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Second-Chance Testing as a Means of Reducing Students' Test Anxiety and Improving Outcomes

Mr. Chinedu Alexander Emeka

Chinedu Emeka is a PhD Candidate in Computer Science at the University of Illinois at Urbana-Champaign. His research interests include Computer Science Education and improving assessments for CS and other STEM students. Mr. Emeka also has a passion for teaching CS, and he has received two awards for his teaching.

Prof. Craig Zilles, University of Illinois at Urbana-Champaign

Craig Zilles is a Professor in the Computer Science department at the University of Illinois at Urbana-Champaign. His research focuses on computer science education and assessment with an emphasis on effective teaching at scale.

Prof. Matthew West, University of Illinois at Urbana-Champaign

Matthew West is a Professor in the Department of Mechanical Science and Engineering at the University of Illinois at Urbana-Champaign.

Dr. Geoffrey L. Herman, University of Illinois at Urbana-Champaign

Dr. Geoffrey L. Herman is the Severns Teaching Associate Professor with the Department of Computer Science at the University of Illinois at Urbana-Champaign.

Prof. Timothy Bretl, University of Illinois at Urbana-Champaign

Timothy Bretl is a Severns Faculty Scholar at the University of Illinois at Urbana-Champaign, where he is both Professor and Associate Head for Undergraduate Programs in the Department of Aerospace Engineering. He holds an affiliate appointment in the Coordinated Science Laboratory, where he leads a research group that works on a diverse set of projects in robotics and education (http://bretl.csl.illinois.edu/). He has received every award for undergraduate teaching that is granted by his department, college, and campus.

Second-Chance Testing as A Means of Reducing Students' Test Anxiety and Improving Outcomes

Abstract

This full research paper explores how second-chance testing can be used as a strategy for mitigating students' test anxiety in STEM courses, thereby boosting students' performance and experiences. Second-chance testing is a testing strategy where students are given an opportunity to take an assessment twice. We conducted a mixed-methods study to explore second-chance testing as a potential solution to test anxiety. First, we interviewed a diverse group of STEM students (N = 23) who had taken courses with second-chance testing to ask about the stress and anxiety associated with testing. We then administered a survey on test anxiety to STEM students in seven courses that offered second-chance tests at Midwestern University (N = 448).

We found that second-chance testing led to a 30% reduction in students' reported test anxiety. Students also reported reduced stress throughout the semester, even outside of testing windows, due to the availability of second-chance testing. Our study included an assortment of STEM courses where second-chance testing was deployed, which indicates that second-chance testing is a viable strategy for reducing anxiety in a variety of contexts. We also explored whether the resultant reduction in test anxiety led to student complacency, encouraged procrastination, or other suboptimal student behavior because of the extra chance provided. We found that the majority of students reported that they worked hard on their initial test attempts even when second-chance testing was available.

Introduction

Second-chance testing is a practice of offering students an optional attempt to re-take an exam for some kind of grade replacement [1]. In general, the second-chance exam covers the same course material as the first-chance exam at the same difficulty level, but uses new questions. Second-chance testing can be viewed as a form of mastery testing [2], but students are provided a single re-take attempt.

Previous research has found that second-chance testing leads to improved student performance because it provides students feedback on the shortcomings of their knowledge and an incentive for students to remediate those shortcomings [1, 3, 4]. Students can address gaps in their understanding, take a second version of an assessment to demonstrate their mastery, and boost their score.

In this paper, we investigate whether second-chance testing has affective benefits in addition to its cognitive benefit. Specifically, we investigate whether second-chance testing can help mitigate students' test anxiety.

Test anxiety may be defined as anxiety in evaluative situations [5, 6]. Test anxiety commonly refers to the tension and apprehensiveness associated with taking a test. Test anxiety is a pervasive problem in classrooms, which often leads to diminished performance among students. Consequently, test anxiety may hamper students' ability to progress through a course, either because it can lead to lower grades or lower confidence.

We perform a mixed-methods approach to studying two research questions relating to the interaction between second-chance testing and test anxiety:

RQ1: How does second-chance testing influence test anxiety and student stress in general?

