

Values Affirmation Essay to Mitigate Exam Anxiety and Improve Scores

Sara A. Atwood
Elizabethtown College

Tomás Estrada
Elizabethtown College

SARA A. ATWOOD

Sara A. Atwood is an Assistant Professor of Physics and Engineering at Elizabethtown College. She obtained her BA and MS from Dartmouth College and her PhD in mechanical engineering from the University of California at Berkeley. Her research interests include material failure in medical devices and creativity as a factor in the recruitment and retention of underrepresented undergraduates in engineering.

TOMÁS ESTRADA

Tomás Estrada is an Assistant Professor of Physics and Engineering at Elizabethtown College. He obtained his BS from Universidad de Costa Rica and his MS and PhD from Notre Dame University in electrical engineering. His research interests include control systems applied to sustainability applications and enhancing introductory lab experiences for engineering undergraduates.

Values Affirmation Essay to Mitigate Exam Anxiety and Improve Scores

Abstract

Recent research has found that using psychological interventions can substantially improve the performance of students, particularly when they are in stereotypically underperforming groups including women in college physics courses¹, black students in junior high², and high anxiety students in high-risk testing situations.³ The psychological interventions have included the following: values affirmation at one or two points during the semester in which the student reflects upon values or topics important to them to enhance their self-worth,^{1,2} or expressive writing in which the student writes down concerns about the exam immediately before taking the test.³ Based on these recently published studies, we hypothesized that in a mid-level engineering course, exam underperformers could mitigate the effect of anxiety and improve their exam scores by writing a values affirmation essay immediately prior to the exam.

Our study focused on one mid-level course (thermodynamics) within the ABET-accredited general engineering curriculum at a small (less than 2,000) regional liberal arts college. The course had an enrollment of 30 students spanning sophomores (47%), juniors (43%), and seniors (10%), including 8 women (27%). Before each of two midterm exams, the students were assigned one of two exercises to complete during the 10 minutes prior to the exam: a values affirmation prompt, or the assignment to study their notes. For the second exam, the students switched activities. At the end of each exam, students filled out a survey about their typical exam performance (self-identifying underperformers), perception of how they did on the exam, how anxious they felt during the exam, study time, some demographic information (gender, year), and an identifier code. When the exam was handed back, students filled out another survey with the same identifier and were asked about their actual grade. The resulting data were analyzed using linear regression between variables, t-tests comparing the underperforming group to the consistently performing students, and paired t-tests to compare performance for each student using the two different activities.

Writing the values affirmation essay resulted in higher exam scores for the underperforming students (p-value < 0.20), more B's (38% vs 29%) and fewer D's and F's (20% vs 47%). Exam scores for the consistently performing students were mostly unchanged with the activities (no significant difference). Writing the essay also appeared to mitigate the effect of anxiety on exam score for all students. When studying notes, the underperformers' exam score decreased with increasing anxiety while the consistent performers' exam score increased with increasing anxiety (opposite trends). Writing the essay also brought the underperformers' anticipated grade closer to their actual grade, which was a characteristic of the consistent performers in both activities. Finally, the underperforming students rated the exam as more reflective of their understanding after writing the essay (p-value < 0.10). These results are consistent with those reported in previous studies¹⁻³ and suggest that a psychological intervention just before an exam may help students who tend to underperform on engineering exams.

Introduction

Recent research has found that using psychological interventions can substantially improve the performance of students, particularly when they are in stereotypically underperforming groups including women in college physics courses¹, minority black students in junior high², and high anxiety students in high-risk testing situations.³ The psychological interventions have included values affirmation^{1,2} and expressive writing.³

Values affirmation exercises involve reflecting upon values or topics important to a person, but unrelated to the task at hand, for 10-15 minutes. This is thought to enhance the person's selfworth in an environment requiring them to cope with negative stereotypes.⁴⁻⁵ Expressive writing exercises, on the other hand, involve writing down concerns immediately prior to performing the task. Rather than focusing the person on their anxiety, expressive writing is thought to mitigate anxiety by stopping the cycle of rumination on negative outcomes.⁶

These psychological interventions have been applied to students taking exams in recent studies. Miyake et al.¹ used a values affirmation prompt in a double-blind randomized study of college students in an introductory physics class in an attempt to close the gender achievement gap. Half of the students were asked to select their most important values from a list and write about why they were personally important, while the other half selected their least important values and wrote about why they might be important to other people. The exercise was performed in the first week of the course and was repeated one week prior to the first midterm.

