

Reappraising Test Anxiety Increases Academic Performance of First-Year College Students

Shannon T. Brady, Bridgette Martin Hard, and James J. Gross
Stanford University

The idea that test anxiety hurts performance is deeply ingrained in American culture and schools. However, researchers have found that it is actually worry about performance and anxiety—not bodily feelings of anxiety (emotionality)—that impairs performance. Drawing on this insight, anxiety reappraisal interventions encourage the view that anxiety can be neutral or even helpful. Initial evidence—largely from laboratory studies—suggests that these kinds of reappraisal interventions can improve student performance in mathematics. But can they do so in other domains and within the constraints of everyday classroom activities? If so, for whom and how? In an intervention study, we tested whether a minimal reappraisal message embedded in an email from course instructors could improve students' academic experience and performance in an introductory college course. The night before their first exam, students received an e-mail that either did or did not include a paragraph designed to lead them to interpret exam anxiety as beneficial or at least neutral. First-year students, who experience greater test anxiety and are less certain about how to perform well, benefited from the reappraisal message, showing decreased worry and increased performance on the exam the next day as well as increased performance in the course overall. Mediation analyses revealed that the effect on overall course performance for first-year students was partially mediated by reduced exam worry and enhanced performance on the first exam. The message did not affect the performance of upper year students.

Educational Impact and Implications Statement

The idea that test anxiety hurts performance is deeply ingrained in American culture and schools, but researchers have found that it is students' *worry* about performance and anxiety—not the bodily feeling of anxiety itself—that impairs performance. Can teaching students that anxiety will not necessarily hurt their performance on an upcoming test reduce students' worry and help them perform better? We find that it can: exposure to a message designed to share this insight before the first exam in a college psychology course reduced the worry and improved the academic performance of first-year (but not upper year) students. Our findings indicate that the academic benefits of this kind of anxiety reappraisal intervention are not limited to the domain of math, as prior research suggested, and they may be greater for students with less experience and greater worry. These findings are important because they suggest a highly scalable means of decreasing test-related worry and enhancing academic performance in vulnerable students.

Keywords: test anxiety, cognitive reappraisal, emotion regulation, social-psychological intervention, college transition

Supplemental materials: <http://dx.doi.org/10.1037/edu0000219.supp>

Tests are ubiquitous in academic life, and they become increasingly consequential as students progress through school. By high school and college, students' grades are often largely composed of test scores. In addition, standardized tests are gatekeepers of entry into

higher education, as well as receipt of employment and scholarship opportunities.

Students' desire to do well on tests can lead them to experience anxiety (Beilock & Ramirez, 2011). Unfortunately, the default interpretation of anxiety is that it is harmful (Johns, Inzlicht, & Schmader, 2008). Thus, folk wisdom holds that people should manage anxiety by "calming down" to enhance their performance on test day (Brooks, 2014). Indeed, this is even the advice offered by one of the largest testing organizations in the United States (ACT, 2012).

Unfortunately, there are two problems with this approach. First, suppressing negative emotions is often difficult, requiring attention and effort (Gross, 2014). Second, the recommendation to calm down relies on an overly simplified model of how anxiety affects performance. Although people often think of test anxiety as a unitary emotional experience, previous research has identified two

This article was published Online First December 21, 2017.

Shannon T. Brady, Bridgette Martin Hard, and James J. Gross, Department of Psychology, Stanford University.

Bridgette Martin Hard is now at the Department of Psychology and Neuroscience, Duke University.

We thank the students who participated in this research, as well as Lauren Aguilar, Patricia Chen, Geoff Cohen, Inho Lee, Kirstie Lee, Jana Luft, Kody Manke, Chris Rozek, Greg Walton, Lizzie Wong, and the course teaching assistants.

Correspondence concerning this article should be addressed to Shannon T. Brady, Department of Psychology, Stanford University, 450 Serra Mall, Stanford, CA 94305. E-mail: shannonbrady@gmail.com

components of test anxiety, *emotionality* and *worry*, and has determined that these components affect performance in different, even opposing, ways (Cassady & Johnson, 2002; Liebert & Morris, 1967; Schwarzer, 1984).¹

In the literature on test anxiety, *emotionality* refers to feelings of heightened physiological arousal or emotional activation (e.g., increased heart rate and increased adrenaline). On its own, emotionality does not typically hurt performance and may even facilitate it (Cassady & Johnson, 2002; Eysenck, 2012). Thus, calming down may ironically worsen performance by reducing emotionality.

In the literature on test anxiety, *worry* refers to people's cognitive concerns about the test situation.² Emotionality often—but not invariably—triggers worry, and it is worry, rather than emotionality, that undermines performance and interferes with students' ability to perform to their potential (Bandura, 1997; Cassady & Johnson, 2002; Wine, 1980). Worry reduces working memory and creates distraction (Beilock, 2011). Even people who are highly prepared for an anxiety-provoking situation can suffer the negative consequences of worry (Beilock & Ramirez, 2011). This more nuanced model of how anxiety affects performance suggests that advising students to “calm down” in response to test anxiety may be counterproductive.

Research in affective science suggests an alternative approach to managing test anxiety, namely changing the meaning of the emotionality component of anxiety through cognitive reappraisal. Reappraisal is an emotion-regulation strategy in which an individual reinterprets the meaning of an emotion-eliciting situation or physiological sensation (Gross, 2002). This shift in meaning can change the consequences of the emotional response, affecting downstream outcomes including cognitive performance and social interaction (Gross, 2014). Although a person certainly could reappraise emotionality in a number of ways, we focus on shifting the meaning of emotionality from harmful to neutral or even beneficial. If students do not view emotionality as harmful, they may be less likely to worry and lose confidence, allowing them to perform better.

Laboratory-Based Anxiety Reappraisal Interventions

Encouragement for using reappraisal to manage performance anxiety comes from several laboratory studies. For example, Jamieson and colleagues (2010) recruited students ($N = 60$) intending to take the Graduate Record Examination (GRE). Immediately before completing a practice GRE test, students either did or did not read a reappraisal message: . . . recent research suggests that arousal doesn't hurt performance on these tests and can even help performance. . . . If you find yourself feeling anxious, simply remind yourself that your arousal could be helping you do well (p. 209).

Students who saw the message performed better on the math (but not verbal) portion of the test. A few months later, the researchers followed up with students who had, by that point, taken the actual GRE (one half of the sample). Students in the reappraisal condition again scored better on the math section and also reported less worry.

Other laboratory studies have found that leading people to reappraise anxiety can improve performance on other activities, including karaoke singing, public speaking, and mathematical problem solving

(Beltzer, Nock, Peters, & Jamieson, 2014; Brooks, 2014; Crum, Salovey, & Achor, 2013; Jamieson, Nock, & Mendes, 2012; Johns et al., 2008). These laboratory studies are bolstered by one field experiment ($N = 90$), in which remedial math students either did or did not read summaries of scientific articles sharing a reappraisal message about anxiety and arousal before a course exam (Jamieson, Peters, Greenwood, & Altose, 2016). Reappraisal students performed better on the exam and reported greater perceived ability to cope with the demands of the exam. Although researchers have made great strides in understanding reappraisal and its educational dynamics, three sets of important questions remain unaddressed by prior studies.

Assessing the Generalizability of Reappraisal Intervention Findings

One set of previously unaddressed questions concerns the generalizability of reappraisal interventions. Thus far, benefits of reappraisal on academic test performance have been observed only in the domain of mathematics (Brooks, 2014; John-Henderson, Rheinschmidt, & Mendoza-Denton, 2015; Johns et al., 2008), leading some researchers to suggest that such interventions might be effective only in this domain (Jamieson et al., 2010). In the GRE study discussed earlier, researchers found effects on the math portion of the test, but not the verbal portion. They proposed that the math portion of the test requires greater working memory, which is reduced when students experience worry, and thus restored when students reappraise their anxiety. But most challenging tasks demand working memory (DeCaro & Beilock, 2010), which suggests that reappraisal may improve performance on tests in academic domains beyond mathematics so long as the test questions require executive resources rather than rote recall.

Additionally, students in the laboratory and field studies conducted so far knew they were participating in research on anxiety and performance. Their willingness to engage in reappraisal and the benefits they received from doing so, could be due—at least in part—to demand characteristics (Orne, 1962). What would happen if an instructor tried to help students reappraise their anxiety in a regular classroom context, such as just before an important exam in a course? Would students still be responsive to the reappraisal message? Or, amid the bustle of the course, might students ignore or even resist a reappraisal message, causing the intervention to be ineffective or—worse—backfire (Forsyth, Lawrence, Burnette, & Baumeister, 2007; Wood, Perunovic, & Lee, 2009)?