RQ2: Does second-chance testing lead to sub-optimal student behavior such as procrastination?

In general, reduction of test anxiety is a good thing, because it allows our assessments to more accurately measure the students' true ability. Determining if second-chance testing can mitigate students' anxiety is our first research question. That said, anxiety, especially at low levels, can be a motivating force [7]. Our second research question explores whether the introduction of second-chance testing negatively impacts our students' motivation to study.

Related Work

Test anxiety is a composite problem with two dimensions: emotionality and cognitive worry [8, 9, 10, 11]. The emotionality dimension refers to physiological responses that occur during testing, such as an increase in heart rate or dizziness [11]. The cognivite worry dimension of test anxiety refers to students' cognitive reactions in situations where they are being tested. For instance, cognitive worry includes students worrying about the consequences of failure during a test, as opposed to devoting their attention to actually completing the test [11]. Cognitive worry is often more closely associated with diminshed performance than emotionality [12].

Test anxiety has been found to adversely impact students' performance on assessments [12, 13, 14]. For instance, in one study [12], researchers examined the relationship between cognitive test anxiety, student performance and procrastination, among other things. They developed a measure for test anxiety and collected test anxiety and performance data from 168 undergraduate students in a psychology course. The researchers found that high levels of cognitive test anxiety were associated with significantly lower testing scores. There is a need to address test anxiety due to its negative effects.

Some related work has briefly addressed offering retakes as a means of reducing students' test anxiety. In one study [15], Fernandez administered a course with 10 quizzes and a final exam. Concurrent with the 4th and 8th quizzes, Fernandez offered alternate versions of quizzes 1–3 and 5–7, respectively. On the final, Fernandez offered alternate versions of all of the quizzes. If students scored higher on the optional alternate versions, then their grade was replaced with the higher score. At the end of the semester, his students filled out course evaluations. 21 out of 139 students (15%) mentioned that the alternate versions reduced their stress or anxiety about grades

and learning. Fernandez also stated that he conducted qualitative analysis, and he reported that his new testing scheme - the introduction of shorter, low stakes formative assessments together with "second-chance exams" - led to a great reduction in students' anxiety about testing and grading. Fernandez did not expound on the methods of analysis or further quantify the reduction in anxiety. Our study presents results from a mixed-methods study that includes a much larger population, covers multiple courses, ask students directly about test anxiety, and attempts to quantify the reduction of test anxiety that students get from second-chance testing.

Method

We conducted this mixed-methods study at a large public university in the midwest of the United States, with IRB approval. We identified several courses that offered second-chance testing to students. The courses offered second-chance exams for summative assessments. These courses were all STEM related and spanned across departments: Aerospace Engineering, Computer Science, Chemistry, Electric Engineering and Mechanical Engineering. None of these courses used a full grade replacement policy; students were only able to get back a portion of the points lost on an initial attempt during a retake attempt. The amount of points which could be regained through a retake exam varied by course. The second-chance (or retake) exams were offered within a few days to a few weeks after the first-chance exams (or initial attempts).

Our mixed method approach consisted of open-ended interviews followed by a survey designed to quantify the degree to which the observations we noted in the interviews represented the views of the larger student body.

We conducted 23 interviews over Zoom with students sampled from the diverse collection of courses that we identified. These students were asked a broad range of questions about their experiences with second-chance testing. Most interviews took about 30 minutes, and students were reimbursed for their time at a rate of $15/hour in gift cards. The interviews were semi-structured and included 10 questions. During the interviews, we asked additional questions based on student responses. The interview questions related to this study are:

- Do you like it when classes you take offer second-chance exams? (We then asked students to further explain their sentiments, whether positive or negative.)
- Does the opportunity to take a second-chance exam generally affect how you prepare for an exam?
- Are there differences in general between how you prepare for a first-chance and second-chance exam?