Striking results showed a substantially reduced difference in the overall exam scores for men and women that wrote about their values, and a letter-grade increase for those women. The gender achievement gap persisted in the control group.

In an earlier study, Cohen et al.² used values-affirmation prompts in two randomized field experiments to similarly close the minority achievement gap. Students in 7th grade were asked to reflect on personal values in structured writing assignments. After one or two exercises, the overall grades of African American minority students improved compared to a control group and to historic performance data, while European Americans grades remained unchanged. A two year follow-up recently showed that the impacts were long-term, as the minority achievement gap remained more closed for those cohorts.⁷

Ramirez and Beilock³ used expressive writing exercises in a series of randomized laboratory and classroom studies to mitigate the effect of underperforming in a high-pressure testing situation. They found that writing about the exam specifically, as opposed to any ordinary topic, improved the scores, particularly for high anxiety students in a high-pressure exam situation. Results were consistent for two 9th grade biology cohorts, and suggest that a psychological intervention may allow all students to demonstrate their true level of understanding, without being diminished by the effects of anxiety.

Based on these recently published studies, we hypothesized that in a mid-level engineering course, serial exam underperformers could mitigate the effect of anxiety and improve their exam scores by writing a values affirmation essay immediately prior to the exam.

Methods

Our study focused on one mid-level course (thermodynamics) within the BET accredited general engineering curriculum at a small (less than 2,000) regional liberal arts college. The course had an enrollment of 30 students spanning sophomores (47%), juniors (43%), and seniors (10%), including 8 women (27%).

Before each of two midterm exams, the students were assigned one of two exercises to complete during the 10 minutes prior to the exam: a values affirmation prompt, or the assignment to study their notes. For the second exam, the students switched activities. The students were ranked according to GPA by the instructors, and then randomly assigned to an activity so that each activity group had a similar average GPA. This ensured that the activity groups were relatively evenly matched in terms of typical performance. After group assignments were made, names were stripped from study materials and instructors were not aware of which students were in which groups when scoring the exams.

At the end of each exam, students filled out a survey about their typical exam performance (self-identifying underperformers), perception of how they did on the exam, how reflective was their exam performance of their understanding, how anxious they felt during the exam, study time, some demographic information (gender, year), and an identifier code. When the exam was handed back, students filled out another survey with the same identifier and were asked about their approximate actual grade. The resulting data were analyzed using linear regression between variables, t-tests comparing the underperforming group to the consistently performing students, and paired t-tests to compare performance for each student using the two different activities.

Results and Discussion

Writing the values affirmation essay resulted in higher exam scores for the underperforming students (p -value < 0.20), more B's (38% vs 29%) and fewer D's and F's (20% vs 47%) (Figure 1, left). Exam scores for the consistently performing students were mostly unchanged with the activities (no significant difference) (Figure 1, right).

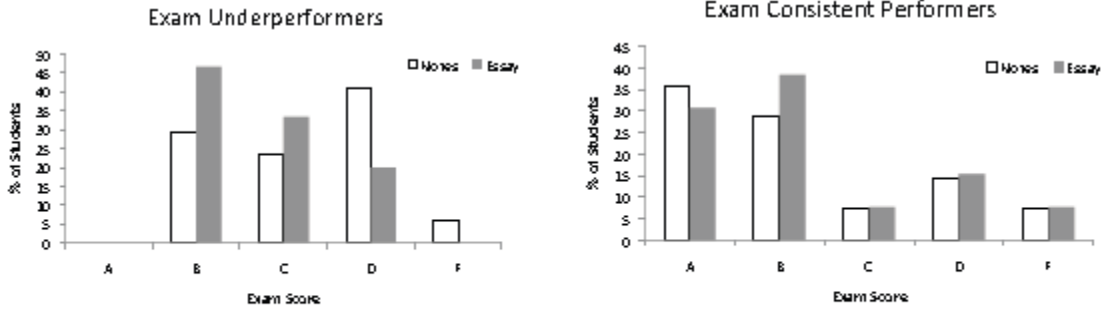


Figure 1. For the underperformers (left), writing the values affirmation essay resulted in more B's (38% vs 29%) and fewer D's and F's (20% vs 47%). For the consistent performers (right), exam scores were mostly unchanged.

