to double the standard amount of time given on exams to measure these effects. Students in two academic quarters of an undergraduate physiology course were given isomorphic midterm exams under two timing conditions. Students in both quarters completed identical surveys to measure their general test anxiety levels at the start of the quarter and their reported test anxiety levels immediately after taking the exam of interest. Our goal is to determine if doubling the amount of time students are given to take an exam will improve their performance by comparing students' exam scores between two academic quarters. We also want to determine if test anxiety levels, reported after taking the exam, are lower for students who are given more exam time. As mentioned in reviewing existing literature surrounding this subject, there is a negative relationship between test anxiety and performance. We also reported that extended time has proven to improve exam performance in some cases. Because of this, we hypothesize that students who are given twice as much time to complete their exams will outperform students who receive the standard exam time, and that this effect will be larger for students with high levels of general test anxiety. We

predict that increasing exam time by 100% reduces test anxiety in students, therefore improving their exam performance. We hope to see effects reflecting that extended exam time improves the exam-taking experience for students as we explore the relationship between exam time, performance, and test anxiety.

Methods

Participants

The participants in this study were undergraduate students at the University of California, San Diego enrolled in an undergraduate human physiology course, BIPN 100. This course is a requirement for some, but not all, majors within UCSD's School of Biological Sciences. The study was performed over two consecutive academic quarters: Fall of 2021, with 240 students included in our study, and Winter of 2022, with 198 students included in our study. Students' data was only included if they completed and submitted all three surveys administered throughout the quarter, as well as if they had completed at least the second midterm examination. We were unable to collect the students' demographic data.

Instruments

In our two experimental quarters, students were asked to complete a questionnaire to compute their baseline test anxiety scores. The Westside Test Anxiety Scale (WTAS) survey (Driscoll, 2007) has ten test anxiety-related statements which students rate on a scale of "Not at all or never true," assigned a score of one, to "Extremely or always true," assigned a score of five. The ten values were totaled and divided by ten to give a normalized general test anxiety score for each student between one and five, referred to as the students' baseline test anxiety scores.

For each of the two academic quarters studied in the present experiment, there were two midterm examinations prior to the course's final exam. Students were given the option to drop their lower midterm score to increase the weight of their final exam score as a means of accommodating for unexpected

sickness and other pandemic-related situations that would prevent them from being present for both midterm exams. The resulting effects of this accommodation were that many students only completed one of the two midterm exams. The second midterm exam of each quarter, abbreviated as MT2, provided the exam score of interest for the present study. The first midterm exam was not evaluated in our study due to the fact that it was taken online in the Winter 2022 quarter due to a surge of the Omicron variant of the COVID-19 virus. Exams were isomorphic between the two academic quarters observed in this study.

After each of the two midterm exams, students were given a post-exam survey asking for them to report their level of test anxiety experienced during the exam, if they felt that they had enough time to complete the exam, and how they felt about their exam performance. Students responded to all items on the post-exam surveys on a Likert scale with five answer choices, ranging from "Strongly agree" to "Strongly disagree." We asked students to indicate to what extent they experienced test anxiety during the exam taken. We coded answers of "Strongly agree" and "Somewhat agree" to be "Yes' in determining whether students experienced test anxiety during the MT2 exam, with the other three response options ("Neither agree nor disagree", "Disagree" and "Strongly disagree") being coded as "No." On the post-exam survey, we asked students how much additional time they would have liked to comfortably complete the exam. Responses of "0" or "N/A" indicated that a student did not want additional time to complete MT2, and were coded as "No." All other responses, indicating that a student *did* want additional time to complete MT2, were coded as "Yes."