In the interviews, we did not specifically ask about test anxiety. The interviews were conducted to identify student sentiment and areas for future exploration in a larger sample. Although the interviews did not ask about test anxiety, the most widely reported benefit of second-chance testing was a reduction in anxiety. This led us to investigate test anxiety in-depth through our survey.

The interviews were transcribed and analyzed using a grounded theory approach [16, 17], where two researchers independently inductively coded the transcripts. The two researchers then met to

reconcile the codes. Afterwards, an external rater re-coded two randomly selected transcripts to ensure that the coding scheme was reliable. Kripperdorff's alpha α, a measure of inter-rater reliability, was calculated and found to be adequate (α = 0.69) [18, 19]. The two researchers then independently identified themes from the codes and reconciled the themes. Some findings from these interviews have been previously reported [20].

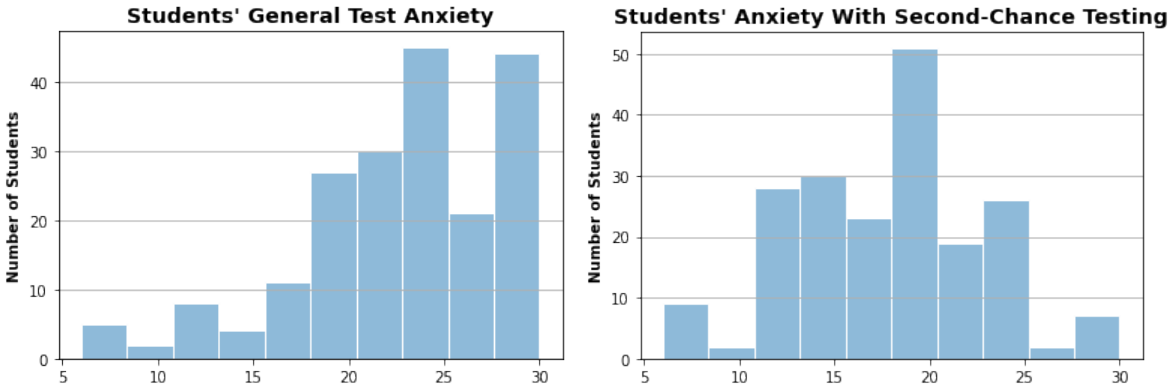
Based on the findings from the interviews, we designed a survey that consisted of 46 questions, including Likert items and multiple choice questions. The survey was intended to be completed in one seating (there was no formal pretest or posttest design). The survey was administered a few weeks prior to the end of the Fall 2021 semester. The survey was only sent to students who were enrolled in a course that used second-chance testing. Because the survey was administered in the final weeks of the term, students had almost a semester's worth of experience with second-chance testing by the time they were asked to complete surveys. The survey was sent to 2102 students. 448 students completed the survey, a response rate of 21.3%. The distribution of respondents was as follows: 33% freshmen, 49% sophomores, 14% juniors, 3% seniors, and 1% declined to provide class standing information. 56% of respondents were male, 40% were female, and 4% declined to provide gender information. Survey responders were entered into a raffle to earn one of a set of $50 gift cards.

Measuring Test Anxiety

We reviewed the literature on test anxiety and found several instruments for measuring test anxiety, including Spielberger's Test Anxiety Inventory [21], a Multidimensional Test Anxiety Scale (MTAS) [22] and the Westside Test Anxiety Scale [23]. In our survey, we wanted to ask other questions regarding students' experiences with second-chance testing in addition to its impact on test anxiety. Therefore, given space constraints with the survey, it was not practical to administer any of these existing instruments in full. Drawing inspiration from these instruments, we constructed a Likert scale consisting of six Likert items to measure how test anxious a student was. We included an equal mix of questions related to emotionality and cognitive worry, as recommended by previous work [24, 25]. Our measure is similar to a short form of the Test Anxiety Inventory [24]. Each Likert item asked students to rate their agreement with various statements on a 5 point-scale, from "Strongly Agree" to "Strongly Disagree", with 3 indicating a "Neutral" opinion. The Likert scale ranges from 6 to 30, because it sums six Likert items that are scored on a five-point scale, from 1 to 5. An example Likert item was "During tests, I get so nervous that I forget facts I really know."

