Emotion

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Thriving Under Pressure: The Effects of Stress-Related Wise Interventions on Affect, Sleep, and Exam Performance for College Students From Disadvantaged Backgrounds

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Nearly all students experience stress as they pursue important academic goals. Because stress can be magnified for students from disadvantaged backgrounds, it becomes important to identify interventions that can help mitigate this stress, particularly for these populations as they enter academic environments. We examine the effects of stress mindset and stress management interventions administered to students from disadvantaged backgrounds (N = 140) before freshman year. We compare effects on affect, sleep, and performance during end-of-year exams seen in a subset of these students who could be tracked via experience sampling (N = 57) to those of a comparison group at the same elite university (N = 74) receiving no such stress interventions. As predicted, we find significant differences in exam-week positive affect between the stress mindset and comparison groups. However, there was no difference in positive affect between the stress mindset and management groups or the stress management and comparison groups. For negative affect, stress, sleep, and exam performance, we find no significant differences between any of the three groups. However, both stress interventions decoupled the significant negative association between exam-week stress and exam performance exhibited by the comparison group, rendering the relationship nonsignificant. The reduction in this association was somewhat more pronounced for the mindset relative to the management group. These findings suggest that mindset and management approaches both confer benefits in certain circumstances and highlight the potential value of targeting mindsets about stress using a "wise intervention" approach for students from disadvantaged backgrounds during stressful times.

Keywords: stress, mindset, positive affect, students from disadvantaged backgrounds, intervention

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Stress—the anticipation or experience of encountering demands in one's goal-related contexts, including uncertainty and pressure (Carver & Connor-Smith, 2010; Crum et al., 2020)—is ubiquitous in the college experience (Ross et al., 1999). In a national survey of 108 postsecondary institutions, 54% of students reported experiencing "more than average stress" or "tremendous stress" in the last year (American College Health Association, 2015). This stress is even greater for students who experience additional threat due to hardships associated with lower socioeconomic status (SES) or historic marginalization of their racial-ethnic group (Blascovich et al., 2001; Cheadle et al., 2020; Williams et al., 2010). These students face additional stressors as they navigate the cultural mismatch between the norms of their college and home environments (Stephens et al., 2019), balance academic work with financial goals (Engle & Tinto, 2008), or confront stereotype threat and belonging uncertainty (Steele, 1997; Walton & Cohen, 2007).

How students approach, manage, and cope with college stressors is a key determinant of mental and emotional health, as well as academic performance (Hayward et al., 2000; Stinebrickner & Stinebrickner, 2014; Yeager et al., 2016). Drawing on research showing that the mindsets students use to interpret ambiguous events, interactions, and obstacles can affect critical outcomes (e.g., Crum et al., 2013; Dweck & Yeager, 2019; Jamieson et al., 2018), this article examines whether an intervention initiated the summer before freshman year can alter students' mindsets about stress to improve their affect, sleep, and performance during their end-of-year final exam week.

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The Benefits of Psychologically Wise Interventions for College Students From Disadvantaged Backgrounds

"Wise" interventions targeting psychological barriers that undermine student outcomes in college have proven useful for students from disadvantaged backgrounds (Harackiewicz & Priniski, 2018). Wise interventions improve outcomes by helping individuals construe situations more adaptively (Walton & Crum, 2020; Walton & Wilson, 2018). For example, values affirmation interventions, which ask students to reflect on core values before encountering stressors, improve belonging and performance for ethnic-minority middle-school students (e.g., Cohen et al., 2009) and can increase their probability of enrolling in college several years later (Goyer et al., 2017). Social belonging interventions, which convey how worries about belonging in academic institutions often decrease with time, improve grade point average (GPA) and self-reported health for underrepresented minority students at selective universities (Walton & Cohen, 2011) and increase full-time enrollment rates among a broader sample of students from disadvantaged backgrounds (Yeager et al., 2016; see also Goyer et al., 2019). Difference-education interventions, in which first-generation students learn how their social-class backgrounds can be an asset in navigating college, can also improve GPAs, thereby, reducing achievement gaps (e.g., Stephens et al., 2014).

Changing Stress Mindsets: A Wise Intervention Approach for Improving Stress Responses

Most wise interventions seek to help students from disadvantaged backgrounds adopt useful mindsets about specific sources of stress (e.g., belonging, being a first-generation student). By contrast, a growing body of wise interventions directly targets how individuals experience arousal, anxiety, and stress. For instance, students who reappraise their preperformance arousal or anxiety as adaptive perform better on standardized tests (Jamieson et al., 2010) and classroom exams (Brady et al., 2018; Jamieson et al., 2016) relative to those who do not reappraise. Furthermore, reappraising anxiety as excitement rather than calmness improves performance in lab-based tasks, such as public speaking and singing (Brooks, 2014). By targeting individuals' resource appraisals, these interventions help individuals feel challenged rather than threatened (Jamieson et al., 2012, 2016). In turn, feeling challenged prompts individuals to take specific action to address a single, immediate threat in a manner that can facilitate performance (Blascovich, 2008a; Blascovich et al., 1999; Blascovich & Tomaka, 1996).

Interventions targeting the nature of stress more broadly, and not solely focused on the emotional or physiological responses associated with stress, have also improved performance. These interventions draw upon stress mindset theory (e.g., Crum et al., 2013), which proposes that whether individuals have the mindset that stress is enhancing rather than debilitating affects how they respond to stress. Individuals with a stronger stress-is-enhancing mindset believe that experiencing stress will help them achieve positive outcomes, such as improved performance, health, and/or well-being. Cross-sectional research has shown that this mindset is associated with more positive emotions, fewer negative health symptoms associated with stress and anxiety, higher overall life satisfaction, adaptive cortisol reactivity, and greater receptivity to feedback, controlling for amount of stress and coping behaviors (Crum et al., 2013). A stress-is-enhancing mindset can also facilitate persistence and performance under conditions of extreme stress, such as specialized military training (Smith et al., 2020).

Like other mindsets (e.g., growth vs. fixed mindsets; Yeager et al., 2016), there is evidence that individuals' stress mindsets are amenable to change. Experimental research exposing participants to a short video intervention orienting them to the enhancing, rather than the debilitating, effects of stress has shown short-term improvements in critical outcomes, including positive affect, cognitive flexibility, and physiological responding (Crum et al., 2013, 2017). Similar effects have been found using a 1-to-2-hr field-based stress-mindset intervention (e.g., Crum et al., 2021) that combines key messages of the video manipulations with many of the best practices of wise interventions (e.g., Walton, 2014; Walton & Wilson, 2018). Taken together, stress-mindset interventions can help empower individuals to actively and deliberately adopt a stress-is-enhancing mindset even when they face conflicting messages about the benefits and harm of stress.

Despite recent demonstrations of the value of lab- and field-based stress-mindset interventions, their real-world effectiveness for populations from socially disadvantaged backgrounds, who may face higher stress and be less aware of tools and techniques to confront stress, remains unknown. More advantaged populations (e.g., employees at financial and technology firms, Crum et al., 2021; nonracial-minority college students, Crum et al., 2017) have exhibited more short-term positive affect and/or higher self-reported work performance (Crum et al., 2021), ranging from immediately to 4 weeks after a stress-mindset intervention. If these interventions are also shown to improve outcomes for disadvantaged populations, they might contribute to the range of social-psychological interventions available for reducing inequities between the advantaged and disadvantaged in society. Because stress is such a prominent feature of the college experience, testing a stress-mindset intervention in this setting may be particularly beneficial, and is therefore the focus of this research.

Stress-Management Versus Stress-Mindset Interventions

Another class of interventions targeting stress has emerged from the dominant historical narrative that stress is harmful and needs to be managed (Holmes & Rahe, 1967). Rather than changing individuals' construal of stress, as stress-mindset interventions do, stress-management interventions focus on teaching individuals behavioral skills that can be used to reduce the frequency or severity of stress and mitigate its negative effects (Carver et al., 1989; Lazarus & Folkman, 1984). These include time-management and prioritization techniques to prevent avoidable stress (Ariely & Wertenbroch, 2002); meditation, deep breathing, and relaxation techniques (e.g., Mohan et al., 2011) to reduce unavoidable stress; and adopting healthy habits to counteract the negative effects of stress, including eating well, exercising, and getting adequate sleep.