¹ Although emotionality and worry can also be considered as individual difference variables, the present research focuses on students' state experiences of emotionality and worry associated with the first exam in a course.

² Throughout the educational psychology literature, scales to assess worry consistently include items that tap both (a) concern about performance, failure, and anxiety and (b) lowered self-confidence (Morris, Davis, & Hutchings, 1981; Schwarzer, 1984). As some scholars have noted, the term *worry* “insufficiently represents the broad class of cognitive processes we associate with test anxiety” (Cassady & Johnson, 2002, p. 271). Despite the acknowledgment that *worry* is an inadequate term, there has not been consensus in the literature on a better alternative. Although some researchers have suggested that self-confidence should be its own component of test anxiety (Hodapp & Benson, 1997), it is still more common to assess worry as single construct that includes components of both worry about anxiety and confidence. Therefore, following this tradition, we use *worry* to describe cognitive concern about one's performance and assess it both in terms of worry about anxiety and loss of confidence.

Exploring Who Benefits From Reappraisal Interventions

A second set of previously unaddressed questions concerns the issue of who benefits from reappraisal interventions. Past research has not typically examined whether some people benefit more from reappraisal interventions than others do. One dimension that may matter in a school setting is students' previous experience—or lack thereof. Specifically, students with less experience (i.e., first-year students) may be more responsive to a reappraisal intervention than students with more experience (i.e., upper year students).

During the transition to college, students must reorient themselves to their new environment. They must make sense of the new academic world in which they find themselves, determine what different experiences and feelings mean in that environment, and decide how to respond (Cook, Purdie-Vaughns, Garcia, & Cohen, 2012; Farrington et al., 2012). Presumably, first-year students are less certain than upper year students about how to undertake major tasks like exams, especially when it is their first time doing so. As such, they may be more open to advice about how to approach those tasks.

In addition to first-year students potentially being more open to new information about how to perform well, one study suggests first-year students experience greater test anxiety than upper year students (Misra & McKean, 2000). Although the study does not differentiate between the two components of anxiety—emotionality and worry—it is reasonable to imagine first-year students might be higher on both components than upper year students are. If this is the case, then changing the meaning of emotionality from negative to neutral or positive may be doubly beneficial for first-year students: first, by mitigating the deleterious effect on performance of worry and, second, because first-year students actually have greater emotionality—arousal—to help them focus and perform well (Eysenck, 2012).

Examining Recursive Processes in Reappraisal

A third set of previously unaddressed questions concerns the time course and mechanisms of reappraisal interventions. If a reappraisal intervention successfully reduces students' worry in the short-term, benefits may accrue not only in the short-term but also in the long-term. Mounting evidence suggests that seemingly “small” social-psychological interventions that are targeted and theoretically precise can catalyze effects on academic performance that persist months or even years (Yeager & Walton, 2011) and sometimes strengthen over time (Blackwell, Trzesniewski, & Dweck, 2007; Walton & Cohen, 2011). Scholars suggest this happens because processes become recursive or self-reinforcing (Brady et al., 2016; Cohen, Garcia, Purdie-Vaughns, Apfel, & Brzustoski, 2009; Stephens, Townsend, Hamedani, Destin, & Manzo, 2015).

Absent any intervention, the recursive cycles that exist with regard to test anxiety may typically be negative. A student experiences emotionality before an important test, interprets this emotionality as harmful, becomes worried about his or her performance, and loses confidence. This worry interferes with his or her performance, and he or she earns a lower grade than he or she otherwise would have. On the next exam, he or she may experi-

ence even greater or equal emotionality (because he or she feels the need to get a higher grade to offset the lower grade). The student might then have greater or equal worry (because he is even more worried and less confident), which again interferes with his performance. This continues to unfold over time.

A reappraisal intervention may be able to disrupt this negative recursive cycle and perhaps even initiate a positive one. The student experiences emotionality before the test but interprets this emotionality neutrally or beneficially—as physiological arousal that could help him perform well. As a result, he experiences comparatively lower worry. Worries about anxiety and lack of confidence do not interfere with his performance, so he earns a higher grade than he otherwise would have. That first higher grade might then translate into better performance over time.

To date, examination of reappraisal effects over time is limited. In the GRE study discussed above (Jamieson et al., 2010), reappraisal students outperformed their control counterparts on the actual GRE completed days or weeks after the reappraisal intervention in the lab. But these findings suffer from two key limitations. First, the study's sample size is modest—only 60 students. Second, attrition is high; fewer than half of the students provided their GRE scores.

Overview of Studies

The present studies aim to both generalize and specify previous research on anxiety reappraisal interventions in the context of authentic college classrooms. We have three primary research questions. First, can an anxiety reappraisal intervention improve student experience and performance on a course exam in a domain outside of mathematics for students overall or specifically among first-year students? Second, if effects are found, do benefits persist such that students perform better overall in the course? Third, is there evidence of a recursive process driving long-term benefits of the intervention?

These questions are addressed in two studies. In the first study, we test the intuition that, in comparison to upper year students, first-year students would report greater emotionality, greater worry, and less knowledge of how to perform well before their first exam in a psychology course. In the second study, we conduct a randomized experiment to examine whether an unobtrusive reappraisal message embedded in regular course activities could enhance student experience and performance in a college psychology course. We examine whether effects are greater among first-year students and examine a possible pathway for long-term effects.

Study 1: Students' Exam Experiences

The purpose of this study was to understand whether there were differences between first-year and upper year students that might make first-year students more responsive to a reappraisal intervention. We assessed students' emotionality, worry, and knowledge of how to perform well before the first exam in a psychology course and examined whether these differed by student year (first-year students vs. upper year students). We predicted that first-year students would report greater emotionality and greater worry than would more advanced students and would also indicate less knowledge about how to perform well on the exam. The study was conducted in a large introductory psychology class—the same

class and same time of year (fall term) as the Study 2 intervention but during a different academic year.

Method

Participants. Two hundred forty-five students in a single lecture section of an introductory psychology course at a selective private university completed the study as part of a class questionnaire for which they could earn a bonus point. Most of the students in the class (93.5%) chose to complete the questionnaire. Of those who participated, about half were first-year students (53%) and half were upper year students (21% sophomores, 13% juniors, 12% seniors). Students provided demographic information via a course evaluation at the end of the term, which was then connected with these data. Of those who provided demographic data (86% of the sample), about two thirds of the students were women (64% women, 34% men, 1% transgender or genderfluid). Most were continuing-generation students (84%; i.e., had at least one parent with a 4-year college degree). Students were allowed to indicate multiple racial-ethnic identities, and 16% did. Sixty percent of the students identified as White, 30% as Asian or Asian American, 12% as Black or African American, 11% as Hispanic or Latino/a, 2% Native American or Pacific Islander, and 2% wrote in another identity background. Although information about student age was not collected, the average age of first-year undergraduates at the university is 18 years old, and the average age for all undergraduates is 20 years old.

Procedure. The study measures were embedded in a questionnaire about students' memories of the first day of class, to be used in a class demonstration. The questionnaire was distributed via an email from the course coordinator three days before the first exam in the course, and students completed it at a time of their choosing. All students who completed the questionnaire at least one full day before the exam were included in the study. Procedures were approved by the Stanford University Institutional Review Board.

Measures. Emotionality was assessed with one question ("When you think about taking the exam this coming Thursday, to what extent do you feel anxious?"). Worry was assessed with two questions ("When you think about taking the exam this coming

Thursday, to what extent do you feel [worried/confident]?"). The two were modestly correlated ($r = -.46$), and were averaged to create a single measure of cognitive concern (higher values representing greater worry and less confidence). A final item asked about the extent to which students felt like they knew how to perform well on the exam ("To what extent do you feel you know what to do to perform well on the exam?"). All items were assessed on 7-point Likert scales ($1 = \text{not at all}$, $7 = \text{extremely}$).

Results and Discussion

Table 1 provides descriptive statistics by cohort. Consistent with our predictions, first-year students reported greater emotionality than did upper year students, $t(243) = -3.71$, $p < .001$, $d = 0.48$. They also reported greater worry than did upper year students, $t(243) = -2.88$, $p = .004$, $d = 0.37$. Finally, they indicated less understanding of how to perform well on the first exam than did upper year students, $t(242) = 2.75$, $p = .006$, $d = 0.35$.