This Likert scale was used twice in the survey. First, it was used to ask the student about their general test anxiety. On the subsequent page of the survey, the same questions were asked but the term "tests" was replaced with "tests which have a retake opportunity available" to have students report their anxiety in courses that offer SCT.[1] We used the matched pairs t-test to compare the two Likert scales.

[1]The entire survey, i.e. the set of 46 questions, was administered twice to solicit more responses. In the first version of the survey, the SCT test anxiety questions were not worded in a way that facilitated comparison between general test anxiety and test anxiety when a retake was available. Therefore, only data on test anxiety from the second survey is reported. The data from the first survey, however, is consistent with these findings.



(a) General test anxiety

(b) Test anxiety for courses with SCT

Figure 1: Comparison of distributions of student reported test anxiety for exams without and with second-chance testing. Our Likert scale goes from 6 to 30.

Analysis and Results

RQ1: How does second-chance testing influence test anxiety and student stress in general?

In the interviews, a majority of students reported that second-chance testing led to a reduction in their stress levels about a course. The following student quote is representative of this sentiment.

> There was always much less stress [with second-chance testing]. In the back of my mind, I always knew that there was a retake and there's an opportunity to actually improve upon that grade, so overall the stress is much less and I could actually devote the time and effort I wanted to actually learning the material properly to do on the quiz, rather than just pure memorization.

This sentiment of stress reduction was prevalent even for those who rarely used second-chance testing. Merely knowing that the option was available was beneficial to students.

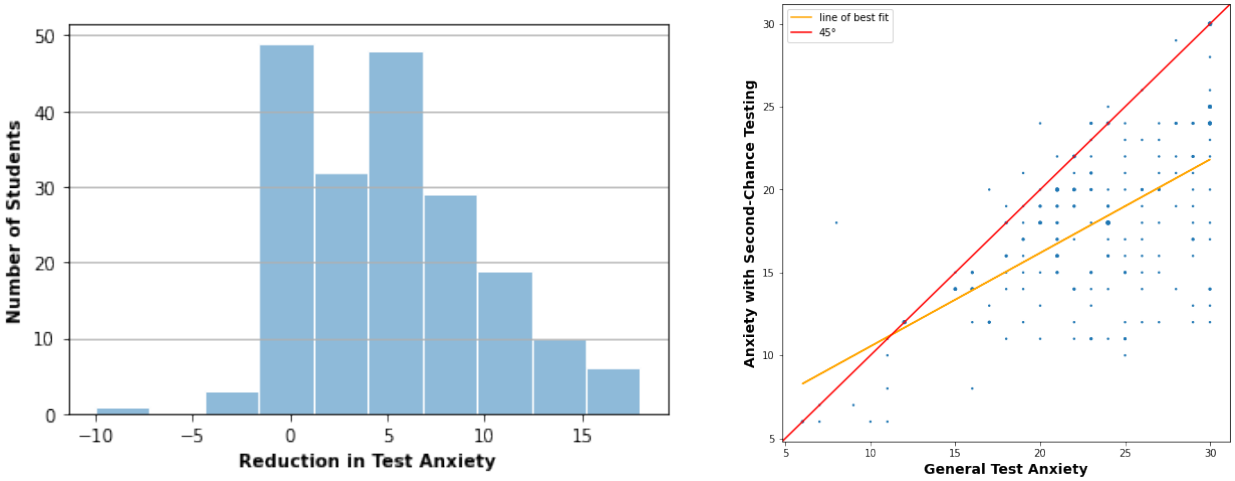
> I thought it was a very good option to have [second-chance exams] so [the course] was never too stressful...but I ended up not needing [the second-chance exams] at all.