Procedure

Students in both academic quarters included in this study were given the WTAS survey at the start of their respective quarter to obtain a measure of each student's baseline test anxiety score, which was submitted within the first week of classes. Students were assigned two midterm exams four and eight weeks into the quarter, and students who completed and submitted the second midterm exam, MT2, were included in our data analysis. Students in the Fall quarter BIPN 100 course were in the treatment group, receiving two hours for each midterm exam, while students in the Winter quarter BIPN 100 course were

in the control group, receiving the previously standard one hour to complete their midterm exams. After each of the two midterm exams, students completed the post-exam survey, but only the data from the second post-exam survey was utilized in our study. Test-taking conditions were consistent between both academic quarters observed except for the amount of time given to students to complete their exams and slight changes made to exam questions to create isomorphic exams. In both quarters, students were asked to write down their worries about the upcoming midterm exam for the five minutes preceding each of the two midterms to calm their nerves. This approach has previously proven to reduce test anxiety, resulting in increased exam scores (Ramirez & Beilock, 2007).

Results

To answer our primary research question, we gave the Fall academic quarter of BIPN 100 students two hours to complete their second midterm exam (MT2), while students in the Winter quarter received the previously standard one hour of exam time. We then needed to determine if doubling exam time for students had a significant effect on their exam performance while eliminating their baseline test anxiety scores as a confounding variable. We first measured the difference in MT2 scores between the two academic quarters in our study to assess whether extending exam time for BIPN 100 students improved their exam performance. Overall, the values of the MT2 scores from both quarters were not significantly different as determined using a Welch-corrected two sample t-test, meaning that extending exam time did not improve student performance ($R^2 = 0.00109$, $\Delta x = 1.013$, $p = 0.493$, Table 1). The average MT2 score for the Fall quarter exam time condition was 67.09%, compared to an average of 68.10% for Winter quarter.

Table 1. Statistical analyses of the differences in students' MT2 scores. The p-value is given for each test statistic, with values below 0.05 representing significance. The Welch two sample t-test measures the significance of the difference between the means of two samples. Its test statistic, Δx, gives the difference in average MT2 score between the two academic quarters below. The one-way ANCOVA measures the significance of the relationship between a dependent variable (MT2 score) and independent variable (exam time condition), while removing the effect of a continuous independent variable (baseline test anxiety score). Its test statistic. F, gives the between-groups variance over within-group variance. The slopes (b_1) of the regression lines for the relationship between baseline test anxiety scores and MT2 scores are given for each quarter.Neither test gave significant results.

Test	Statistic (df)	P-value	R^2
Welch two sample t-test			
Difference in MT2 score means between quarters (Winter – Fall)	Δx (412.16) = 1.013	0.493	0.00109
ANCOVA	F (3,434) = 1.402	0.242	0.00275
Slope for Fall quarter	b_1 (239) = -0.276	0.831	
Slope for Winter quarter	b_1 (197) = -2.899	0.188	

We then used a one-way analysis of covariance (ANCOVA) to evaluate if there was a statistically significant difference between the MT2 scores of Fall quarter students and Winter quarter students, controlling for their baseline test anxiety scores. Using the ANCOVA results, we determined that the amount of time students were given to complete MT2 was not a significant predictor of the relationship between baseline test anxiety levels and MT2 scores (Fig. 1). Only 0.28% of the total variation in MT2 scores was accounted for by anxiety, quarter, or the interaction of anxiety and quarter (F = 1.402, p = 0.242, Table 1).