For descriptive purposes, we analyzed whether there were differences in these same outcomes by first-generation status, racial-ethnic minority status, or gender. There were no differences by first-generation status (parents had or had not earned a 4-year college degree) or racial-ethnic minority status (identified as being Black, Latino/a, Native, or Pacific Islander or not; $t_s < 1.50$, $p_s > .15$, $d_s < .30$).

Consistent with most of the literature on test anxiety (Cassady & Johnson, 2002; Hembree, 1988), there were differences by gender. Compared with men, women reported greater emotionality ($M_{\text{women}} = 4.50$, $SD_{\text{women}} = 1.49$; $M_{\text{men}} = 3.93$, $SD_{\text{men}} = 1.29$), $t(205) = -2.76$, $p = .006$, $d = 0.40$, and greater worry ($M_{\text{women}} = 4.54$, $SD_{\text{women}} = 1.17$; $M_{\text{men}} = 4.20$, $SD_{\text{men}} = 1.19$), $t(205) = -1.98$, $p < .05$, $d = 0.29$. However, there were no differences by gender on knowledge of how to perform well ($M_{\text{women}} = 3.93$, $SD_{\text{women}} = 1.24$; $M_{\text{men}} = 3.96$, $SD_{\text{men}} = 1.32$), $t(204) = 0.18$, $p = .86$, $d = 0.03$.

In summary, first-year students reported greater emotionality and greater worry than their upper year peers and indicated having less knowledge about how to perform well on the upcoming exam. This acknowledged lack of understanding of how to perform well on the exam might make first-year students more receptive to

Table 1
Studies 1 and 2: Descriptive Statistics for Key Outcomes by Cohort

Key outcomes by study	First-year students			Upper year students		
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>
Study 1						
Emotionality	4.60 [4.36, 4.85]	1.35	131	3.97 [3.71, 4.22]	1.47	115
Worry	4.62 [4.43, 4.82]	1.14	131	4.22 [4.01, 4.43]	1.15	115
Know what to do	3.75 [3.53, 3.96]	1.27	130	4.19 [3.96, 4.42]	1.21	115
Study 2						
Emotionality	3.56 [3.38, 3.74]	1.38	224	3.22 [3.02, 3.41]	1.51	183
Worry	3.26 [3.12, 3.39]	1.11	224	2.90 [2.75, 3.05]	1.10	183
Exam 1	88.55 [87.66, 89.45]	8.24	237	87.96 [86.97, 88.95]	8.21	194
Final grade	88.82 [88.20, 89.44]	5.71	236	88.42 [87.73, 89.11]	5.86	192
Final grade without Exam 1	88.91 [88.29, 89.54]	5.46	236	88.52 [87.82, 89.21]	5.89	192

Note. Means and confidence intervals are adjusted and control for previous performance. Standard deviations are raw. Because of the different timing of the studies (Study 1: before Exam 1; Study 2: immediately after Exam 1), slightly different items were used to assess emotionality and worry between the two studies.

information about how to perform well. Additionally, given their greater emotionality and greater worry, it seems likely that first-year students might derive greater benefit from an anxiety reappraisal intervention than upper year students.

Although this study revealed gender differences in emotionality and worry, it is not clear that an anxiety reappraisal intervention should benefit women more than men. This is because the heightened test anxiety observed among women is not typically accompanied by greater performance decrements (Cassady & Johnson, 2002; Chapell et al., 2005; Hembree, 1988; Zeidner, 1990) and, despite reporting greater test anxiety, women on average outperform men academically (Voyer & Voyer, 2014).

The differences by cohort are unsurprising given that upper year students have taken many more exams at the college level than first-year students have, but the differences are not yet well-documented in the literature. These findings may suggest a developmental process whereby students' emotionality and worry regarding exams attenuate as they gain more experience in a context (cf. Blascovich & Mendes, 2000). However, it may also be that students who take a given course (e.g., introductory psychology) early in their college career are different than those who take it later. Future research should examine students' test anxiety longitudinally over their college careers to better understand its developmental trajectory.

Study 2: Classroom Intervention

Building on the first study, we sought to test whether a reappraisal intervention would improve students' experience and performance in an introductory college psychology course and—if so—for whom and by what pathway. We did so by delivering an unobtrusive reappraisal message in an email from teaching staff the night before the first exam in the course (cf. Legg & Wilson, 2009). We measured students' reports of emotionality and worry the next day, as well as their performance on the first exam and overall in the course. The intervention was delivered in the same introductory psychology course and during the same time of year as Study 1, but during a different academic year.

Moving research from the laboratory to everyday situations is an important but often overlooked theoretical contribution (Paluck & Cialdini, 2014; Sternberg & Lyon, 2002). Embedding the study in a college psychology classroom context allows us to test the generality of Jamieson and colleagues' (2010) basic effect on performance and student experience with a much larger sample, in a domain outside of math and in a situation unlikely to be influenced by demand characteristics. It also allows us to examine the question of who benefits—specifically, whether effects are greater among first-year students. Furthermore, it enables us to collect a long-term outcome, final course grade, from nearly all participants (98%) to better understand the durability of effects.

If reappraisal operates by changing people's interpretations of their physiological responses, then it should be changes in worry—not emotionality—that mediate improvements in performance. In particular, the reappraisal manipulation might initiate a recursive process (Cohen et al., 2009), whereby it reduces worry, which bolsters short-term performance and in turn improves long-term performance. To test this, we measured whether increased performance was statistically mediated by reduced worry.

We hypothesized that the unobtrusive reappraisal message would lead students, but first-year students especially, to experience reduced worry and to earn a higher psychology exam grade. We expected that the intervention might improve end-of-course performance (cf. Yeager & Walton, 2011) and, if so, that reduced worry would statistically mediate enhanced performance.

Method

Data were collected during two successive terms (fall and winter) of an introductory psychology course at a selective private university. Results were similar across the two terms (see the online supplemental material for tests of moderation), so data were collapsed across term for analysis.

The course syllabus explained that research activities might occur in the course, and students were encouraged to contact the teaching staff if they wished to opt out of experimental course activities or if they did not want their course data analyzed for research purposes. The experimental messages and survey measures were presented as regular course activities. To reduce the likelihood of suspicion, students did not complete any measures of emotionality or worry until after they had received the intervention message and completed the first exam. No students contacted the teaching team to opt out of research activities nor reported suspicion at any point in the course. Procedures were approved by the Stanford University Institutional Review Board.

Course structure. Within a term, all students in the course attended the same thrice-weekly lecture, taught by a single primary instructor. Across the two terms, there were two different primary instructors. A course coordinator oversaw the curriculum and assessments both terms. In addition to lecture, students attended once-weekly discussion sections, led by one or two teaching assistants. In total, there were 38 different discussion sections (26 in fall, 12 in winter) taught by 21 different graduate and undergraduate teaching assistants.

Participants. Four hundred thirty-one students were randomly assigned to one of two conditions (standard or reappraisal). Random assignment to condition was stratified on class year and was conducted before we had access to data regarding students' prior academic performance. Approximately one half of the students were first-year students (55%) and one half were upper year students (25% sophomores, 11% juniors, and 9% seniors). Slightly over one half of the students were women (58% women, 42% men). Additional demographic information was obtained from student self-reports on an end-of-course evaluation administered the last day of class, which 88% of students completed. Of those who responded, most were continuing-generation students (84%; i.e., had at least one parent with a 4-year college degree). Students could indicate multiple racial-ethnic identities, and 21% did. Sixty-four percent of the students identified as White, 27% as Asian or Asian American, 11% as Black or African American, 14% as Hispanic or Latino/a, 7% Native American or Pacific Islander, and 1% wrote in another identity background. As with Study 1, information about student age was not collected.

All students completed the first exam. Course attrition was low (<2%) and did not differ by year or gender. Though few students dropped out of the course, attrition was lower in the reappraisal condition, suggesting a possible unanticipated benefit of the intervention (see the online supplemental material).

Procedure. The night before the first exam in the course, students received an e-mail from the course coordinator. The standard or intervention message, described in the following text, was embedded in this email. The next day, all students took Exam 1. The exam was administered on paper in a large lecture hall. The questionnaire with the measures of emotionality and worry was appended to the end of the exam, after the last page of exam questions. Both written and oral instructions described the questionnaire as optional and that students who wished to complete it should do so after finishing the exam. Despite its optional nature, nearly all students completed it (94%). Completion did not differ by condition, year, or gender.