Stress-management interventions can be beneficial at times when individuals must prioritize several goals simultaneously, as often occurs in college. For instance, a study of college students found that those who used time-management behaviors reported being less overwhelmed and had better performance, greater work and life satisfaction, and fewer work-related tensions (Macan et al., 1990).

However, managing stress, without also changing mindsets about stress, may have drawbacks. First, given that stress typically arises when people are pursuing personally meaningful (Park & Folkman, 1997) or self-concordant (Sheldon & Elliot, 1999) goals that they are unwilling or unable to abandon, a primary focus on reducing or avoiding stress may cause individuals to devalue and withdraw from such goals (Folkman & Moskowitz, 2000b) and prevent them from using stress productively to achieve benefits, such as personal growth and an appreciation for one's close relationships. Second, stress-reduction or avoidance methods can place more demands on individuals (e.g., to exercise, engage in meditation), leaving them even less time and attention for the focal goal that was the original source of stress (e.g., performing well on exams). Similarly, seeking to suppress rather than accept negative emotions (Hofmann et al., 2009), an aspect of stress management, tends to be cognitively taxing (Troy et al., 2018). When individuals try to suppress their stress, they may succumb to negative ruminative cycles of anxiety and worry that further increase stress (Troy et al., 2013), impairing long-term health and well-being (Blascovich, 2008b; Folkman & Lazarus, 1985). Therefore, studying the relative benefits of stress-mindset and management-intervention approaches among students attending the same university during a shared stressful experience may identify ways to improve key outcomes for college students from disadvantaged backgrounds.

The Present Study

In the present study, we examine the effects of stress-focused training for students from socially disadvantaged backgrounds at the beginning of their freshman year at an elite university. To recruit as many of these students as possible, we worked with a university program that selects 70 incoming freshmen each year to engage in an 8-week on-campus summer program. During the program, students take math, science, writing, and physical education courses, interact with faculty and students, and explore campus in an effort to facilitate their adjustment to the university. Our study was included as one of the workshops in the summer experience.

We selected freshman end-of-year exam week as the focal outcome period because exam periods involve many shared sources of stress (Folkman & Lazarus, 1985). In addition, at this university specifically, students' exam performance may be especially sensitive to their levels of exam-week stress. Spring final exams are the first exams at this university to affect students' college GPAs. In addition, exams are typically mandatory for course completion and degree progress, and cannot be postponed except under extreme extenuating circumstances. Though exam week offers unavoidable stress and negative affect, it also affords opportunities for the experience of positive affect (e.g., high-arousal emotions such as excitement; Brooks, 2014) arising from the challenge of performing well. Further, in breaks between exams, students may experience low-arousal positive emotions (e.g., McManus et al., 2019) as they recover and reflect on their future goals and other benefits to be gained from this stressful experience (Folkman & Lazarus, 1985).

We test whether *stress-mindset* training, relative to *stress-management* training and no training (i.e., *comparison*), differentially influences affect, sleep, and exam performance during the spring end-of-school-year final exam week for freshman students. We expected that stress-mindset training would be equivalent to or potentially more effective than stress-management training on these outcomes based on the aforementioned research examining the relative benefits of the two trainings. Our comparison group was a sample of campus-wide freshmen recruited approximately 1 month before final exam week. Below we outline our dependent variables, affect, sleep, and exam performance, and highlight our predictions about the effects of stress mindset, stress management, and no training on each of these variables.

Positive and Negative Affect

During times of intense, chronic, or unavoidable stress, positive affect is critical for well-being, for at least three reasons (Folkman & Moskowitz, 2000a, 2000b, 2007). First, positive affect helps individuals cope with repeated or unrelenting stressors (Folkman, 2008; Folkman & Moskowitz, 2000a), despite periods of doubt or hopelessness (Folkman, 1997). Second, positive affect accelerates recovery from negative emotional experiences and restores depleted resources (Billings et al., 2000; Folkman, 2008). Third, positive affect offers relief during prolonged negative emotional periods (Folkman, 2008; Folkman & Moskowitz, 2000b, 2007), serving as a psychological time-out (Folkman et al., 1997).

Given these associations, we examine whether the two stress interventions (mindset and management) help students experience higher levels of positive affect during final exam week, relative to untrained classmates, without decreasing levels of negative affect. Stress-mindset interventions aimed at appraising acute stressful situations as challenges have been found to increase positive affect (Crum et al., 2017). Such interventions may also increase positive affect in the long, stressful experience of a final exam week, as students strive to perform well while also finding broader benefits from stress, including a sense of meaning. We did not expect to observe changes to negative affect as might occur if individuals sought to shift or suppress their negative affect (e.g., Hofmann et al., 2009), as a stress-is-enhancing mindset encourages individuals to acknowledge and utilize their stress and associated negative affect rather than ignoring or trying to reduce it.

If stress-management training increases positive behaviors that allow students to successfully reduce their negative exam-week affect or threat appraisals, such as time management (Macan et al., 1990) and healthy habits (e.g., adequate sleep), they might also experience higher positive affect relative to comparable individuals with no stress training. However, stress management may cultivate fewer kinds of positive emotions than the stress-is-enhancing mindset often does, as it does not typically involve meaning-making (Folkman, 2008), mindfulness of ordinary positive moments during stress (Folkman, 1997), or consideration of the broader benefits of stress for personal growth, values, and identity (Folkman & Moskowitz, 2000a).

Exam-Week Sleep

As an exploratory analysis, we examine whether either intervention causes students to sleep more—an important indicator of health for college students (Becker et al., 2018; Lund et al., 2010) and well-being during stress (Drake et al., 2004; Vargas et al., 2015). There is evidence that college students are particularly at risk for sleep disturbance (Brown et al., 2001; Buboltz et al., 2001; Coren, 1994) and are more likely than adolescents and adults to experience daytime sleepiness (Oginska & Pokorski, 2006), which may in turn reflect challenges obtaining adequate hours of sleep (Hershner &

Chervin, 2014; Lack, 1986; Taylor & Bramoweth, 2010). In addition to daytime sleepiness and sleep deprivation, college students tend to have lower sleep quality and irregular sleep habits (Brown et al., 2002; Buboltz et al., 2001; Hershner & Chervin, 2014; Hicks & Pellegrini, 1991). Further, some research suggests sleep duration and quality vary by ethnicity (Hicks et al., 1999b; Johnson et al., 2019), with racial-ethnic minorities (Johnson et al., 2019) or individuals with lower SES (Jarrin et al., 2013) tending to have lower levels of these than groups from more advantaged backgrounds.

We do not have strong a priori hypotheses about intervention effects on sleep, which has been unexamined in most studies of wise interventions (e.g., Cohen et al., 2009; Walton & Cohen, 2011), including reappraisal intervention studies (Brady et al., 2018; Jamieson et al., 2016). Our goal was to better understand how the stress mindset and management interventions may influence sleep during a time of moderate-to-intense stress, such as final exams. Difficult to attain even when stress is mild (Minkel et al., 2012), adequate sleep may be especially difficult for freshmen (Tsai & Li, 2004) during final-exam week in particular. In contrast to the acute stress of a single motivated performance situation (e.g., a quiz), final-exam week requires extensive preparation time for multiple exams in different subjects, with little time for rest or recovery between exams.

Given associations between poor sleep and depression (Tsuno et al., 2005), anxiety (Horenstein et al., 2019), and stress (Kim & Dimsdale, 2007; Minkel et al., 2012), as well as past empirical research showing that stress-mindset interventions can reduce depressive and anxiety symptoms (Study 2; Crum et al., 2013), (Crum et al., 2021), we speculated that sleep might be positively affected by a stress-mindset intervention, especially if it prompts students to be mindful about getting enough sleep as a means of optimizing their well-being during stress. Our stress-management intervention might also increase sleep, as it explicitly instructs students to manage their stress by sleeping. However, if this instruction is overshadowed by the recommendation to participate in other health-focused activities that require extra time, stress management might not increase exam-week sleep. Overall, because students often must study more during exam periods, sometimes sacrificing sleep, their response to such demands is worthy of exploration.