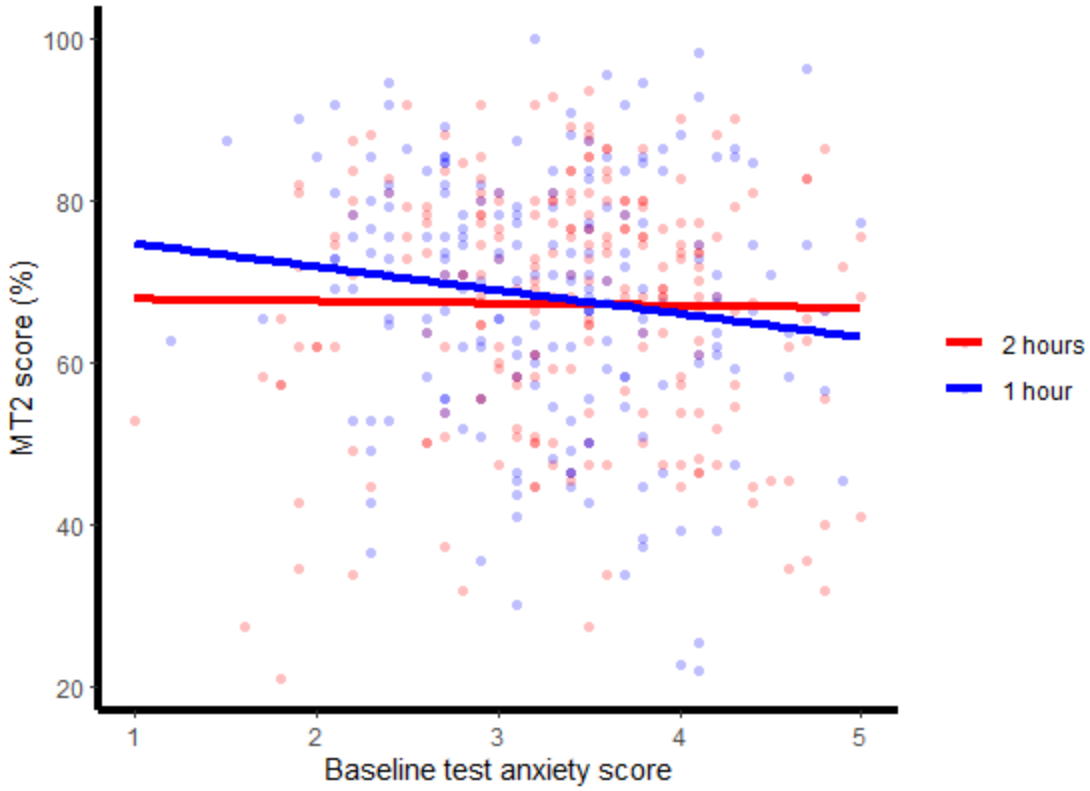

Figure 1. Students' midterm 2 (MT2) performance as a function of their baseline test anxiety scores and the academic quarter in which they took the BIPN 100 course. Each point on the graph represents an individual student's baseline test anxiety score and their MT2 score; points are colored to match the exam time condition the student received, with red representing Fall quarter students and blue representing Winter quarter students. The regression lines represent each quarter's relationship between its students' baseline test anxiety scores and MT2 scores. The Fall quarter line's slope (b_1 = -0.276) and Winter quarter line's slope (b_1 = -2.899) were not significantly different.

The ANCOVA results also show that there were no significant differences in MT2 scores for students with similar baseline test anxiety scores between the two exam time conditions. While the slope of the regression line between baseline test anxiety and MT2 score was more negative for Winter quarter students (b_1 = -2.899, p = 0.188, Table 1), the difference in the slopes of the regression lines for the Fall and Winter quarters were not statistically significant (F = 1.402, p = 0.242, Table 1). Neither quarter displayed a significant relationship between anxiety and MT2 score, as shown by the slopes of their regression lines that were not significantly different from zero (Fig. 1).

Table 2. Statistical analyses of the differences in students' test anxiety levels. The Welch two sample t-test was used to measure the difference between average baseline test anxiety scores for each academic quarter of students, given by Δx below. The difference was insignificant. A linear model explains how much the value of the dependent variable is predicted by the independent variable, represented by b_1, the slope of the regression line between these variables. The relationship between students' baseline test anxiety scores and wanting additional exam time was insignificant. The relationship between students' baseline test anxiety scores and experiencing test anxiety during MT2 was significant ($p < 0.05$).