The course instructors (one per term) and course coordinator were blind to students' condition assignments. Teaching assistants who graded course assignments were blind to study procedures, study hypotheses, and condition assignments.

Standard message and reappraisal intervention message. As noted in the preceding text, the night before the first exam in the course, students received an e-mail from the course coordinator. For all students, the e-mail included general exam reminders and general encouragement. The standard (control) message was very similar to messages sent by the course coordinator before exams in previous terms. It read as follows: "As you know, your first midterm is tomorrow. We know that taking an exam can be a stressful experience, so we wanted to remind you of exam details, and provide a note of encouragement." (Four logistical reminders about room location, necessary supplies, and exam format were included here.) "We hope your studying is productive and we look forward to seeing how much you've learned tomorrow!"

The e-mail for students in the reappraisal condition included an extra paragraph. For these students, the second sentence in the message above was replaced by a paragraph with a reappraisal message adapted from previous research (Jamieson et al., 2010):

We know that taking an exam can be a stressful experience, and so before reminding you of exam details, we wanted to provide a note of research-based encouragement: People think that feeling anxious while taking a test will make them do poorly on the test. However, recent research suggests that arousal doesn't generally hurt performance on tests and can even help performance. People who feel anxious during a test might actually do better. This means that you shouldn't feel concerned if you do feel anxious while studying for or taking tomorrow's exam. If you find yourself feeling anxious, simply remind yourself that your arousal could be helping you do well.

Exposure to condition-specific messages occurred only before Exam 1 and was not repeated at any subsequent time during the course.

Measures.

Academic experience. We assessed students' feelings of emotionality and worry with measures designed to target how students felt during the exam. Emotionality was assessed with one question ("During the exam, how anxious or aroused did you feel?"; scale: 1 = *not at all*, 7 = *extremely*). In Study 1, the question had simply asked how anxious students felt; in Study 2, to more directly assess physiological arousal and because the experimental message had used the words *anxious* and *arousal* interchangeably, the question asked how "anxious or aroused" students felt.

Worry was assessed with two questions ("During the exam, how [worried about feeling anxious/confident in your performance]

were you?"; scale: 1 = *not at all*, 7 = *extremely*). Because the reappraisal message was designed to target worries about anxiety, we refined the worry item from Study 1 to address these worries specifically. The two questions in Study 2 were modestly correlated ($r = -.22$) and, as in Study 1, were averaged to create a worry measure (higher values representing greater worry and less confidence). Although students completed the academic experience items immediately after the exam before turning it in, the items specifically asked about how students felt during the exam, and students did not know their exam scores when they completed the questionnaire.

Academic performance. Two major academic performance outcomes were collected: students' score on Exam 1 and their overall performance in the course. Exam 1 consisted of 50 multiple-choice questions and two short essay questions. Each multiple-choice question was worth 1.5 points and together the two essay questions were worth 25 points, for a total of 100 points. The questions covered lectures and assigned readings from the first third of the course. Point biserial information for the multiple-choice questions revealed no bad questions (i.e., no items had a negative correlation with overall exam score). Students' final course grades were based on three exams (including Exam 1; 20% per exam), a research proposal writing project (20%), an in-class end-of-course essay requiring students to integrate concepts and knowledge from different parts of the course (10%), and discussion section participation (10%). For exams, multiple-choice questions were graded electronically and essay questions were graded by course teaching assistants. The research proposal writing project, the in-class integrative essay, and discussion section participation were graded by course teaching assistants using standardized rubrics.

Grades were not curved for any portion of the course. The grading scale was 90% to 100% = A, 80% to 89% = B, 70% to 79% = C, 60% to 69% = D, and below 60% = F. Further information regarding course assignments can be obtained from the authors upon request.

Data analysis.

Sample size and exclusions. Sample size was determined by including all students who were randomized to condition and completed the first exam ($N = 431$). Students who enrolled in the course after random assignment was conducted are excluded from analyses.

Control variables. A previous academic performance composite was created by standardizing and averaging high school test score and previous college GPA (if available). These variables were obtained from student self-report on an end-of-course evaluation administered the last day of class or from institutional data. Despite random assignment, first-year students who received the reappraisal message had significantly higher previous performance scores than their standard message counterparts, and upper year women were more likely to be in the reappraisal condition than the standard condition (see the online supplemental material). Therefore, all analyses controlled for previous performance. Controlling for gender did not substantially affect analyses; thus, consistent with recent reappraisal research (Brooks, 2014; Jamieson et al., 2010), it was not included as a covariate (see the online supplemental material for tests of moderation). We also examined models that accounted for nesting of students within course discussion

Table 2
Study 2: Overall Descriptive Statistics and Correlations Among Key Variables

Variable	<i>M</i> or % (<i>SD</i>)	1	2	3	4	5	6	7
1. Previous performance	.01 (.93)	—						
2. Emotionality	3.42 (1.45)	-.27**	—					
3. Worry	3.10 (1.11)	-.31**	.68**	—				
4. Exam 1 grade	88.28 (8.22)	.52**	-.18**	-.33**	—			
5. Final grade	88.73 (5.72)	.54**	-.11*	-.26**	.81**	—		
6. Final grade without Exam 1	88.73 (5.65)	.50**	-.08	-.22**	.66**	.98**	—	
7. Cohort (1 = first-year)	55%	-.01	.12*	.16**	.03	.03	.03	—

* $p < .05$. ** $p < .01$.

section and those that controlled for term. Results were similar and conclusions unchanged.

Primary analyses. For each analysis, we analyzed scores using a general linear model with condition (standard vs. reappraisal) and student cohort (first-year vs. upper year) as between-subjects factors.³ Though we present the omnibus tests for each analysis, our specific interest in whether effects would be greater among first-year students led us to focus on planned contrasts (Rosenthal & Rosnow, 1985) to test the effect of reappraisal within cohort, with the expectation that first-year students would be more likely to benefit.

Results and Discussion

Preliminary analyses. Table 1 provides descriptive statistics by cohort. Table 2 provides overall descriptive statistics and correlations among key variables. Consistent with Study 1, first-year students reported greater emotionality and greater worry than upper year students did, $F(1, 404) = 6.43, p = .01, d = 0.25$, and $F(1, 404) = 11.17, p < .001, d = 0.33$, respectively. There were no differences by cohort in Exam 1 grade or course grade ($F_s < 1, p_s > .35, d_s < 0.10$).

Contrary to Study 1, there were no significant gender differences in emotionality ($F < 2.4, p > .10, d = .16$). But consistent with past literature (Cassady & Johnson, 2002) and Study 1, women reported greater worry than did men, $F(1, 404) = 5.16, p = .02, d = 0.23$. They also performed better on Exam 1 and in the course overall than did men, $F(1, 428) = 3.92, p < .05, d = 0.19$, and $F(1, 425) = 14.13, p < .001, d = 0.37$, respectively. As discussed in the online supplemental material, gender did not moderate treatment effects on performance.

Did the reappraisal intervention reduce worry and enhance performance on Exam 1, among students overall or specifically among first-year students?

Academic experience. There were no main effects of condition on student reports of their emotionality or worry during Exam 1 ($F_s < 1, p_s > 0.34, d_s < 0.10$), but there were Condition \times Cohort interactions for each, $F(1, 402) = 4.31, p = .04$, and $F(1, 402) = 5.20, p = .02$, respectively. See Figure 1. The reappraisal message did not affect first-year students' reports of emotionality, $t(402) = -0.83, p = .41, d = 0.11$, but it reduced their reported worry, $t(402) = -2.38, p = .02, d = 0.32$. In contrast, and contrary to expectations, the reappraisal message increased upper year students' reports of emotionality, $t(402) = 2.04, p = .04, d = 0.30$. It did not affect their reported worry, $t(402) = 0.91, p = .36, d = 0.13$.

Academic performance. Students who received the reappraisal message performed better on Exam 1 than those who did

not, $F(1, 426) = 3.94, p < .05, d = 0.19$. See Figure 2. Planned contrasts revealed that the boost in performance was specific to first-year students: reappraisal message students outperformed their standard message counterparts by approximately two percentage points, $t(426) = 2.43, p = .02, d = 0.32$. There were no differences by condition for upper year students, $t(426) = 0.48, p = .63, d = 0.07$.