Exam Performance

In many evaluative situations, stress or test anxiety can impair performance (e.g., Chapell et al., 2005; Hancock, 2001), especially when individuals experience additional threat due to negative stereotypes (Cohen & Sherman, 2014; Steele, 1997). However, when college students learn to effectively regulate their performance-related emotions—for example, when first-year students use reappraisal to lessen exam worry (Brady et al., 2018) and community college students use it to lessen math evaluation anxiety (Jamieson et al., 2016)—then anxiety and arousal can be neutral or beneficial for performance. There is some evidence to suggest that stress-mindset interventions improve self-reported work performance (Crum et al., 2021) and increase cognitive flexibility (Crum et al., 2017). However, it is unclear whether a stress-mindset intervention could also improve exam-week performance, 10 months later. Reappraisal interventions that have leveraged construals of stress to increase performance have conveyed that arousal or anxiety immediately before a single upcoming exam can benefit performance on that exam specifically (e.g., Brady et al., 2018; Jamieson et al., 2016). By contrast, a stress-mindset intervention is meant to apply to any stress in individuals' lives, whatever its source or time of occurrence (Crum et al., 2017).

Whether or not a stress mindset directly improves performance, it may sever the negative association between stress and performance. Values affirmation interventions have interrupted negative recursive cycles between threat and poor performance for Black and Latinx students (e.g., Cohen et al., 2009; Cook et al., 2012; Sherman et al., 2013). To the extent the stress-mindset intervention helps students connect with and honor the personal values underlying their stress (e.g., Folkman & Moskowitz, 2007), and accept stress without evaluating it negatively (e.g., Troy et al., 2018), the stress-mindset intervention may be able to achieve a similar effect.

If stress management helps students feel more capable of dealing with exam-week stress, management participants might experience higher performance (e.g., Blascovich et al., 1999; Jamieson et al., 2010). It is also possible that, if students receiving stress-management training engage in problem-focused coping (Folkman, 1997; Folkman & Lazarus, 1985) and study more, such additional preparation may also allow them to perform better. If, instead, the stress-management intervention reinforces the belief that stress is debilitating, then initial negative affect triggered by exam-week stress may evolve into a negative cycle of worry, anxiety, and rumination (Nolen-Hoeksema et al., 1997) and prevent students from performing to their potential (Cassady & Johnson, 2002).

Method

Setting and Timeline

The study was conducted with two consecutive cohorts of freshman students at a highly selective U.S. university during the 2014–2015 (Cohort 1) and 2015–2016 (Cohort 2) academic years. Figure 1 illustrates the timing of interventions and measures for each cohort of students.

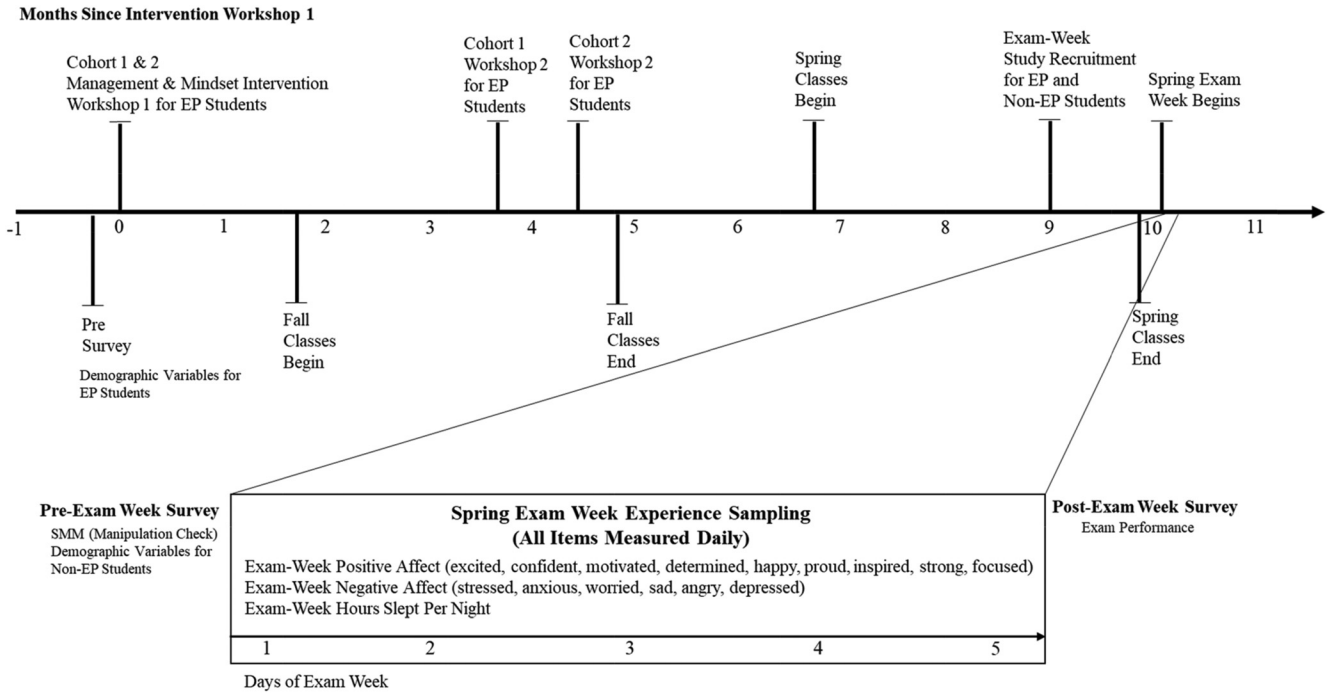
Participants

EP Intervention Participants

Students randomly assigned to stress training were incoming freshmen in an enrichment program (EP) designed by the university to foster community and college success for students from disadvantaged backgrounds. This university-sponsored program provides programming during the summer after high school and throughout the first 2 years of college. The first stress training (Workshop 1) was incorporated into existing EP activities offered in the summer prior to matriculation. A follow-up stress-training workshop (Workshop 2) was provided for all EP participants once during their freshman fall semester.

The EP program invites students from socially and economically disadvantaged backgrounds who are admitted to the university to apply in May of 12th grade and accepts a maximum of 70 students per year. Our sample size reflected this enrollment limit. All incoming freshmen students who enrolled in the EP during the two academic years of the study were randomized into stress-mindset (N = 70) or stress-management (N = 70) conditions.

Figure 1
Study Timeline



Note. Timeline for key study activities and academic calendar dates with numbers representing months since intervention Workshop 1 for each cohort. Due to scheduling conflicts, the timeline for one activity (Workshop 2) differed between cohorts (see online Supplemental Materials Table S1). SMM = Stress Mindset Measure.

Because the goal of this research was to understand the potential benefits of wise interventions for students from disadvantaged backgrounds who tend to be underrepresented at educational institutions, such as Black and Latinx students (who comprised 4–6% and 14–16% of the student body during the two academic years of our study, respectively), we needed to partner with a program to adequately include this demographic.

Non-EP Comparison Students

Comparison students (N = 77) were recruited from the general university population. To the extent possible, we tried to recruit non-EP students of low SES; as such, 25% of non-EP students recruited had household income less than or equal to the EP program median.[1]

Participants in Exam-Week Experience Sampling

One month before final exam week, we recruited all EP students and non-EP students to participate in an experience sampling study during final exam week, which occurred 10 months after the initial intervention and was not part of EP-sponsored activities. Of the total sample of 140 EP students, 41% participated in this experience-sampling study. Despite this attrition, the subset of EP students who participated in experience sampling did not significantly differ from EP nonparticipants on any baseline characteristic in either intervention condition (see online Supplemental Materials Table S2).

The final sample consisted of 57 EP and 74 non-EP comparison students (N = 131). While this sample size was lower than anticipated, the repeated measures design of our experience sampling study, which included up to twice-daily surveys over all 5 days of exam week, combined with customized, ecologically valid interventions, increased power to detect intervention effects (see Open Science Collaboration, 2015; see also Goyer et al., 2019).