Test	Statistic (df)	P-value	R^2
Welch two sample t-test			
Difference in baseline test anxiety scores between quarters (Winter – Fall)	Δx (428.33) = -0.114	0.111	0.00575
Linear regression			
Relationship between baseline test anxiety scores and wanting additional exam time	b (436) = -0.147	0.256	
Relationship between baseline test anxiety scores and experiencing test anxiety during MT2	b (436) = 0.584	0.00112	

Using a Welch-corrected two sample t-test, we determined that students' baseline test anxiety scores were not significantly different between the Fall experimental quarter and the Winter control quarter ($R^2 = 0.00575$, Δx = -0.114, $p = 0.111$, Table 2). This was important for our study because this ensured that differences in baseline test anxiety levels between students in the Fall and Winter quarters wouldn't be a confounding variable in observing the relationship between increased exam time and exam performance. We also determined that students' baseline test anxiety scores were not significant

predictors of whether students wanted additional exam time (b_1 = -0.147, p = 0.256, Table 2). However, as expected, students' baseline test anxiety scores were significant predictors of whether students indicated experiencing test anxiety during MT2 (b = 0.584, $p < 0.05$, Table 2).

Table 3. Statistical analyses of differences in students wanting additional exam time. The linear model below explains how much the value of the dependent variable (MT2 score) is predicted by the independent variable (whether the student requested additional exam time), represented by b_1, the slope of the regression line between these variables. The relationship between wanting additional exam time and MT2 score was insignificant. A chi-square test gives the significance of the relationship between two categorical variables, represented by X^2 below. In this case, we measured the relationship between receiving additional exam time and requesting additional exam time. This relationship was significant ($p < 0.05$).

Test	Statistic (df)	P-value
Linear regression		
Relationship between wanting additional exam time and MT2 score	b_1 (436) = 1.826	0.214
Chi-squared (X^2)		
Relationship between receiving more time and requesting additional exam time	X^2 (1) = 125.85	2.2e-16

In order to determine if increasing exam time given for students to complete MT2 affected whether or not they experienced test anxiety during the exam, we asked students to rank how much test anxiety they experienced during MT2 using a Likert scale. Only responses of "Strongly agree" and "Somewhat agree" were coded as "Yes," indicating that a student did experience test anxiety during MT2. We expected that students who received additional time to complete MT2 would experience lower levels of test anxiety as a result of having more time to process exam questions and retrieve their answers from memory; however, we observed that there was no significant difference in the proportion of students who

indicated experiencing test anxiety during MT2 between the two exam time conditions (X^2 = 2.59, p = 0.108, Fig. 2). About 87% of students in the Winter quarter reported experiencing test anxiety during the exam, compared to about 81% of students in the Fall quarter (Fig. 2).