Writing the values affirmation essay also appeared to mitigate the effect of anxiety on exam score for all students (Figure 2, left). When studying notes, the underperformers' exam score decreased with increasing anxiety while the consistent performers' exam score increased with increasing anxiety (Figure 2, right).

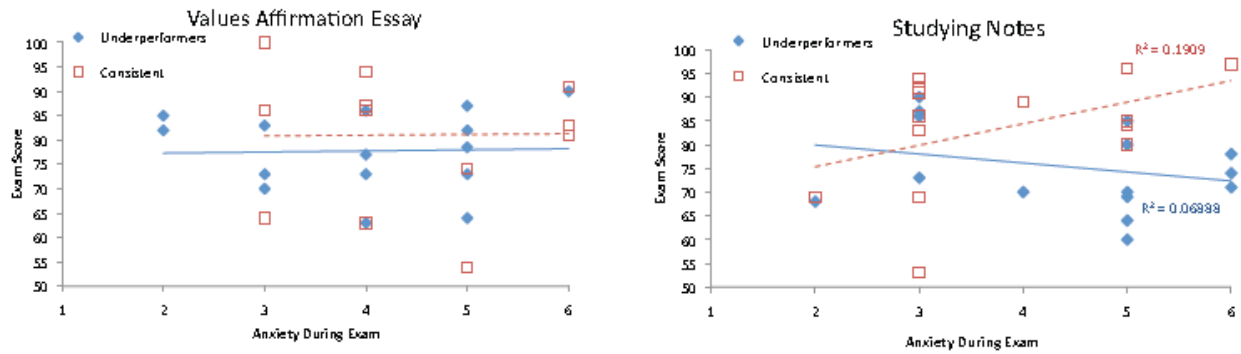


Figure 2. Students writing the values affirmation essay (left) had no relationship between anxiety during the exam and the exam score. For the control group studying notes (right), exam underperformers had a decreasing exam score with increased anxiety, while the trend was opposite for consistent performers.

Writing the essay also brought the underperformers' anticipated grade closer to their actual grade, which was a characteristic of the consistent performers in both activities (Figure 3).

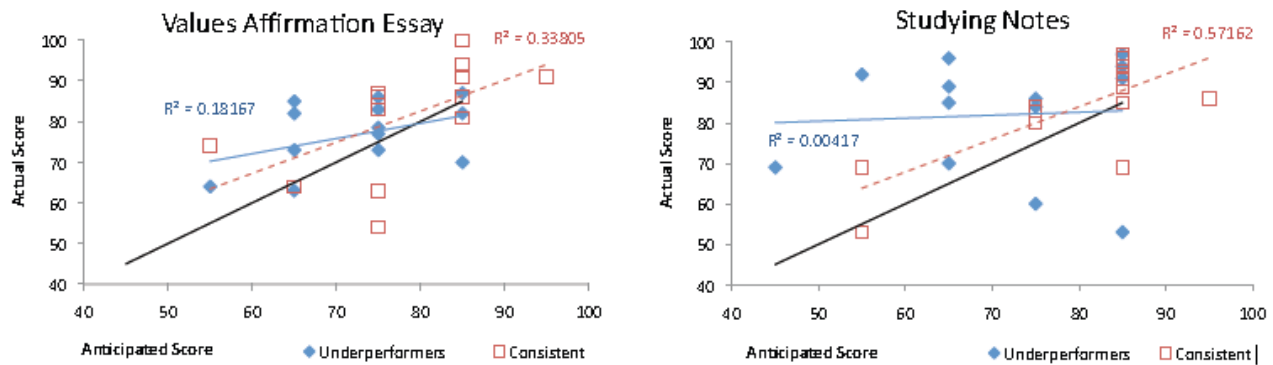


Figure 3. For the underperformers, writing the values affirmation essay (left) brought their anticipated score closer to their actual score (solid black line is perfect agreement). Consistent performers had the characteristic of anticipating their score more accurately in both activities.