Participant Demographics

The EP program analytic sample was 51% female and 67% Black or Latinx.[2] Their mean SES was 5.72 (SD = 2.14, Min = 2, Max = 10), parental education level was 4.88 (SD = 1.84, Min = 1, Max = 7), and SAT score was 2,121 (SD = 125, Min = 1,860, Max = 2,360). Given that they were not targeted by the university for the EP program, non-EP comparison students significantly differed from EP students on every available demographic indicator (see Table 1). For instance, the non-EP comparison sample was 81% female and 12% Black or Latinx. Their mean SES was 7.20 (SD = 2.18, Min = 1, Max = 10), parental education level was 5.93 (SD = 1.30, Min = 2, Max = 7), and SAT score was 2269 (SD = 99, Min = 1,980, Max = 2,400). Nevertheless, there was still sufficient variability in the non-EP comparison condition on several relevant covariates, such as SES and parental education, to permit comparisons between EP intervention students and similar

[1] Three comparison students completed the preexam-week survey but not experience sampling.

[2] One stress-management participant was Native American and grouped with Latinx students.

Table 1
Comparison of EP and Non-EP Students on All Available Preexam Week Measures

	Exam-week sample							
	Condition means				Condition contrasts			
Measure	Non-EP comparison	EP program	EP management	EP mindset	EP program vs. comparison	EP management vs. comparison	EP mindset vs. comparison	EP mindset vs. management
Manipulation check								
Stress mindset before exam week	2.94	3.03	2.80	3.35	0.09	−0.15	0.41**	0.55***
Regression covariates								
Prop. in Cohort 2	0.66	0.56	0.48	0.67	−0.10	−0.18∼	0.00	0.18
Prop. whose gender is female	0.81	0.51	0.48	0.54	−0.30***	−0.33***	−0.27**	0.06
Prop. whose race-ethnicity is Asian	0.42	0.05	0.06	0.04	−0.37***	−0.36**	−0.38**	−0.02
Prop. whose race-ethnicity is Black	0.04	0.35	0.36	0.33	0.31***	0.32***	0.29***	−0.03
Prop. whose race-ethnicity is Latinx	0.08	0.32	0.30	0.33	0.23***	0.22**	0.25**	0.03
Prop. whose race-ethnicity is Black or Latinx	0.12	0.67	0.67	0.67	0.55***	0.55***	0.55***	0.00
Socioeconomic status	7.20	5.72	5.45	6.08	−1.48***	−1.75***	−1.12*	0.63
Parent education	5.93	4.88	4.79	5.00	−1.06***	−1.14***	−0.93**	0.21
SAT score	2,269	2,121	2,098	2,152	−149***	−172***	−118***	54∼

Note. EP = enrichment program; Prop. = proportion. This table compares students in the exam-week sample on demographic and academic measures available for both non-EP and EP students, by condition (N = 131). It also shows condition means and contrasts for the stress mindset measure, which served as the manipulation check for affect outcomes. All means are raw means, obtained from regressing the measure listed in column 1 on condition and no other predictors, using logistic (dichotomous measures) or linear (continuous measures) regression. Condition contrasts are represented as the difference in group means (for logistic regression, the difference in proportions). We report the significance of the regression coefficient associated with each contrast. All measures represent data reported by students in an in-person survey administered the summer before freshman year (EP student demographics) or in an online survey during the week before final exam week (non-EP student demographics and stress mindset measure).
∼ $p \leq .10$. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

students who received no stress training. For this reason, we control for several baseline covariates in regression analyses and also conduct formal matching analyses as explained further below and on pp. 13–15 of the online supplemental materials.

Procedure

The study was approved by the Institutional Review Board at the authors' institutions, Columbia University (IRB-AAAP5751) and Stanford University (39616), and the study site, Massachusetts Institute of Technology (151129954R001). EP program students completed a baseline survey assessing various measures the summer before matriculating. Approximately 1 week after this survey, EP students were randomly assigned to receive a 90-min in-person stress-management or stress-mindset intervention. EP students also received a brief follow-up 90-min booster session in the fall semester, in late October (Cohort 1) or in mid-December (Cohort 2), in which the same facilitator reiterated the content conveyed in Workshop 1 and answered participants' questions (see Figure 1).

Non-EP comparison students (N = 77) were recruited through e-mail listservs and the school's internal freshman Facebook page in April of freshman year to participate in an experience sampling study during the spring final exam week the next month, without receiving any stress training. All originally assigned EP participants were also invited at the same time to participate in experience sampling. Nearly all comparison students (N = 74) and a subset of each EP condition agreed to participate: 47% of EP stress-management students (N = 33) and 34% of EP stress-mindset students (N = 24). All students were offered $50 for participation in experience sampling.

The final 131-person sample with available data for freshman experience sampling was used in all analyses, except for exam performance (see below). Each day during the 5-day final exam week, participants were alerted twice per day to rate their current positive and negative affect and report their hours slept the previous night using experience sampling administered via a mobile application (Thai & Page-Gould, 2018). They also reported their current health, self-esteem, and energy level (see online supplemental materials, pp. 27–28). Stress-mindset scores (for all students) and demographics (for non-EP students) were collected in an online survey before exam week, and exam performance (for all students) was collected via an online survey after exam week (see Figure 1 and online supplemental materials, pp. 4–5).

Intervention Content

Stress-Mindset Intervention

The stress-mindset intervention (Crum et al., 2013, 2021) provided participants with research, anecdotes, and exercises to help them adopt a *stress-is-enhancing* mindset. A facilitator acknowledged both positive and negative aspects of stress, emphasized the power of mindset to change construals of and responses to stress, and encouraged participants to try a three-step technique to help them adopt a stress-is-enhancing mindset whenever they experienced stress. This technique included: (a) acknowledging the stress a given stressor caused them, (b) embracing this stress, and (c) utilizing their stress to effectively confront the stressor and to appreciate the inherent learning and growth opportunities it offered (see online supplemental materials, pp. 7–8 for further details).

Stress-Management Intervention

This intervention was designed to represent state-of-the-art stress-management approaches. A trained facilitator taught stress-management messages and techniques using materials that were identical in format and length to the stress-mindset intervention. These materials emphasized the negative consequences of stress and reinforced a stress-is-debilitating mindset. They also encouraged individuals to try a three-step technique to address stress: (1) avoiding stress, where possible, through time management and prioritization; (2) reducing stress through relaxation techniques, such as deep breathing; and 3) counteracting the negative effects of stress through healthy diet, exercise, and sleeping habits (see online supplemental materials, pp. 8–9).

Dependent Variables

Stress Mindset Measure

Stress mindset was assessed in the survey 1 week before the experience sampling study using the Stress Mindset Measure (SMM; Crum et al., 2013) and served as the manipulation check. SMM asks participants to rate how strongly they agree with eight statements (e.g., "*the effects of stress are positive and should be utilized*") on a 1 (*strongly disagree*) to 5 (*strongly agree*) scale. We created a composite by reverse-scoring four negatively valenced items and then averaging all eight items. The scale reliability of preexam-week SMM was .86.

Exam-Week Positive Affect

We assessed exam-week affect using an adapted Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). For positive affect, we measured the daily exam-week average of participants' responses to nine states: *excited*, *happy*, *inspired*, *confident*, *proud*, *strong*, *focused*, *determined*, and *motivated*. Items were scored on a 1 (*not at all*) to 6 (*extremely*) scale. Scale reliability was .92.

Exam-Week Negative Affect

Negative affect was the daily exam-week average of participants' responses to six negative states: *stressed*, *anxious*, *worried*, *sad*, *angry*, and *depressed*. It was also assessed on a 1 (*not at all*) to 6 (*extremely*) scale. Scale reliability was .90.

Exam-Week Stress

The single negative affect item *stressed* was used to assess exam-week stress levels and served as a moderator of condition effects on exam performance.

Exam-Week Sleep

The items we used to assess sleep were derived from the Pittsburgh Sleep Quality Index (PSQI), a widely used scale for measuring subjective sleep quality (Buysse et al., 1989). To reduce participant burden and ensure high responsiveness to all outcomes assessed over ten survey administrations during the exam week, we used two items from the sleep duration subscale of the full 19-item PSQI ("What time did you go to bed last night?"; "What time did you wake up this morning?"). We modified the two relevant PSQI items so that they asked participants about the previous night's sleep rather than the previous month, as in the full PSQI. Other studies assessing sleep in experience sampling have used similar procedures, using two (Lydon et al., 2016) or three items (Kalmbach et al., 2014) from the PSQI to assess the duration of previous-night sleep. PSQI component scores such as sleep duration can be considered on their own (Brown et al., 2002; Osorio et al., 2006), and even single-item measures of sleep have been found to have high reliability and validity (Cappelleri et al., 2009). We subtracted each report of a student's time of waking from time of going to bed and aggregated all of a student's reports within each day into a daily average (see online supplemental materials, pp. 6–7 for detailed procedure).