Do benefits of the reappraisal intervention persist to affect overall course performance? To assess the durability of this boost in performance, we examined overall final course grades.⁴ Given that the initial effects on performance were limited to first-year students, we expected that long-term effects would also be. As such, the planned contrast among first-year students was the analysis of greatest interest. There was no main effect of condition, $F(1, 423) = 1.72, p = .19, d = 0.13$, but there was a marginal Condition \times Cohort interaction, $F(1, 423) = 2.86, p = .09$. See Figure 2. Planned contrasts revealed that, again, first-year students who received the reappraisal message outperformed those who did not, $t(423) = 2.23, p = .03, d = 0.29$. To determine whether or not the effect of the reappraisal message on final grade was driven entirely by its effect on Exam 1, we reconducted the analysis with the outcome being final course grade without Exam 1. Though slightly weaker, the effect was consistent in direction and magnitude, $t(423) = 1.82, p = .07, d = 0.24$. For upper year students, the reappraisal message did not affect overall final grades, $t(423) = -0.25, p = .80, d = 0.04$.

Mediation analysis: Is there evidence for a recursive process driving long-term benefits? Does the reappraisal manipulation initiate a recursive process by fostering lower worry, which bolsters short-term performance and in turn improves long-term performance? If so, reductions in students' worry should mediate the benefits for Exam 1 performance, and the benefits for Exam 1 performance should, in turn, mediate effects on final course performance.

We investigated these relationships with two mediation analyses: first, a mediation analysis testing the indirect effect of condition on Exam 1 grade via worry; and second, a mediation analysis testing the effect of condition on final grade without Exam 1 via two sequential mediators: worry and Exam 1 grade. For this

³ Exam 1 performance and final course grade each included a few scores that were outliers ($z > 3$). We reconducted the primary analyses Winsorizing these outliers. The reported effects are robust to Winsorization.

⁴ The final grade of students who received an incomplete in the course was calculated on the basis of the course components they completed. Final grades were not calculated for three students who only completed Exam 1.

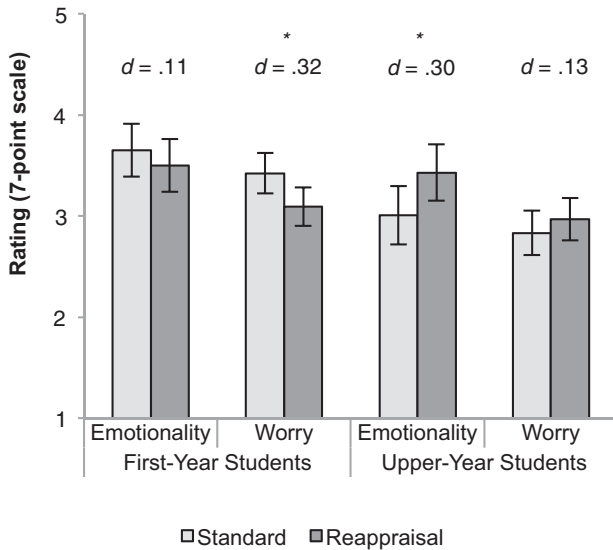


Figure 1. Study 2: Self-reported ratings of Exam 1 emotionality and worry by condition and cohort. Error bars represent 95% confidence intervals. Means and confidence intervals are adjusted and control for previous performance. * $p < .05$.

second analysis, we tested models with and without a direct path from condition to Exam 1 grade and with and without a direct path from worry to final grade without Exam 1.

These analyses were conducted using the structural equation modeling R package lavaan (Rosseel, 2012). Significance was tested for using bias-corrected bootstrapped confidence intervals. We specified a 95% confidence interval (CI) and 10,000 resamples. Mediation was observed ($\alpha = .05$) if the resulting 95% CI of the indirect effect did not include zero. Previous performance

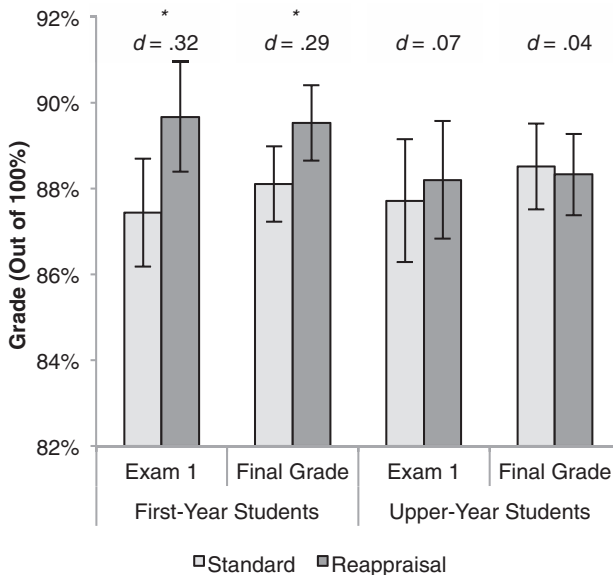


Figure 2. Study 2: Course performance by condition and cohort. Error bars represent 95% confidence intervals. Means and confidence intervals are adjusted and control for previous performance. * $p < .05$.

was predictive of worry, Exam 1 grade, and final grade without Exam 1, and thus it was included as a covariate of each of these variables in the relevant models.

For the first analysis (testing the indirect effect of condition on Exam 1 via worry), we found evidence that worry partially mediated the effect of condition on Exam 1. Condition predicted worry ($\beta = -.16, p = .02$), and worry predicted Exam 1 grade ($\beta = -.16, p = .02$). The point estimate of the indirect effect was .42, with a 95% CI ranging from .02 to 1.08. Because the 95% CI does not include 0, the indirect effect is significant at the $\alpha = .05$ level. (The model was saturated, so fit statistics could not be obtained.) The direct path from condition to Exam 1 remained significant ($\beta = .11, p = .04$). Possible explanations for this direct effect are addressed in the online supplemental material.

For the second analysis (testing the indirect effect of condition on final grade without Exam 1 via the sequential mediators of worry and Exam 1 grade), the model with no internal paths fit the data well, $\chi^2(2, N = 222) = 3.40, p = .18$, comparative fit index $> .99$, (root mean square error of approximation = .06, standardized root-mean-square residual = .03). We found evidence for our predicted pathway: The reappraisal manipulation reduced first-year students' worry, which partially mediated higher Exam 1 scores and in turn partially mediated higher final grades. See Figure 3. All paths were significant except the direct effect of condition on final grade without Exam 1. The point estimate of the indirect effect was 0.15, with a 95% CI ranging from 0.02 to 0.35. Because the 95% CI does not include 0, the indirect effect is significant at the $\alpha = .05$ level. Two alternate, less parsimonious models fit the data similarly well; they are reported in the online supplemental material. Of note, in neither alternate model does the 95% confidence interval for the indirect effect include 0.

General Discussion

A targeted anxiety reappraisal message embedded in an e-mail from instructors the night before an exam reduced exam worry and improved the academic performance of first-year students in an introductory college psychology course. Benefits of the reappraisal message were immediate, reducing exam worry and bolstering exam performance the next day. They were also durable, improving overall final course grades. The magnitude of the boost in performance is consistent with past research on the negative effect of test anxiety among college students (Chapell et al., 2005).

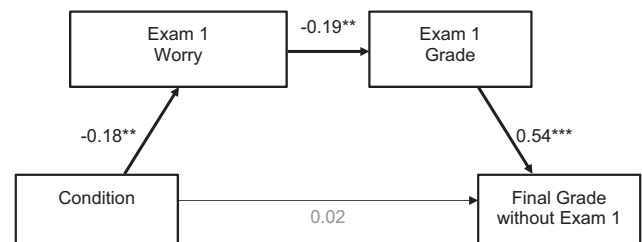


Figure 3. First-year students in Study 2: Mediation model showing the indirect effect of condition on final grade without Exam 1 was mediated by Exam 1 worry and Exam 1 grade. Previous performance was included as a covariate of worry ($\beta = -.26, p < .001$), Exam 1 grade ($\beta = .50, p < .001$), and final grade without Exam 1 ($\beta = .30, p < .001$). Coefficients are standardized. ** $p < .01$, *** $p < .001$.

Among upper year students, students in the reappraisal condition reported increased emotionality, but there were no differences by message condition on exam worry or on either performance outcome. The observation that benefits were limited to first-year students underscores the “sensitive period” of the transition to college (Cook et al., 2012; Walton & Cohen, 2011). Addressing students’ interpretations of anxiety early in their college career may be a lever for promoting their academic success while being less helpful to students later in their careers. Finally, we document a recursive process by which a reappraisal intervention delivered before a stressful exam can exert long-term effects by reducing students’ exam worries that boost performance in the short-term which then enhances subsequent performance.