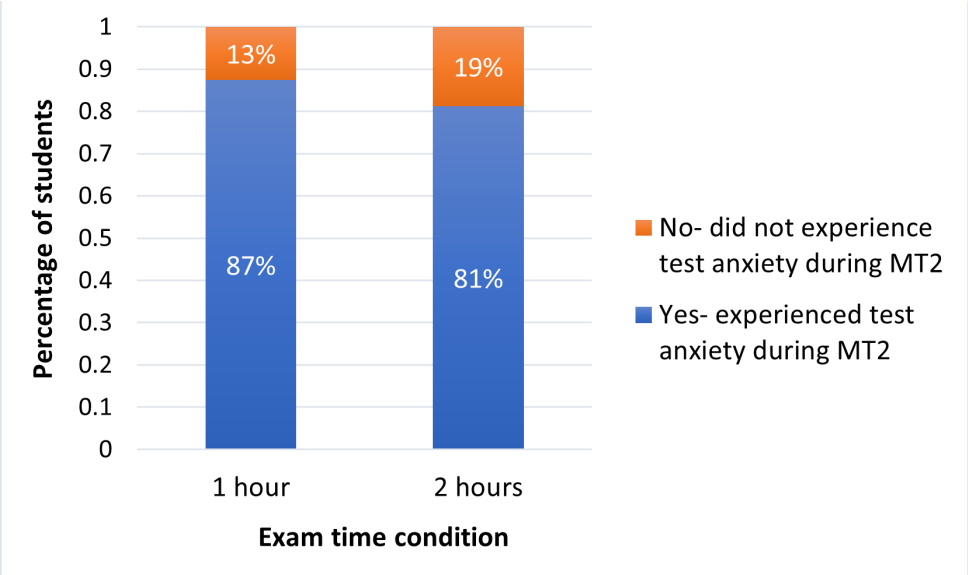

Figure 2. Percentages of students in both exam time conditions who indicated on the post-exam survey that they experienced test anxiety during MT2. About 87% of students in the Winter quarter, who had one hour to complete MT2, reported experiencing test anxiety during MT2 compared to 81% of students in the Fall quarter who had two hours to complete MT2. This difference was not statistically significant (X^2 = 2.59, p = 0.108).

To determine if students who asked for additional exam time performed worse on MT2, we performed a simple linear regression and found that whether students reported wanting additional time on MT2 on the post-exam survey was not a significant predictor of students' MT2 scores; the slope of this regression line was not significantly different from a slope of zero, meaning this relationship was not significant (b_1 = 1.826, p = 0.214, Table 3). Finally, we also wanted to measure if increasing exam time decreased students' requests for additional exam time. We performed a chi-squared test to determine if the relationship between time received to complete MT2 and whether students indicated wanting additional exam time was statistically significant. As anticipated, we observed that amount of exam time received and requesting additional exam time were not independent of one another (X^2 = 125.85, p < 0.05, Table

3). We found that the probability of students wanting additional exam time was significantly higher for students who only received one hour to complete MT2 than for students who received an additional hour of exam time (Fig. 3). The last item on the post-exam survey asked students to indicate how much additional time, if any, they would have liked to receive to comfortably complete the MT2 exam. Any non-zero response was coded as "Yes," indicating that the student did want additional time to comfortably complete MT2. The difference between the proportion of students whose answers were coded as "Yes" between the two exam time conditions was statistically significant, with about 85% of students who had one hour of exam time indicating that they wanted additional exam time compared to only 31% of students who had two hours of exam time ($X^2 = 125.85$, $p < 0.05$, Fig. 3).

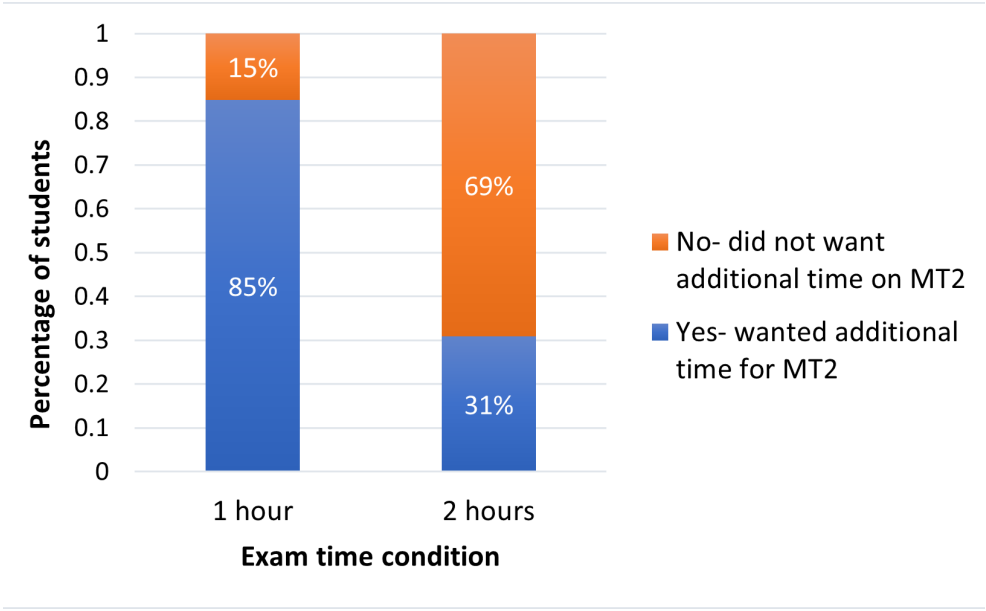

Figure 3. Percentages of students in both exam time conditions who desired more time to complete MT2. About 85% of students in the Winter quarter, who had one hour to complete MT2, reported wanting additional exam time to complete MT2 compared to only 31% of students in the Fall quarter who had two hours to complete MT2. This difference was statistically significant ($X^2 = 125.85$, $p < 0.05$).