Exam Performance

While we were not given permission to access the university registrar to obtain objective exam scores, there is evidence that subjective performance is also valid (Gibbs et al., 2005; Leung & Xu, 2013) and even essential in measuring human performance (Muckler & Seven, 1992). In the online survey administered after exam week, students provided their grade (in numeric format on a 100-point scale or letter grade format) on each of their exams for up to six classes. Letter grades were converted to the numeric 0–100 scale. A composite score was formed by averaging each student's grade on each exam. To assess the validity of self-reported exam scores in our sample specifically, we asked students in the analytic sample to volunteer to provide their transcripts. Among those students who provided their transcripts and reported their GPA on the online postexam-week survey (N = 80), the correlation between official and self-reported semester GPA was high, $r = .85$, $p < .001$, providing confidence that self-reported exam performance for the full sample was likely to be accurate.

Baseline Measures

Cohort

Cohort was represented as a 0/1 dichotomous variable, defined as 0 if students were freshmen during Year 1 of the study and 1 if students were freshmen during Year 2.

Gender

Students were asked to indicate their gender, which we codified as 1 for female and 0 for nonfemale.[3]

Race-Ethnicity

Students came from one of six racial-ethnic groups: 1 = *Asian-Pacific (Japan, Korea, China)*; 2 = *Black or African American*; 3 = *Hispanic, Latin American, or Spanish*; 4 = *Native American*; 5 = *South Asian (India, Pakistan, Bangladesh)*; 6 = *White or Caucasian*. For model-fitting purposes, we grouped three South Asian students with Asian-Pacific students and one Native American student with Hispanic students, creating four categories: Asian, Black, Latinx, and White, represented by three dichotomous 0/1 contrasts, with White as the reference category.

[3] One transgender student who identified as male was classified with the "nonfemale" group.

Objective SES

Students were asked to indicate their best estimate of their parent(s)' household income on a categorical scale, ranging from 1 (*less than $15,000*) to 10 (*more than $300,001*).

Parental Education

The education level of students' parents was assessed with a single question, "What is the highest level of education either of your parents has completed?" Responses could range from 1 (*did not complete high school*) to 7 (*doctoral degree or equivalent*), with five corresponding to a "*bachelor's degree or equivalent*."

SAT Scores

To account for individual differences in aptitude that could affect exam performance, we used students' self-reported SAT scores on a 2,400-point scale, reflecting their total score on the Reading, Math, and Writing sections.

Missing Data

All students in the primary analytic sample ($N = 131$) had available scores for stress mindset before exam week and for experience sampling outcomes, while 90% ($N = 118$) reported a score for at least one exam ($M = 2.97$ exams, $SD = 1.24$ exams). We had complete data for baseline measures, except for SAT scores, which were available for 89% ($N = 117$) of the exam-week sample.[4] To account for missing SAT scores in analyses of exam performance, we used multiple imputation techniques (see online supplemental materials, pp. 13 and 24–26).

Baseline Equivalence of EP Conditions

EP students initially assigned to stress management or mindset training were equivalent on all but two covariates (see online supplemental materials, pp. 9–10). The mindset condition had higher SAT scores than the management condition ($p = .054$), though scores for both groups were high (Ms = 2,156 vs. 2,098). Stress-mindset participants also had significantly lower ($p = .034$) Preworkshop-1 stress mindset scores (Ms = 2.69 vs. 2.93), though these scores were still near the midpoint of the scale. Among experience-sampling participants, there were no significant differences between the management and mindset conditions (see Table 1); however, SAT scores continued to be marginally higher ($p = .097$) for the mindset condition (Ms = 2,152 vs. 2,098).

Analytical Strategy

Since comparison students differed on several key demographic variables relative to EP students, we controlled for the following baseline covariates in all analyses: dichotomous cohort, dichotomous gender, dichotomous race-ethnicity (represented as three dummy variables, as described above), and continuous SES and parental education. For analyses of exam performance, we additionally controlled for SAT score (see online supplemental materials pp. 24–26 for results that use multiple imputation to impute SAT for participants with missing SAT). We standardized all covariates within the exam-week sample and also centered each on the EP program mean for that covariate, so intervention effects would be evaluated relative to the mean of a student comparable with a prototypical EP student who received no stress training.

We used a multilevel random effects regression model (online supplemental materials, p. 11) to assess (separately for each outcome) condition effects on average daily exam-week positive affect, negative affect, and hours slept, as we had multiple measures of these for each student. We also use a slightly more complex multilevel model (see online supplemental materials, pp. 11–12) to assess the linear daily change in each outcome during the exam week. We used a single-level regression model to assess condition effects on exam-week performance.

As a robustness check, we also conducted analyses using formal treatment estimation techniques designed to identify causal effects in observational data (e.g., propensity score analyses) for the average exam-week affect, hours slept, and performance outcomes (online supplemental materials, pp. 13–20). We focus on multiple regression analyses in the article because they better capture the unfolding of a stressful experience over time (see Blascovich, 2008b; Folkman & Lazarus, 1985) and can also be easily modified to compute overtime slopes and moderation of condition effects by level of stress, other analyses of interest. Generally speaking, treatment estimation techniques yielded similar results as regression analyses for all primary outcomes (online supplemental materials, pp. 16–20).

In all analyses, we used two dichotomous condition contrasts to distinguish each stress intervention condition from comparison students (EP Mindset = 1 vs. Non-EP Comparison = 0; EP Management = 1 vs. Non-EP Comparison = 0). For analyses requiring data that was unavailable for the comparison students (e.g., SMM immediately after intervention Workshop 1), we used a single condition contrast (Mindset = 1 vs. Management = 0). For stress moderation analyses, we additionally included the main effect of the stress moderator, average exam-week stress, and its interaction with each condition contrast. We then computed the simple association between exam-week stress and exam-week performance in each condition (when that condition was defined as 0 for both condition contrasts).

We begin by reporting condition differences on the manipulation check, stress-is-enhancing mindset before exam week, which we expected to be higher for the stress mindset condition than for the other two conditions. We then report condition differences on daily exam-week positive affect, negative affect, and hours slept. We next report condition differences on exam-week performance. Finally, we assess whether condition moderated the association between exam-week stress and exam-week performance.

Results

Stress Mindset Measure Manipulation Check

Immediately before exam week, approximately 10 months after the initial stress intervention, mindset-condition participants had significantly higher stress-is-enhancing mindsets than management-condition participants in a model that also included non-EP

[4] However, only 108 students had nonmissing data for exam performance, demographics, and SAT.

comparison students (M_{MIND} = 3.32 vs. M_{MAN} = 2.81), b = .51, 95% confidence interval [CI: .20, .81], p = .001, d = .85. This difference, though sizable, was approximately half as large (d = .85 vs. d = 1.68) as the mindset-condition effect on stress mindset immediately after the first training (summer before freshman year). Stress-is-enhancing mindset before exam week was marginally higher for mindset-condition participants than for comparison students (M_{MIND} = 3.32 vs. M_{COM} = 3.01), b = .31, 95% CI [−.01, .63], p = .056, d = .52.[5] Thus, the stress-mindset intervention was successful in inducing the mindset intended and adequate in sustaining it through the end of freshman year.

Main Effects of Condition

Exam-Week Positive Affect

Average Positive Affect. Aligned with our prediction, mindset-condition participants had significantly higher exam-week positive affect than comparison students with values on all predictors equal to the EP program mean (M_{MIND} = 3.96 vs. M_{COM} = 3.52), b = .44, 95% CI [.07, .80], p = .019, d = .63. Management-condition participants also had higher exam-week positive affect than comparison students. However, the difference was nonsignificant and also lower in magnitude (M_{MAN} = 3.81 vs. M_{COM} = 3.52), b = .29, 95% CI [−.06, .63], p = .106, d = .41. See Figure 2A. There was no difference between mindset and management conditions in mean exam-week positive affect, b = .15, 95% CI [−.20, .50], p = .40, d = .22.