Anxiety Reappraisal in the Classroom

A robust science of human behavior requires both replication of important findings and extension of those findings to different contexts and populations (Bonett, 2012; Schmidt, 2009). The present study addresses both of these goals. We conceptually replicate Jamieson and colleagues’ (2010) laboratory-based finding that a reappraisal intervention can improve students’ academic experience and performance. We do so among a larger sample, in a new content area, and amid the bustle and noise of a college classroom. We too observe long-term benefits of the intervention. Although Jamieson and colleagues (2010) were able to obtain long-term data from only half of their sample, we have virtually no attrition on the long-term outcome of final grade, lending credence to the claim that a one-time reappraisal intervention can have lasting effects. Furthermore, our findings suggest that anxiety reappraisal effects may be both more general and more conditional than previously appreciated.

Previous work has posited that anxiety reappraisal may only be effective in the academic domain of math (Jamieson et al., 2010). The present results suggest that anxiety reappraisal interventions have the potential to be effective in many academic domains. If, by mitigating worry, working memory is enhanced and distraction reduced (Beilock & Carr, 2001), then anxiety reappraisal might be effective in enhancing performance on demanding tasks across the curriculum (Holmes & Gathercole, 2014; Jarvis & Gathercole, 2003), especially those involving time pressure and considerable working memory demands (Beilock & Ramirez, 2011; Hembree, 1988). Extracurricular activities such as public speaking, cross-group interactions, financial concerns, romantic relationships, and many others may also elicit emotionality and worry from students. To the extent that students’ worry about anxiety and lack of confidence interfere with positive outcomes in these domains, reappraisal may foster benefits in them as well.

Even as our findings indicate that reappraisal interventions may be more broadly relevant than previously appreciated, they also suggest an important moderating factor. Previous reappraisal laboratory studies have placed all participants in a new, unfamiliar environment. Implementing the present study in a field context allowed for variation in students’ prior experiences; doing so revealed benefits specifically among first-year students who have relatively little prior experience taking college exams. We expect people in unfamiliar situations and those experiencing greater task demands (Blascovich & Mendes, 2000) will be more responsive to reappraisal messages or cues, perhaps because they will be more anxious than other people, more attentive to such information,

more likely to change thoughts or behavior, or a combination of these factors. Beyond first-year students, we expect other groups of students might be relatively more vulnerable to the pernicious effects of worry. For example, first-generation students, students who are learning English, and students from underrepresented racial-ethnic minority backgrounds may all experience greater threat in schools (Harackiewicz et al., 2014; Horwitz, 2001; Steele, 1997; Stephens, Fryberg, Markus, Johnson, & Covarrubias, 2012) and have relatively fewer resources to meet the demands they face. Studies well-powered to examine effects among these subpopulations of students may find that these students, too, disproportionately benefit from anxiety reappraisal interventions.

Why did the reappraisal intervention lead to increased emotionality among upper year students? One possibility is that the message inadvertently communicated that students should be anxious—either because anxiety was described as normative (“We know that taking an exam can be a stressful experience”) or because the emotionality associated with anxiety was described as potentially beneficial (“People who feel anxious during a test might actually do better . . . your arousal could be helping you do well.”). In the first case, upper year students might report greater emotionality to align with perceived norms (Eid & Diener, 2001). In the second case, they might report greater emotionality aspirationally, hoping it would help their performance. Importantly, upper year students’ heightened emotionality did not translate to greater exam worry or to performance decrements on Exam 1 or overall in the course. Still, in some circumstances, drawing attention to anxiety may backfire (West, Pearson, & Stern, 2014), especially for those who would otherwise experience relatively low levels of anxiety.

Implications for Practice

Given that this study is, to our knowledge, only the second study to test an anxiety reappraisal intervention in a classroom context, we are tentative in offering recommendations for practice. However, as many college students identify text anxiety as a key academic issue they want support in dealing with (Bishop, Bauer, & Becker, 1998), there are several implications for practice that we believe warrant attention.

The first implication is that the way an instructor addresses text anxiety in the classroom, especially the advice they offer about how to respond to test anxiety, can shape how students view anxiety and ultimately perform. This may seem obvious, but there is a counterintuitive twist: The classic advice to reduce anxiety (i.e., “calm down”) might actually be part of what cultivates students’ worry that feelings of anxiety will hurt their performance. Instructors should take this into consideration when discussing exams and other anxiety-provoking academic situations. It is certainly true that anxiety can be counterproductive, but more balanced advice that acknowledges the potential value of physiological arousal may ultimately serve students better (Crum et al., 2013). Although the present study specifically focused on mitigating deleterious effects of worry on student performance by addressing students’ interpretation of anxiety, we see this work as a complement to—not a substitute for—implementing other evidence-based practices and strategies to support student learning (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; Freeman et al., 2014). Some of these practices may also, albeit in

different ways, reduce the negative consequences of anxiety in the classroom.

The second implication is related to the first and complicates it: Efforts to shape students' emotion regulation in the classroom may yield differing effects for different groups of students. What supports first-year students' academic experience and performance may have negligible or even unintended negative consequences for upper year students. Other student characteristics or individual differences beyond those examined here (e.g., students' typical orientation toward tests; Davis, DiStefano, & Schutz, 2008) may also influence how students respond to instructor messages about tests, anxiety, and emotion regulation. Instructors may need to differentiate messages to support different students and should not assume that one message "fits all."

The third implication is that emails from instructors also have the potential to shape students' experience and performance in a course. Again, this may seem obvious, but we believe it is not truly appreciated. In our experience, instructors (including ourselves) often think of emails as serving perfunctory information-communication purposes. Appreciating the potential of e-mails to enhance students' academic experiences and performance—or also, potentially, to interfere with them—could change the way teachers think about communicating with their students. We urge instructors to attend to the meaning students are likely to draw from e-mails and other communications, not simply the "dry facts" that are being shared.

Limitations and Future Directions

Although these studies make a number of important contributions, several limitations are important to acknowledge. One limitation is that the measures of exam emotionality and worry were extremely brief and, in Study 2, were obtained after students completed Exam 1, rather than before or concurrently. These measurement and timing choices were made for ethical and theoretical reasons. We were concerned that asking extensive questions immediately before the exam might seed worries, undermine confidence, and thereby have a negative effect on students' performance and experience, particularly among students in the standard condition. Further, this would have created ambiguity about whether differences between conditions were due to increased performance for students in the reappraisal condition or decreased performance for students in the standard condition. Asking students about anxiety before the exam—or even on long scales after the exam—may have also attuned students to our interest in test anxiety, possibly changing the way they responded and introducing demand characteristics that we were vigilant to avoid. However, these measurement decisions had drawbacks. First, emotionality was assessed with only a single item, asking generally about how anxious (Study 1) or anxious/aroused (Study 2) students felt. In future studies, researchers should more precisely assess emotionality by asking specifically about bodily sensations of physiological arousal. Second, worry was assessed with only two items (worry and confidence) that correlated with each other only modestly. In future studies, researchers may want to use more extensive measures that address different aspects of worry (i.e., worry about performance, worry about anxiety, confidence). Third, because emotionality and worry were assessed after the exam in Study 2, students' subjective sense of their performance on the

exam may have influenced their reports of these feelings. Future research should examine whether similar findings are obtained when the measures are obtained before the exam. In sum, refined psychological measures in future studies may further pinpoint the psychological beliefs anxiety reappraisal interventions affect and the psychological mechanisms by which they operate.

A second limitation is that we did not assess whether students read the email with the standard or reappraisal message. Given that we find an effect of the intervention both on the specific theorized mediator and on performance, we assume at least a meaningful number of students must have read the e-mail, but we do not know how many. That said, this limitation suggests that the reported results may be a conservative estimate of the treatment effect. Future studies should examine not only whether students read the email but also whether the reappraisal message changes students' explicit beliefs about whether anxiety typically helps or harms performance and whether these beliefs persist through time.

A third limitation is that the students in the two experimental groups differed on the baseline variable of previous performance. Previous performance was not available to us when randomization occurred, so it was not possible to stratify on this variable. It bears noting that the significant difference in prior performance was limited to first-year students and occurred in only one of the two terms. Reassuringly, the patterns of findings are consistent across the two terms, and we accounted for the imbalance as much as possible by controlling for previous performance in all analyses. Nonetheless, it would be important to see these findings replicated in future research.