Finally, the underperforming students rated the exam as more reflective of their understanding after writing the values affirmation essay (p-value < 0.10) (Table 1). Table 1 shows the results for both overall t-tests for each group (values affirmation essay versus control studying notes) and paired t-tests for individual students. Similar trends for both the overall and paired t-tests were found. For the underperformers, the exam scores and reflectivity of the exam were statistically significantly higher after writing the values affirmation essay (p-value < 0.20) (Table 1). Interestingly, for the consistent performers, writing the values affirmation essay increased their anxiety during the exam. This may be because they were not allowed to look over their notes prior to the exam, which is the observed usual pre-exam routine for these students.

	Approximate Grade in Course	Exam Score Anticipated	Nervous During	Exam Score	Reflective
<i>Overall t-test</i>					
consistent	0.932	0.619	*0.130	0.858	0.658
underperformers	0.421	0.636	0.388	*0.198	*0.092
<i>Paired t-test</i>					
consistent	0.677	0.822	*0.079	0.884	0.793
underperformers	0.452	0.922	0.538	0.327	*0.109

Table 1. Results for overall t-tests for each group (values affirmation essay versus control studying notes) and paired t-tests for individual students. Similar trends for both the overall and paired t-tests were found. For the underperformers, the exam scores and reflectivity of the exam were statistically significantly higher after writing the values affirmation essay.

The outcomes that are not statistically significant are important as well. The approximate grade in the course, the anticipated exam score, and the exam score for the consistent performers were all statistically insignificant (Table 1). This suggests that the attempt to have intervention and control groups equal in ability was successful.

Furthermore, this suggests that the midterm exams were similar in their difficulty and rigor in grading.

This study has several limitations. Primarily, the size of the cohort is relatively small at 30 students. This limits the statistical power of the t-tests and linear correlations. However, trends are still apparent. Another limitation is the self-reporting on a Likert scale of nervousness during the exam and reflectivity of the exam, as well as using self-reporting to identify exam underperformers. The discrete nature of the Likert scale makes linear correlations more difficult to detect. However, given the lack of a continuous objective measure, these methods are similar to those used elsewhere.¹⁻³

Furthermore, there may have been lingering effects from the first values affirmation activity in the students who wrote the essay first, and then switched to the control activity (studying notes) for the second midterm. Similar studies report that the intervention starting having an impact after only one or two exercises. This may be why the paired t-test for individual students in the underperformers category was not as strong a statistical result as for the overall groups (Table 1). Despite the possibility of lingering effects, the data show that underperformers scored significantly higher immediately after writing the values affirmation essay.

The control activity is also substantially different than writing a “dummy” essay as other studies have done.¹ We think this is a unique strength of this study, in that we are implementing the psychological intervention in a more realistic classroom setting where students will typically study their notes in the few minutes before the exam is handed out. Another strength of this study is its implementation in an engineering curriculum. Engineering courses often require strong performance on challenging exams. However, students with a variety of talents often make excellent engineers (communication skills, seeing the big picture in a company, innovation in problem solving, hands-on skills). These students may be overly penalized if they internalize their poor performance on exams due to anxiety. Furthermore, the engineering field may be penalized if we lose these talented students because they have exam anxiety that negatively impacts their performance.

Our results are consistent with those reported in previous studies¹⁻³ and suggest that a psychological intervention, such as a values affirmation essay, just before an exam may help students who tend to underperform on engineering exams.

References

1. Miyake et al., *Science*. 2010 Nov 26; 330 (6008): 1234-1237.
2. Cohen et al., *Science*. 2006; 313: 1307.
3. Ramirez et al., *Science*. 2011 Jan 14; 331 (6014): 211-213.
4. Steele, C.M., *Advances in Experimental Social Psychology*, L. Berkowitz, Ed. Academic Press, New York, 1988, 261-302.
5. Cohen, G.L., Garcia, J. *Curr. Dir. Psychol. Sci.* 2008; 17: 365.
6. Smyth, L.M., *J. Consult. Clin. Psychol.* 1998; 66: 164.
7. Cohen et al., *Science*. 2009 Apr 17; 324 (5925): 400-403.