Linear Change in Positive Affect Over the Exam Week. With respect to the day-to-day change in positive affect over the exam week, mindset-condition participants had directionally higher positive affect on the first day, b = .30, p = .13, d = .43, yet exhibited greater increases in positive affect relative to comparison students over the exam week (i.e., more positive slope; see Figure 3 and online Supplemental Materials Table S7). In other words, daily positive affect levels were relatively flat over time in the comparison condition, b = .021, p = .60, d = .03, but significantly increased over time in the mindset condition, b = .091, p = .024, d = .13. As a result, mindset-condition participants had significantly higher positive affect than comparison students on the last day of the exam week, b = .58, p = .013, d = .84. Positive affect in the management condition was also directionally higher than comparison students on Day 1, b = .18, p = .33, d = .26, and increased over the exam week, b = .076, p = .031, d = .11. As this slope was lower in magnitude than the mindset-condition slope (.076 vs. .091), last-day positive affect was only marginally greater for the management condition relative to comparison students, b = .40, p = .074, d = .58. However, neither the difference in exam-week slope nor last-day positive affect between mindset-condition and management-condition participants reached significance, ps ≥ .44.

Taken together, it was only the mindset condition that significantly differed from the comparison condition in positive affect overall and in linear daily change in positive affect during exam week. No other condition comparisons significantly differed.

Exam-Week Negative Affect

Average Negative Affect. Consistent with our predictions, mindset-condition participants had similar levels of exam-week negative affect as comparison students (M_{MIND} = 2.56 vs. M_{COM} = 2.31), b = .25, 95% CI [−.16, .66], p = .23, d = .32. Management-condition participants also had similar levels of negative affect as comparison students (M_{MAN} = 2.50 vs. M_{COM} = 2.31), b = .19, 95% CI [−.20, .59], p = .34, d = .25, and mindset-condition participants, b = .06, p = .77, d = .08 (Figure 2B).

Linear Change in Negative Affect Over the Exam Week. As expected, there was also no difference between conditions with respect to the day-to-day change (i.e., slope) in negative affect over the exam week, all ps ≥ .37. Negative affect significantly decreased over the exam week for all three conditions, −.172 ≤ b ≤ −.111, ps ≤ .025.

Average Stress. The mindset (M_{MIND} = 3.18), management (M_{MAN} = 3.05), and comparison (M_{COM} = 2.95) conditions did not differ in their levels of average exam-week stress, ps ≥ .35.

Linear Change in Stress Over the Exam Week. As expected, there was also no difference between conditions with respect to the day-to-day change in stress over the exam week, all ps ≥ .36. Similar to overall negative affect, stress declined over the exam week in all conditions, −.400 ≤ b ≤ −.297, ps < .001.

Exam Week Sleep

Mindset-condition participants slept the same hours per exam-week night as comparison students (M_{MIND} = 7.02 vs. M_{COM} = 7.08), b = −.06, 95% CI [−.67, .55], p = .85, d = −.05, a nonsignificant difference (Figure 2C). By contrast, management participants slept fewer hours per night than comparison students (M_{MAN} = 6.54 vs. M_{COM} = 7.08), b = −.54, 95% CI [−1.12, .05], p = .073, d = −.47, a marginally significant difference. The difference in exam-week sleep between mindset-condition and management-condition participants was a trend, b = .48, 95% CI [−.12, 1.07], p = .115, d = .42. This difference seemed to reflect management students going to bed slightly later than the other groups (average go-to-bed times: M_{COM} = 1:12 AM; M_{MIND} = 1:21 AM; M_{MAN} = 1:38 AM; average wake-up times: M_{COM} = 8:21 AM; M_{MIND} = 8:28 AM; M_{MAN} = 8:30 AM).[6]

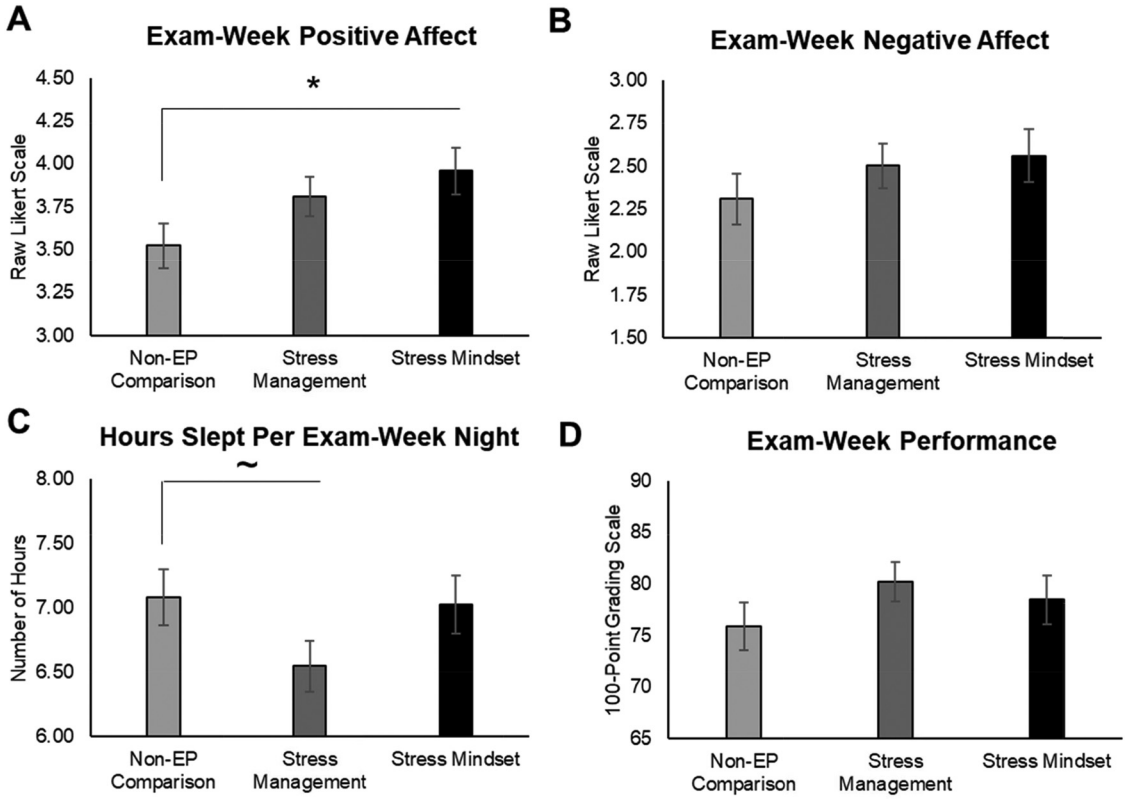
Exam-Week Performance

In complete-data analyses controlling for demographics and SAT score, exam-week performance was directionally but not significantly higher for both the mindset condition, b = 2.60, 95% CI [−3.72, 8.93], p = .42, d = .24, and the management condition, b =

[5] In a slightly larger sample that contained eight more students who participated in the preexam-week survey but not in exam-week experience sampling (N = 139), mindset-condition participants had significantly higher stress-is-enhancing mindsets than both the management and non-EP comparison participants, all ps ≤ .036.

[6] In the supplement, we also assess students' changes in perceptions of their general health over the exam week, a measure that also reflects well-being. These show that general health declined over the exam week for the comparison group, was stable in the management condition, and marginally increased for the mindset condition. By the end of exam week, the management condition had marginally higher health than comparison students and the mindset condition had significantly higher health than comparison students. See online Supplemental Materials Table S8 (p. 23).

Figure 2
Main Effects of Condition on Exam-Week Outcomes



Note. This figure displays predicted levels of (A) daily positive affect, (B) daily negative affect, (C) daily hours slept, and (D) exam performance during freshman exam week, by condition, controlling for dichotomous cohort, gender, race-ethnicity (three 0/1 variables with White as reference category), and continuous socioeconomic status (SES) and parental education. Means for Panels A to C were obtained from multi-level rather than single-level regression as in Panel D. Analyses underlying Panel D additionally controlled for SAT, excluding students with missing SAT scores (for multiply imputed analyses including such students, see online supplemental materials p. 25). Error bars are ±1 *SE*. Any condition contrasts not indicated with lines are nonsignificant. $\sim p \leq .10$. $^{*}p \leq .05$.