Future research may also clarify the mechanisms by which changes in students' worry translate to long-term academic gains. In addition to increased memory as a result of reduced worry (Beilock & Ramirez, 2011; Johns et al., 2008), increased use of productive study or test-taking strategies such as reflective self-monitoring or rehearsal of key ideas (Pintrich, Smith, Garcia, & McKeachie, 1991; Weinstein, Palmer, & Acee, 2002) might indirectly improve performance. Additionally, increased performance on an early exam could heighten students' self-efficacy or enhance their perceptions of their potential or of the course's value (Chen-ers, Hu, & Garcia, 2001; Pokay & Blumenfeld, 1990), thereby yielding distal benefits.

How might a reappraisal intervention affect students' emotionality, worry, and appraisals of anxiety over time? Reduced exam worry and relatively better academic performance might foster even lower worry over time. With regard to emotionality, after experiencing the benefits of the reappraisal intervention, a student might decide it's not "necessary" to be anxious about exams, leading to reduced emotionality over time. Alternatively, another prediction would be that emotionality would not be affected, as students who receive the reappraisal message might intentionally try to activate physiological arousal and "pump themselves up" before tests. An interesting implication of this theorizing is that what begins as a reappraisal might, over time, simply become an appraisal (Gross, 2015). If students truly internalize the anxiety reappraisal message, their default interpretation of anxiety might change from negative to neutral or beneficial. Intensive longitudinal research, ideally integrating psychological, physiological, and behavioral data, is needed to further elucidate these processes and pathways.

Conclusion

In summary, the present results suggest that a minimal message designed to help students reappraise anxiety as not necessarily detrimental can improve their academic experience and performance in a college psychology course. The benefits of reappraisal interventions in education are not, as previously suggested, limited to the domain of math, and they may be greater for students with less experience and greater anxiety in a setting. These findings contribute to a growing literature on social-psychological interventions in education (Lazowski & Hulleman, 2015; Yeager & Walton, 2011) and underscore that how students make sense of themselves and their experiences is consequential for their wellbeing and performance.

References

- ACT. (2012). *National collegiate retention and persistence to degree rates*. Iowa City, IA: ACT.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.
- Beilock, S. L. (2011). *Choke: What the secrets of the brain reveal about getting it right when you have to*. New York, NY: Atria Books.
- Beilock, S. L., & Carr, T. H. (2001). On the fragility of skilled performance: What governs choking under pressure? *Journal of Experimental Psychology: General*, *130*, 701–725. <http://dx.doi.org/10.1037/0096-3445.130.4.701>
- Beilock, S. L., & Ramirez, G. (2011). On the interplay of emotion and cognitive control: Implications for enhancing academic achievement. In J. Mestre & B. Ross (Eds.), *Psychology of learning and motivation* (Vol. 55, pp. 137–169). <http://dx.doi.org/10.1016/B978-0-12-387691-1.00005-3>
- Beltzer, M. L., Nock, M. K., Peters, B. J., & Jamieson, J. P. (2014). Rethinking butterflies: The affective, physiological, and performance effects of reappraising arousal during social evaluation. *Emotion*, *14*, 761–768. <http://dx.doi.org/10.1037/a0036326>
- Bishop, J. B., Bauer, K. W., & Becker, E. T. (1998). A survey of counseling needs of male and female college students. *Journal of College Student Development*, *39*, 205.
- Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, *78*, 246–263. <http://dx.doi.org/10.1111/j.1467-8624.2007.00995.x>
- Blascovich, J., & Mendes, W. B. (2000). Challenge and threat appraisals: The role of affective cues. In J. Forgas (Ed.), *Feeling and thinking: The role of affect in social cognition* (pp. 59–82). Cambridge, UK: Cambridge University Press.
- Bonett, D. G. (2012). Replication-extension studies. *Current Directions in Psychological Science*, *21*, 409–412. <http://dx.doi.org/10.1177/0963721412459512>
- Brady, S. T., Reeves, S. L., Garcia, J., Purdie-Vaughns, V., Cook, J. E., Taborsky-Barba, S., . . . Cohen, G. L. (2016). The psychology of the affirmed learner: Spontaneous self-affirmation in the face of stress. *Journal of Educational Psychology*, *108*, 353–373. <http://dx.doi.org/10.1037/edu0000091>
- Brooks, A. W. (2014). Get excited: Reappraising pre-performance anxiety as excitement. *Journal of Experimental Psychology: General*, *143*, 1144–1158. <http://dx.doi.org/10.1037/a0035325>
- Cassady, J. C., & Johnson, R. E. (2002). Cognitive test anxiety and academic performance. *Contemporary Educational Psychology*, *27*, 270–295. <http://dx.doi.org/10.1006/ceps.2001.1094>
- Chapell, M. S., Benjamin, Z., Silverstein, M. E., Takahashi, M., Newman, B., Gubi, A., & McCann, N. (2005). Test anxiety and academic performance in undergraduate and graduate students. *Journal of Educational Psychology*, *97*, 268–274. <http://dx.doi.org/10.1037/0022-0663.97.2.268>
- Chemers, M. M., Hu, L., & Garcia, B. F. (2001). Academic self-efficacy and first year college student performance and adjustment. *Journal of Educational Psychology*, *93*, 55–64. <http://dx.doi.org/10.1037/0022-0663.93.1.55>
- Cohen, G. L., Garcia, J., Purdie-Vaughns, V., Apfel, N., & Brzustoski, P. (2009). Recursive processes in self-affirmation: Intervening to close the minority achievement gap. *Science*, *324*, 400–403. <http://dx.doi.org/10.1126/science.1170769>
- Cook, J. E., Purdie-Vaughns, V., Garcia, J., & Cohen, G. L. (2012). Chronic threat and contingent belonging: Protective benefits of values affirmation on identity development. *Journal of Personality and Social Psychology*, *102*, 479–496. <http://dx.doi.org/10.1037/a0026312>
- Crum, A. J., Salovey, P., & Achor, S. (2013). Rethinking stress: The role of mindsets in determining the stress response. *Journal of Personality and Social Psychology*, *104*, 716–733. <http://dx.doi.org/10.1037/a0031201>
- Davis, H. A., DiStefano, C., & Schutz, P. A. (2008). Identifying patterns of appraising tests in first-year college students: Implications for anxiety and emotion regulation during test taking. *Journal of Educational Psychology*, *100*, 942–960. <http://dx.doi.org/10.1037/a0013096>
- DeCaro, M. S., & Beilock, S. L. (2010). The benefits and perils of attentional control. In B. Bruya (Ed.), *Effortless attention: A new perspective in the cognitive science of attention and action* (pp. 51–73). Cambridge, MA: MIT Press. <http://dx.doi.org/10.7551/mitpress/9780262013840.003.0003>
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, *14*, 4–58. <http://dx.doi.org/10.1177/1529100612453266>
- Eid, M., & Diener, E. (2001). Norms for experiencing emotions in different cultures: Inter- and intranational differences. *Journal of Personality and Social Psychology*, *81*, 869–885. <http://dx.doi.org/10.1037/0022-3514.81.5.869>
- Eysenck, M. (2012). *Attention and arousal: Cognition and performance*. Berlin, Germany: Springer-Verlag.
- Farrington, C. A., Roderick, M., Allensworth, E., Nagaoka, J., Keyes, T. S., Johnson, D. W., & Beechum, N. O. (2012). *Teaching adolescents to become learners: The role of noncognitive factors in shaping school performance—A critical review*. Chicago, IL: Consortium on Chicago School Research. Retrieved from <http://eric.ed.gov/?id=ED542543>.
- Forsyth, D. R., Lawrence, N. K., Burnette, J. L., & Baumeister, R. F. (2007). Attempting to improve the academic performance of struggling college students by bolstering their self-esteem: An intervention that backfired. *Journal of Social and Clinical Psychology*, *26*, 447–459. <http://dx.doi.org/10.1521/jscp.2007.26.4.447>
- Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences of the United States of America*, *111*, 8410–8415. <http://dx.doi.org/10.1073/pnas.1319030111>
- Gross, J. J. (2002). Emotion regulation: Affective, cognitive, and social consequences. *Psychophysiology*, *39*, 281–291. <http://dx.doi.org/10.1017/S0048577201393198>
- Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry*, *26*, 1–26. <http://dx.doi.org/10.1080/1047840X.2014.940781>
- Gross, J. J. (Ed.), (2014). *Handbook of emotion regulation* (2nd ed.). New York, NY: Guilford Press.
- Harackiewicz, J. M., Canning, E. A., Tibbetts, Y., Giffen, C. J., Blair, S. S., Rouse, D. I., & Hyde, J. S. (2014). Closing the social class achievement gap for first-generation students in undergraduate biology. *Journal of*