Discussion

We conducted an experiment to determine if doubling the amount of time students receive to take a midterm exam would improve their exam scores. We also aimed to determine if this extended time condition resulted in lower test anxiety levels experienced during the midterm exam. We found that increasing exam time did not have significant effects on students' exam performance or test anxiety levels, but only served to reduce the probability that students will request additional exam time.

Expected effects of increased exam time on the relationship between performance and test anxiety

Prior literature suggested that increasing exam time constraints sometimes, but not always, improves students' exam performance (Colker, 2007; Evans & Reilly, 1971; Onwuegbuzie & Seaman, 2010). Colker (2007) references the "differential boost theory" that explains that extended time is an accommodation that benefits some students more than others. They argue that extended time benefits students with learning disabilities while having no significant effect on students without disabilities (Colker, 2007). Evans and Reilly (1971) demonstrated that both fee-free and paying students improved their LSAT scores in an unspeeded version of the exam, with fee-free students improving slightly more but not to a significant extent. Onwuegbuzie and Seaman (2010) found a significant improvement in exam performance on a statistics course final exam with unlimited exam time as compared to having a 90 minute time constraint; these effects were more significant for students with high test anxiety than for their peers. We hoped to see that students in the Fall quarter of the BIPN 100 course, given double the standard amount of allotted time to complete their MT2 exam, would perform significantly better than students in the Winter quarter who only had the previously standard one hour to complete MT2. Instead, we did not see any significant differences in MT2 scores between the two timing conditions (Table 1). Others have found that test performance is negatively correlated with test anxiety (Cassady & Johnson, 2002; DordiNejad et al., 2011). However, we observed that there was no significant relationship between students' baseline test anxiety scores and their exam performance, with no significant differences in MT2

scores between students with high and low baseline test anxiety scores (Table 1). Most surprisingly, students with high baseline test anxiety scores did not perform significantly better in the extended exam time condition that, theoretically, should have reduced their test anxiety levels (Table 1).

Explaining the lack of relationship between exam performance and test anxiety

The simplest explanation for the lack of test anxiety-induced decreases in exam performance was that we employed an expressive writing technique to reduce students' test anxiety levels before each exam. We asked students in both academic quarters to write down their worries on the backside of their midterm exams immediately before starting the exam. Ramirez and Beilock (2011) showed that using this expressive writing intervention before an exam improved students' performance as compared to a "pre-test" where this intervention was not used. They also observed that the effects of students' high test anxiety levels on their exam performance were significantly reduced in the condition where this writing intervention was used, meaning that the significant negative relationship between test anxiety and performance in the pre-test was eliminated in the post-test. Because we also used this writing intervention before the midterm exams in both academic quarters, this may explain why we did not see the significant negative relationship between students' baseline test anxiety levels and their MT2 scores that we expected.

In addition, UCSD students with learning disabilities or who need special testing accommodations already receive extended exam time as an accommodation. In other words, these students received the additional exam time accommodation typically granted to them regardless of the exam time condition their academic quarter of BIPN 100 was assigned to. Because this group of students may account for the higher end of the baseline test anxiety spectrum, it is possible that their test anxiety and MT2 score data affected the expected negative relationship between test anxiety and exam performance. Students with exam time accommodations in the Winter quarter, where most students only received one hour of exam time, may have reported lower test anxiety during MT2 as compared to their baseline test anxiety scores as a result of receiving increased exam time that their peers did not receive. It

is also possible that receiving extra time does, in fact, improve exam performance for these students *because* their disabilities warrant needing additional time; the extra time may benefit these students more than students who do not need testing accommodations, which may have skewed the linear relationship between test anxiety and MT2 performance observed.