4.31, 95% CI [−1.82, 10.43], $p = .17$, $d = .40$, relative to comparison students ($M_{COM} = 75.86$, $M_{MAN} = 80.16$, $M_{MIND} = 78.46$; Figure 2D). There was no difference in exam performance between the mindset and management condition, $b = -1.70$, 95% CI [−7.82, 4.41], $p = .58$, $d = -.16$.[7]

We also examined whether condition moderated the association between exam-week stress and exam-week performance. The results revealed that comparison students exhibited the expected negative relationship between exam-week stress and exam performance, $b = -3.46$, 95% CI [−6.04, −.87], $p = .009$, $d = -.32$. However, the mindset intervention reduced this association by 75%, rendering the relationship nonsignificant, $b = -.88$, 95% CI [−4.89, 3.14], $p = .67$, $d = -.17$. The management intervention also reduced this association to nonsignificance, by 48%, $b = -1.79$, 95% CI [−5.83, 2.25], $p = .38$, $d = -.08$ (see Figure 4).[8]

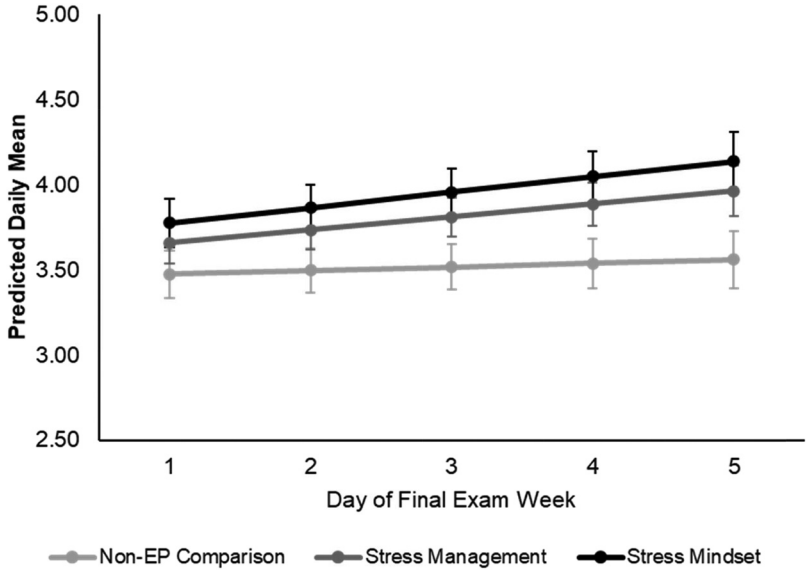
Discussion

The goal of this research was to examine the effect of a brief (90-min plus one booster session) stress-focused wise intervention on affect, sleep, and performance during final exams for students from disadvantaged backgrounds. Research suggests that understudied (e.g., Adler et al., 1994) and underserved populations (Gwede et al., 2016) are particularly exposed to stress that can negatively affect their health (Cheadle et al., 2020; Williams et al., 2010). We find that, among a sample of high-achieving college students, two-thirds of whom were Black, Latinx, or Native American, those receiving a stress-mindset intervention experienced similar levels of exam-week positive affect, negative affect, sleep, and performance compared with those receiving a stress-management intervention. Yet, only those receiving the stress-mindset

[7] In multiple-imputation analyses ($N = 118$), the main effect of condition was marginally significant for the management condition and continued to be nonsignificant for the mindset condition. See online Supplemental Materials p. 25.

[8] These moderation results ($N = 108$), including the negative association between stress and performance for comparison students, and its reduction by the intervention conditions, were similar but somewhat weaker in multiple-imputation analyses that imputed SAT based on other covariates when SAT was missing ($N = 118$). See online supplemental materials, p. 26.

Figure 3
Over-Time Trajectories of Exam-Week Positive Affect by Condition



Note. The figure displays the predicted daily change in levels of overall positive affect over the exam week, by condition. Predicted means were obtained from a multi-level regression model that was the same as the model used for Figure 2A except it included a main effect of linear time and its interaction with each predictor in the model. Error bars are ±1 *SE*. For associated parameter estimates, see online Supplemental Materials Table S7.

intervention experienced positive affect levels significantly greater than those of a campus-wide comparison group receiving no intervention. The positive association between the stress-mindset intervention and positive affect during stress is consistent with stress-mindset theory (Crum et al., 2013; Crum et al., 2017, 2021), which posits that individuals can improve well-being during stressful experiences even when they do not or cannot reduce stress or negative affect.

College students tend to be especially at risk for stress, anxiety, and depression (Mofatteh, 2021; Pedrelli et al., 2015). These mental health risks may be greater for students facing race-based stereotype threat (Steele & Aronson, 1995) or those less familiar with postsecondary institutional culture and processes due to social class background (Stephens et al., 2012). Further, these populations can also be difficult to study and serve (Roberts et al., 2020). For example, Black students are less likely than White students to enroll in selective institutions (Baker et al., 2018), and Black and Latinx students who enroll are less likely than other groups to graduate (Libassi, 2018; Shapiro et al., 2017). Thus, these findings suggest stress-focused wise interventions offer one way to potentially mitigate stress during college for these students.

The Significance of High Positive and Negative Affect Together

The exam-week affect pattern of higher positive affect without decreases in negative affect exhibited in the stress-management and particularly the stress-mindset condition has also been observed in other contexts. This pattern resembles the stress responses of individuals with high trait-level resilience, who are able to exhibit greater positive emotionality and persistence in stressful circumstances relative to those with low resilience (Fredrickson et al., 2003), while tending to experience similar levels of frustration and anxiety (Tugade & Fredrickson, 2004). Similarly, individuals subject to chronic stress, as when caregiving for a terminally ill loved one, are able to generate and sustain positive affect throughout their stressful experience (Folkman et al., 1997; Folkman & Moskowitz, 2000a; Moskowitz et al., 1996) even as they experience high levels of negative affect (Folkman, 1997).

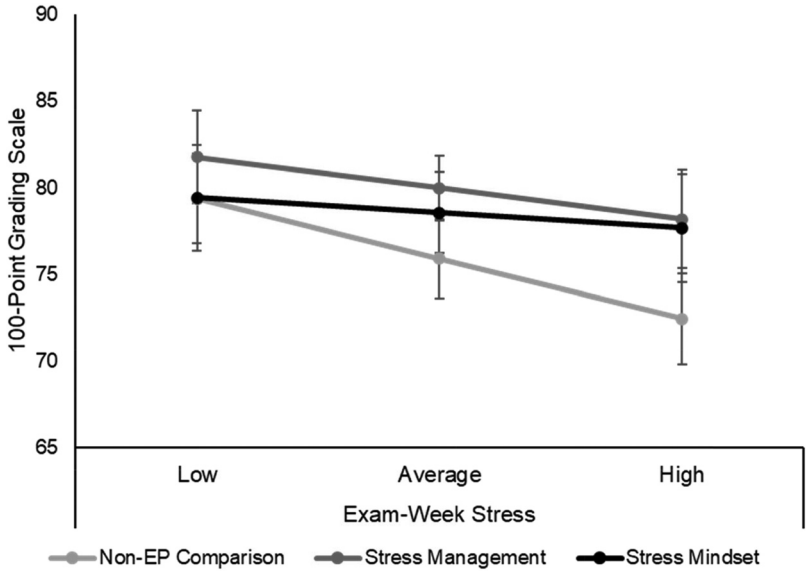
Thus, our findings suggest that a stress-mindset intervention in particular may help individuals develop more resilience under stress, whether or not they already possess high levels of trait resilience. These findings also suggest that, in helping individuals cultivate the same affect profile that is beneficial in more extreme or sustained stress experiences, the stress-mindset intervention may prepare individuals to effectively confront more significant or unrelenting adversity later in life.