We looked at the survey data (i.e., our sample) to estimate test anxiety in the larger student population. Figure 1a shows the distribution of test anxiety for our participants in general. Figure 1b shows the corresponding distribution of test anxiety with second-chance testing. It can be seen that the students report a significant reduction in test anxiety from SCT; the mean Likert scale value reduces from 22.7 to 17.7, a 30% reduction.[2] Our analysis finds these distributions to be statistically significantly different (test statistic $t = 14.87$ and the p-value was less than 0.001).[3]

While most students reported a reduction in test anxiety on tests that offered second chances, the

[2]Recall that the minimum Likert scale value is 6. $(17.7 - 6)/(22.7 - 6) = .700$.

[3]We used the matched pairs t-test to compare the two distributions. The null hypothesis was that there was no difference between the distributions.



(a) Baseline test anxiety - SCT test anxiety

(b) SCT test anxiety vs general test anxiety

Figure 2: Two plots showing how test anxiety is affected by second-chance testing in the population: (a) a histogram of the reduction in test anxiety and (b) plotting students SCT test anxiety against their baseline test anxiety (the size of the dot corresponds to how many students are at that point in the plot).

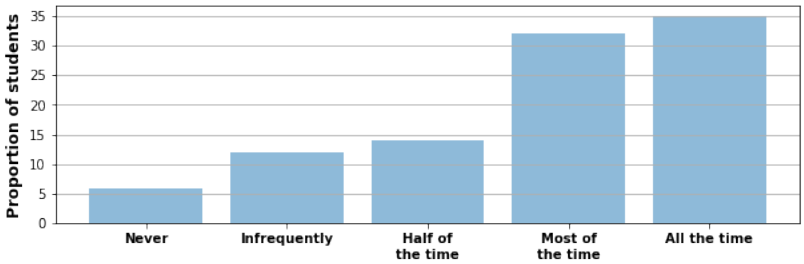


Figure 3: Student reported retake frequency ($N = 251$)

reported reduction in anxiety were not uniformly distributed. As shown in Figure 2a, some students had significant reduction in reported test anxiety (a positive value indicates that test anxiety is reduced with second-chance testing), others reported little or no effect, and a small number of students reported higher anxiety on SCT exams.

Furthermore, there seems to be little correlation between a student's baseline level of test anxiety and the degree to which SCT alleviates their anxiety. Figure 2b shows a bubble chart relating students' two test anxiety Likert scales. The size of the bubbles corresponds to the number of students in each position. It is difficult to discern any pattern beyond the fact that the points are predominantly in the lower triangle, which indicates a reduction of anxiety from second-chance testing. It is important to note that, in addition to the few students that report an increase in anxiety due to SCT, some of the most anxious students report no reduction in anxiety from SCT, as indicated by the bubble at (30, 30).

Test anxious students do, however, report taking second-chance exams at higher rates. For comparisons, we marked the quartile (i.e., 25% of the respondents) with the lowest reported test anxiety scores as having "low-anxiety." Likewise, we maked the quartile with the highest reported

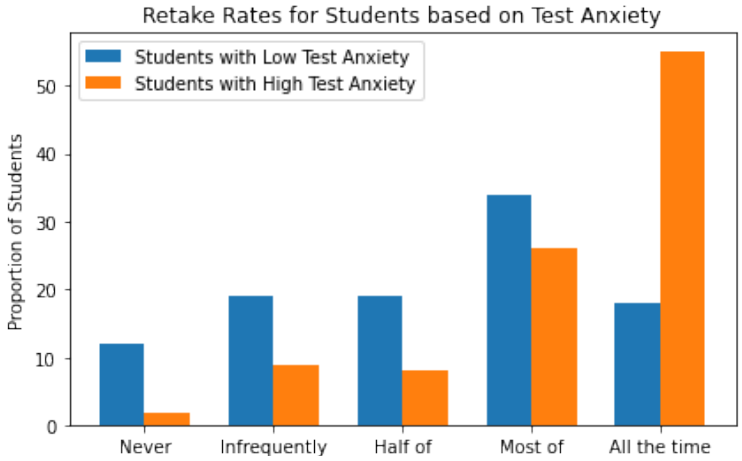


Figure 4: Reported retake frequency for low vs. high test anxious students

test anxiety as "high anxiety." Low-anxiety students had a mean anxiety of 15 on the 30-point scale. High anxiety students had a mean anxiety of 29 on the 30-point scale.