Differentiating the two components of test anxiety

Using the expressive writing intervention, we would have also expected to see that the proportion of students who reported experiencing test anxiety during the MT2 exam would have been low in both academic quarters studied. Instead, we measured that the vast majority of students in both quarters reported experiencing test anxiety during the exam. One possible reason for this is that test anxiety can be broken down into two main contributing factors: emotionality and cognitive test anxiety (Cassady & Johnson, 2002). *Emotionality* is described as the recognition and reactions to the physiological symptoms of anxiety that emerge in response to being assessed, while *cognitive test anxiety* is described as the negative thoughts and mental dialogue that come about when thinking about being assessed (Schwarzer, 1984, as cited in Cassady & Johnson, 2002). What may be the case is that the expressive writing intervention reduces cognitive test anxiety, but leaves the emotionality component of test anxiety unaffected. While the vast majority of students in both the Fall and Winter quarters reported experiencing test anxiety during MT2 (Fig. 2), this could explain why we observed no correlation between students' baseline test anxiety and their MT2 scores, just as was observed by Ramirez and Beilock (2011). Perhaps reporting feelings of test anxiety on both the WTAS survey and the post-exam survey is reflective of the emotionality component of test anxiety instead of the cognitive component, which might explain why this was not indicative of students' performance on MT2.

Retroactively reporting test anxiety

Another possible explanation for why there were no differences in reported test anxiety levels is that students' reported test anxiety levels do not arise from the exam itself, but from the expectation that

they did not perform well on the exam. After witnessing similar results, Seipp (1991) hypothesized that students who report experiencing test anxiety may do so in anticipation of performing poorly on their exam. It is almost as if students report higher levels of test anxiety to excuse what they expect to be a "bad" grade on the exam they just completed. It is then unclear if low performance associated with high test anxiety is due to test anxiety itself, or if a student's test anxiety stems from the knowledge that they were underprepared for an exam, which would be the underlying contributor to their poor performance (Huntley et al., 2016). Reporting their test anxiety levels retroactively after having completed the exam may have resulted in students reporting on how they feel they performed on the exam rather than reporting how much test anxiety they experienced before or during the exam.

The effect of the COVID-19 pandemic on exam performance

One final possible explanation for the lack of difference in MT2 scores between Fall and Winter quarter is more generally related to learning during a pandemic. The COVID-19 pandemic has been the source of many life disruptions for the past two years due to lockdowns and closures, especially in schooling at every academic level. It is fair to assume that the COVID-19 pandemic has also likely had some negative effect on students' education, given its unprecedented nature and the forcing of new ways of teaching and learning on both instructors and students. Halloran et al. (2021) found that changes in schooling mode during the 2020-2021 school year had significant effects on students' standardized exam performance, with drastically larger decreases in test scores than were observed in typical year-to-year fluctuations. Test score decreases were significantly greater in districts that employed less in-person learning during the 2020-21 school year (Halloran et al., 2021), meaning that remote learning was detrimental to student performance. This explanation could potentially mean that, after nearly two years of remote learning, students in both the Fall and Winter quarters performed worse on their exams than they might have before the pandemic. In this case, it is possible that the amount of exam time given was irrelevant in determining how students performed on the MT2 exam. The expectation that students in Fall

quarter would perform better due to having increased exam time may have been unfair following nearly two years of unprecedented adaptation to remote learning.

Final conclusions

Because we failed to observe a significant difference in exam performance despite a 100% exam time increase, our results suggest that both the one hour and two hour exam time conditions were unspeeded and sufficiently long enough to allow students to perform to their best abilities. What may be the case is that student performance increases with increasing exam time, until a certain point where performance plateaus regardless of how much additional exam time is given. We have drawn what this relationship might look like below (Fig. 4). If this is the case, this would mean that students did, in fact, have enough time to perform to the best of their abilities with one hour of exam time; the additional hour simply made them feel more comfortable.