- Educational Psychology*, 106, 375–389. <http://dx.doi.org/10.1037/a0034679>
- Hembree, R. (1988). Correlates, causes, effects, and treatment of test anxiety. *Review of Educational Research*, 58, 47–77. <http://dx.doi.org/10.3102/00346543058001047>
- Hodapp, V., & Benson, J. (1997). The multidimensionality of test anxiety: A test of different models. *Anxiety, Stress, and Coping*, 10, 219–244. <http://dx.doi.org/10.1080/10615809708249302>
- Holmes, J., & Gathercole, S. E. (2014). Taking working memory training from the laboratory into schools. *Educational Psychology*, 34, 440–450. <http://dx.doi.org/10.1080/01443410.2013.797338>
- Horwitz, E. (2001). Language anxiety and achievement. *Annual Review of Applied Linguistics*, 21, 112–126. <http://dx.doi.org/10.1017/S0267190501000071>
- Jamieson, J. P., Mendes, W. B., Blackstock, E., & Schmader, T. (2010). Turning the knots in your stomach into bows: Reappraising arousal improves performance on the GRE. *Journal of Experimental Social Psychology*, 46, 208–212. <http://dx.doi.org/10.1016/j.jesp.2009.08.015>
- Jamieson, J. P., Nock, M. K., & Mendes, W. B. (2012). Mind over matter: Reappraising arousal improves cardiovascular and cognitive responses to stress. *Journal of Experimental Psychology: General*, 141, 417–422. <http://dx.doi.org/10.1037/a0025719>
- Jamieson, J. P., Peters, B. J., Greenwood, E. J., & Altose, A. J. (2016). Reappraising stress arousal improves performance and reduces evaluation anxiety in classroom exam situations. *Social Psychological & Personality Science*, 7, 579–587. <http://dx.doi.org/10.1177/1948550616644656>
- Jarvis, H. L., & Gathercole, S. E. (2003). Verbal and non-verbal working memory and achievements on national curriculum tests at 11 and 14 years of age. *Educational and Child Psychology*, 20, 123–140.
- John-Henderson, N. A., Rheinschmidt, M. L., & Mendoza-Denton, R. (2015). Cytokine responses and math performance: The role of stereotype threat and anxiety reappraisals. *Journal of Experimental Social Psychology*, 56, 203–206. <http://dx.doi.org/10.1016/j.jesp.2014.10.002>
- Johns, M., Inzlicht, M., & Schmader, T. (2008). Stereotype threat and executive resource depletion: Examining the influence of emotion regulation. *Journal of Experimental Psychology: General*, 137, 691–705. <http://dx.doi.org/10.1037/a0013834>
- Lazowski, R. A., & Hulleman, C. S. (2015). Motivation interventions in education: A meta-analytic review. *Review of Educational Research*. <http://dx.doi.org/10.3102/0034654315617832>
- Legg, A. M., & Wilson, J. H. (2009). E-mail from professor enhances student motivation and attitudes. *Teaching of Psychology*, 36, 205–211. <http://dx.doi.org/10.1080/00986280902960034>
- Liebert, R. M., & Morris, L. W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. *Psychological Reports*, 20, 975–978. <http://dx.doi.org/10.2466/pr0.1967.20.3.975>
- Misra, R., & McKean, M. (2000). College students' academic stress and its relation to their anxiety, time management, and leisure satisfaction. *American Journal of Health Studies*, 16, 41–51.
- Morris, L. W., Davis, M. A., & Hutchings, C. H. (1981). Cognitive and emotional components of anxiety: Literature review and a revised worry-emotionality scale. *Journal of Educational Psychology*, 73, 541–555. <http://dx.doi.org/10.1037/0022-0663.73.4.541>
- Orne, M. T. (1962). On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. *American Psychologist*, 17, 776–783. <http://dx.doi.org/10.1037/h0043424>
- Paluck, E. L., & Cialdini, R. B. (2014). Field research methods. In H. Reis & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology* (2nd ed., pp. 81–97). New York, NY: Cambridge University Press.
- Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991). *A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ)*. (Tech. Rep. No. No. 91- B-004). Ann Arbor, MI: University of Michigan.
- Pokay, P., & Blumenfeld, P. C. (1990). Predicting achievement early and late in the semester: The role of motivation and use of learning strategies. *Journal of Educational Psychology*, 82, 41–50. <http://dx.doi.org/10.1037/0022-0663.82.1.41>
- Rosenthal, R., & Rosnow, R. L. (1985). *Contrast analysis: Focused comparisons in the analysis of variance*. New York, NY: Cambridge University Press.
- Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, 48, 1–36. <http://dx.doi.org/10.18637/jss.v048.i02>
- Schmidt, S. (2009). Shall we really do it again? The powerful concept of replication is neglected in the social sciences. *Review of General Psychology*, 13, 90–100. <http://dx.doi.org/10.1037/a0015108>
- Schwarzer, R. (1984). Worry and emotionality as separate components in test anxiety. *Applied Psychology*, 33, 205–220. <http://dx.doi.org/10.1111/j.1464-0597.1984.tb01429.x>
- Steele, C. M. (1997). A threat in the air. How stereotypes shape intellectual identity and performance. *American Psychologist*, 52, 613–629. <http://dx.doi.org/10.1037/0003-066X.52.6.613>
- Stephens, N. M., Fryberg, S. A., Markus, H. R., Johnson, C. S., & Covarrubias, R. (2012). Unseen disadvantage: How American universities' focus on independence undermines the academic performance of first-generation college students. *Journal of Personality and Social Psychology*, 102, 1178–1197. <http://dx.doi.org/10.1037/a0027143>
- Stephens, N. M., Townsend, S. S. M., Hamedani, M. G., Destin, M., & Manzo, V. (2015). A difference-education intervention equips first-generation college students to thrive in the face of stressful college situations. *Psychological Science*, 26, 1556–1566. <http://dx.doi.org/10.1177/0956797615593501>
- Sternberg, R. J., & Lyon, G. R. (2002). Making a difference to education: Will psychology pass up the chance? *APA Monitor*, 33, 76–78.
- Voyer, D., & Voyer, S. D. (2014). Gender differences in scholastic achievement: A meta-analysis. *Psychological Bulletin*, 140, 1174–1204. <http://dx.doi.org/10.1037/a0036620>
- Walton, G. M., & Cohen, G. L. (2011). A brief social-belonging intervention improves academic and health outcomes of minority students. *Science*, 331, 1447–1451. <http://dx.doi.org/10.1126/science.1198364>
- Weinstein, C. E., Palmer, D. R., & Acee, T. W. (2002). *LASSI user's manual: For those administering the learning and study strategies inventory*. Clearwater, FL: H & H Publishing.
- West, T. V., Pearson, A. R., & Stern, C. (2014). Anxiety perseverance in intergroup interaction: When incidental explanations backfire. *Journal of Personality and Social Psychology*, 107, 825–843. <http://dx.doi.org/10.1037/a0037941>
- Wine, J. D. (1980). Cognitive-attentional theory of test anxiety. In I. G. Sarason (Ed.), *Test anxiety: Theory, research and applications* (pp. 349–385). Hillsdale, NJ: Lawrence Erlbaum.
- Wood, J. V., Perunovic, W. Q. E., & Lee, J. W. (2009). Positive self-statements: Power for some, peril for others. *Psychological Science*, 20, 860–866. <http://dx.doi.org/10.1111/j.1467-9280.2009.02370.x>
- Yeager, D. S., & Walton, G. M. (2011). Social-psychological interventions in education: They're not magic. *Review of Educational Research*, 81, 267–301. <http://dx.doi.org/10.3102/0034654311405999>
- Zeidner, M. (1990). Does test anxiety bias scholastic aptitude test performance by gender and sociocultural group? *Journal of Personality Assessment*, 55, 145–160. <http://dx.doi.org/10.1080/00223891.1990.9674054>

Received November 17, 2016

Revision received June 1, 2017

Accepted June 1, 2017 ■