Figure 3 shows the reported retake rates of the survey population as a whole. As a whole, the majority of students (67%) report taking second-chance exams either "most of the time" or "all of the time" in almost equal proportions. If we look at the (self-reported) most and least anxious students, we see different trends. Figure 4 plots the self-reported retake frequency data from for students from the lowest and highest quartile by the baseline test anxiety Likert scale. While low anxiety students are roughly distributed uniformly among the retake frequencies, the students reporting the highest test anxiety report being frequent re-takers, with a majority reporting that they take all of the second-chance exams. Our analysis finds these distributions to be statistically significantly different ($\chi^2 = 40.00$, $p <= 0.001$).[4]

RQ2: Does second-chance testing lead to sub-optimal student behavior such as procrastination?

Procrastination has been defined as "freely postponing an action with the awareness of the detriment it may cause in the future" [26, 27]. Procrastination is a type of self-regulatory failure [28, 29]. Procrastination can lead to failure in completing tasks adequately or in a timely manner. The additional flexibility provided by second-chance testing could lead to procrastination, as students do not have to demonstrate mastery on a first-chance exam. In related work, researchers showed that task completion decreased as students were given greater flexibility [30].

Another potential pitfall of second-chance testing is that some students may try to "game the system" by attempting the first-chance test without preparing, in order to gain exposure to questions, and then study those areas in preparation for the second-chance test.

Therefore, some anxiety or risk may be needed to encourage students to work hard on tests or in a course in general [7]. Because second-chance testing gives students an opportunity to retake an assessment, there is a concern that the reduced risk can lead to procrastination or sub-optimal

[4]We use a chi-square test of homogeneity to check if the two distributions are equal. The null hypothesis is that they are equal.

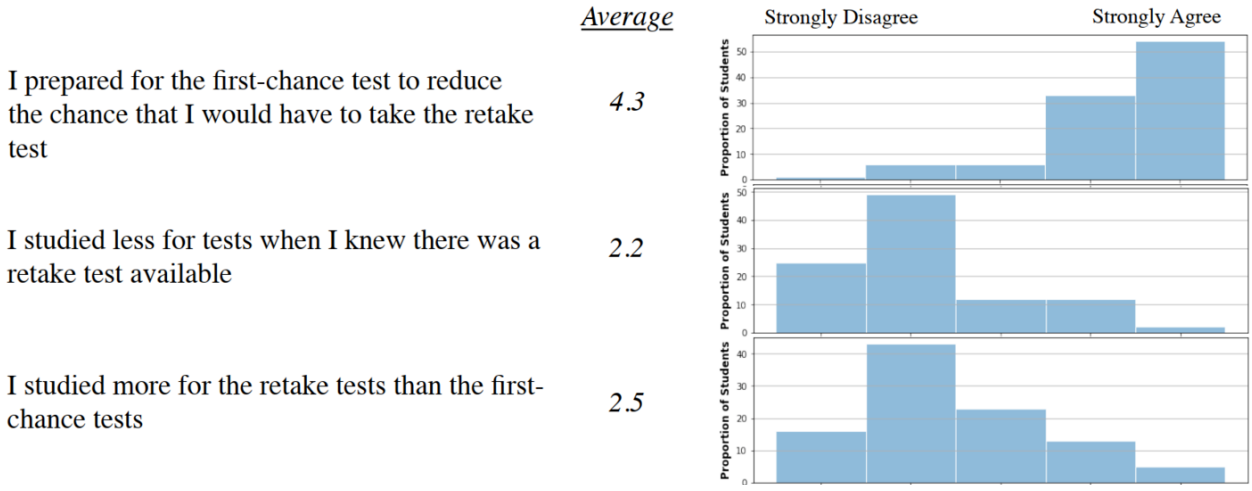


Figure 5: Survey data relating to second-chance exam preparation ($N = 448$)

behavior such as dimished studying.