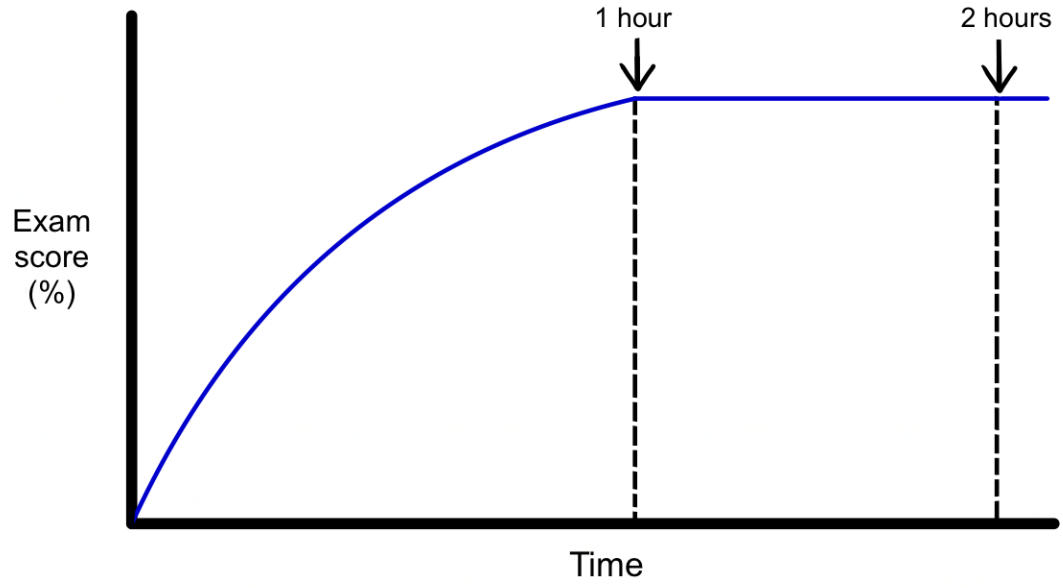

Figure 4. Predicted relationship between exam time and exam performance (%). Given our results, we predict that students' exam performance increases with increasing exam time until a certain point where increasing exam time stops being effective in improving exam performance. At this point, exam performance plateaus regardless of the further addition of exam time.

Our results suggest that increasing exam time only serves to reduce the proportion of students who request additional exam time. This finding is important because, although increased exam time did not improve students' performance or test anxiety levels significantly as we expected, students felt more comfortable with the amount of time they were given to complete the MT2 exam. That is, when given an additional hour of exam time, significantly more students left the exam feeling that they were given enough time to perform to the best of their abilities. It is possible that significantly more students felt satisfied with their performance in the extended exam time condition, as shown by their indications that they did not want more time to comfortably complete the exam. Even if they did have enough time to do so with only one hour of exam time, their perceptions of the effectiveness of the amount of exam time given were significantly improved when exam time was extended. This may be reason enough to extend exam time for students, especially if they experience less test anxiety and dread in the days leading up to an exam because they know that they will have enough time to demonstrate their knowledge. It is worth researching further to determine if there is a shorter amount of additional exam time that would result in the same findings.

If a similar experiment is to be conducted, it should be when schooling conditions are less variable and students have had time to adjust to university-level courses. It is also possible that extended exam time benefits some academic courses more than others, such as those that are heavily dependent on calculations. Future studies should also consider what other factors may be significant predictors of students' exam performance at the university level, such as their high school GPAs and demographic data. We would like to compare these variables for the two groups of students involved in our study to determine if there were significant differences in Fall and Winter quarter students that may account for or explain our results. In the future, comparing the proportion of students with diagnosed anxiety disorders in the two experimental groups may also prevent confounded results in measuring differences in test anxiety amongst two exam time conditions.

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