Our interviews asked questions about how students prepared for both first and second chance exams. The majority of the interviewed students reported studying broadly for the first exam, and studying in an amount comparable to how much they would study for a traditional one-shot exam. Multiple students indicated that they studied for the first-chance exam as if it were the only exam precisely so that they would not have to take the second-chance exam. For second-chance exams, students generally reported focusing their studying on the topics that they got wrong on the first exam. This dominant behavior aligns well with most instructors' motivations for introducing second-chance exams.

In the interviews, however, a few students reported studying less on the first-chance exams than they would if they only had a single attempt at the exam. The following quote is representative of the minority sentiment.

> Psychologically for me, ... [second chance testing] gave me cushioning thinking, 'if I don't do well on my first try, I have my second try.' I think that's a little bad for me personally, because I think of [second-chance testing] that way and I concentrate more on other stuff than that course

To see the degree that these behaviors were represented in a larger population, we included a collection of Likert items in our survey about their studying habits based on the interviews. We attempted to include both positively and negatively framed questions to mitigate social desirability bias. The questions and their results are shown in Figure 5.

As in the interviews, the majority of students report studying in the desired manner. 87% of students agree or strongly agree with the statement "I prepared for the first-chance test to reduce the chance that I would have to take the retake test." Most (72%) students disagreed or strongly disagreed with the statement "I studied less for tests when I knew there was a retake available." Similarly, few (18%) students report spending more time studying for second-chance exams than first-chance exams, something that could be an indication of procrastination.

Discussion

Test anxiety is a significant problem and one without a lot of clear, easy solutions. As such, we were surprised by the large reduction in test anxiety that students report from second-chance testing. Second-chance testing is a very straight-forward technique, albeit one that can create additional work on the part of the faculty and their course staff. The classes that we surveyed that use second-chance testing all utilize a computer-based testing facility [31] that facilitates a significant amount of automatic grading, which may have enabled these faculty to adopt second-chance testing.

As we noted in the results, while second-chance testing leads to a reported reduction in test anxiety by most students, there are students that report the maximum test anxiety in both conditions (e.g., $(30, 30)$). We can think of two possible interpretations of this finding. First, these students might have no reduction of anxiety from second-chance testing. The second interpretation is there is a reduction in anxiety, but we cannot measure it because of a ceiling effect on our Likert scale. For example, such a student might have test anxiety of 43 normally, but only 35 with second-chance testing, but our scale only goes up to 30.

In general, we find the results related to procrastination to be promising. The finding that students study for first-chance exams as if they are the only exam agrees with previous quantitative results from an across-semester study that compared the amount of student studying for an exam with and without a second-chance exam [4]. Importantly, both these surveys and that previous empirical study were performed in contexts where only partial grade replacement was possible from the second-chance exam (i.e., one's performance on the first exam affects the final score even if a student were to score perfectly on the second exam). Anecdotally, procrastination is more significant in instances where full-grade replacement is offered for the second-chance exam, including students entirely skipping the first exam because "it doesn't count."

Limitations

The primary limitation of this work relates to the measurement of test anxiety. Our surveys ask students to recall their test anxiety in two different testing situations. It could be more accurate to assess test anxiety in actual testing situations, but doing a comparison would require getting the same students taking equivalent high-stakes exams with and without second-chance tests being offered. Furthermore, our measure of test anxiety is a self-reported one, so it deserves the same scrutiny that any self-reported metric warrants. That said, self report is the predominant means of collecting test anxiety data.

In addition, student self-reports of studying are prone to social desirability bias, in that students might report studying behavior that they believe makes them look better than what they actually engage in.

Conclusion

Second-chance testing is designed to encourage students to remediate their mistakes and demonstrate improved mastery of the material. It does so by offering students an opportunity to

improve their grade if they score poorly on an exam. We found that second-chance testing led to a reduction in test anxiety among students. Furthermore, we found that the majority of students report maintainig desirable study behaviors, in spite of the opportunity to re-take exams. Therefore, we conclude that second-chance testing can be a potent strategy for reducing anxiety, thereby facilitating learning.

Acknowledgements

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