The Decoupling of Stress and Performance

Although we did not find any differences between the stress interventions and the comparison condition in overall exam-week performance, we did observe an intriguing difference in the relationship between exam-week stress levels and exam performance by condition. Without any intervention, the correlation between how stressed students were on average during each day of the exam week and how they performed on their exams was negative. However, for the stress mindset and stress management groups, the negative relationship between stress and performance was weakened. Moreover, this relationship was the weakest in the

Figure 4

Simple Effects of Condition on Exam Performance, by Levels of Average Exam-Week Stress



Note. This figure displays levels of exam-week performance, as a function of condition and level of exam-week stress, controlling for demographics and SAT in the complete-data sample (N = 108). Low, average, and high-stress levels represent −1, 0, and 1 *SD*s below/above the enrichment program (EP) program mean for the stress moderator and values of all other covariates equal to the EP program average. For multiply imputed analyses, see online Supplemental Materials Table S10.

stress-mindset condition. The benefits of stress mindset for decoupling are consistent with research on the adaptive roles of acceptance (Troy et al., 2018) and resilience (Tugade & Fredrickson, 2004) in chronic stress, which serve to undo the lingering effects of negative stress-related emotion (Fredrickson & Levenson, 1998) and facilitate recovery (Folkman, 2008).

It is also important to understand why we did not observe the main effects on performance achieved by other wise interventions, most notably reappraisal of arousal and anxiety interventions (Brady et al., 2018; Jamieson et al., 2016). One explanation is timing and focus. Reappraisal interventions focus on arousal or anxiety that immediately precedes an upcoming performance situation (e.g., a single exam, Brady et al., 2018; Jamieson et al., 2016; public speaking, Brooks, 2014) and specify that the arousal or anxiety experienced can be beneficial for the focal performance situation. In contrast, adopting a stress-is-enhancing mindset is not situation-specific and is meant to apply to any stressful situation, regardless of timing (Crum et al., 2017). Additionally, the stress-mindset intervention does not uniquely focus on performance; improved performance is presented as one of many possible benefits that can ensue from a stressful experience.

Implications for Sleep

This study also expands our understanding of the capacity of stress interventions to affect sleep. Obtaining an optimal amount of sleep is an important component of well-being and performance (e.g., Becker et al., 2018), especially during times of stress (Kim & Dimsdale, 2007). However, college students particularly struggle with this (Buboltz et al., 2001). During final exam weeks, college students may experience additional pressure to sacrifice sleep, as final-exam weeks tend to have several features known to impair sleep: high workload (Dahlgren et al., 2005), variable schedules (Machado et al., 1998), and anticipatory stress (Block et al., 2020). Mindset participants experienced similar or higher positive affect and similar performance as the other two conditions while sleeping the same amount as or directionally more than these students. Empirically, a stress-is-enhancing mindset has been associated with optimal physiological regulation, including by facilitating optimal cortisol reactivity in response to stress (Crum et al., 2013). However, the evidence in the present study is not strong enough to confirm that sleep is another metric of adaptive physiological regulation related to having a stress-is-enhancing mindset. It is also possible that assessing sleep quality ("Last night, how would you rate your quality of sleep?") rather than sleep duration may have yielded stronger effects. Some evidence suggests positive affect in particular, the primary outcome affected by the stress-mindset intervention, is more associated with sleep quality than with sleep duration (Bower et al., 2010; Pilcher et al., 1997), and positive affect in combination with better sleep quality may be most effective in offsetting the negative effects of stress (Blaxton et al., 2017).

By contrast, stress-management training resulted in marginally lower exam-week sleep duration than no training and was associated with later bedtimes, even though management training explicitly mentioned adequate sleep as one way to counteract the

negative effects of stress. Management participants may have gone to bed later and slept less during freshman exam week to study more or to incorporate more stress-management activities. If the belief that stress is debilitating led to higher levels of stress-related rumination at night, this may also have contributed to their later bedtimes (Zoccola et al., 2009). Management participants' lower exam-week sleep may illustrate a "knowing-doing gap" (Pfeffer & Sutton, 2000), where management participants were aware of the intervention's recommendation to manage stress by obtaining adequate sleep but nevertheless did not implement this recommendation or chose to use other recommendations offered by the stress-management intervention. Indeed, this finding is consistent with other research that finds only weak associations between knowledge of sleep hygiene or good sleep habits and implementing them in practice (Brown et al., 2002; Hicks et al., 1999a). It also reinforces the importance of a guiding design principle of wise interventions (Cohen et al., 2017): they may not yield intended effects when they have too many messages or multiple messages that conflict with each other.

Though stress-related sleep disturbance can facilitate hyperarousal (Drake et al., 2004), which undermines well-being, our study does not suggest that stress-management training lowered sleep sufficiently to cause such hyperarousal. Mean levels of sleep in the management condition (6.5) are within 30 min of the minimum sleep (i.e., 7 hr) recommended for healthy adults aged 18 or older by the Centers for Disease Control and Prevention and the National Sleep Foundation (see Watson et al., 2015). Consistent with this, supplemental analyses (online supplemental materials p. 28) indicated that stress-management participants were just as likely as participants in other conditions to report optimal energy levels during exam week. This level of sleep also suggests management participants did not consistently experience acute sleep deprivation that is characteristic of "pulling an all-nighter" (Hershner & Chervin, 2014) and also did not fall below the threshold that is most associated with performance deficits, which tends to be less than 5 to 6 hr of sleep per night (Dinges et al., 1997; Pilcher & Walters, 1997). However, management participants' relatively lower sleep levels do suggest that they may have prioritized well-being less than other goals during exam week, such as preparation for performing well, and the cumulative partial sleep deprivation they experienced may have had some costs (see Van Dongen et al., 2003).

It is important to note some potential limitations of our sleep measure. Students may not have accurately recalled their sleeping and waking times, and, especially at a selective university where industriousness is valued, may have been inclined to underreport sleep to manage others' impressions of them. However, we expect students in all three conditions would experience these same institutional pressures. The management condition might also have had incentives to overestimate their sleep because their training explicitly conveyed that sleep was important for stress management, an incentive that works against the effects we found. Future studies could improve upon the measure of sleep we used by providing a dropdown of sleep or wake times rather than asking students to write in times as free response, by using instructions that clarify that hours of sleep may differ from number of hours spent in bed (as is done in Lydon et al., 2016), and by using instructions that help to more clearly distinguish naps from bedtime periods (Lockley et al., 1999). Additionally, sleep duration does not fully capture subjective sleep quality (Buysse et al., 1989; Pilcher et al., 2000). Future studies could assess how wise stress interventions affect additional components of sleep quality (Block et al., 2020; Lydon et al., 2016), such as sleep efficiency (total sleep time divided by time in bed; McGowan et al., 2016; Rosipal et al., 2013), and also supplement these measures with more objective ones (e.g., Girschik et al., 2012; Lauderdale et al., 2008).

General Limitations

It is important to highlight that these results are based on a small sample, in partdue to the fact that the fact that disadvantaged populations tend to be underrepresented at universities. The need to partner with a specific university program to access these students also constrained our sample size (to the program's enrollment limits) and prevented us from randomly assigning students to a "no-training" condition. Consistent with the difficulties associated with conducting longitudinal real-world research, our ability to detect intervention effects in an already small sample was further hampered by attrition that occurred between intervention delivery and outcome assessment, especially for performance. Finally, the quasi-randomized nature of our design makes it challenging to make causal claims about the strength of our interventions. Although we recruited a meaningful proportion of low-SES students for the campus comparison group, controlled for all available covariates in multiple regression analyses, and confirmed the robustness of our regression-estimated intervention effects using techniques designed to identify causal effects in observational data in supplemental analyses, we cannot rule out the role of other, unknown differences between conditions. We acknowledge that our results can be considered preliminary evidence warranting replication in future field interventions with larger samples and random assignment to all conditions.

Future Directions

Though preliminary, our findings set the stage for future studies that can deepen understanding of how wise interventions may best help students from disadvantaged backgrounds improve their stress response. Our results were robust to several implementation differences: our sample combined two separate cohorts, who completed the intervention in different academic years and received training from different instructors. But questions remain about the kinds of contexts that best support the intervention messages and the best manner for delivering the interventions. The stress-management and mindset interventions tested here did not achieve the same magnitude of change in academic performance that other wise interventions have achieved, such as social belonging and reappraisal of arousal interventions. Does this reflect fundamental differences in intervention design, or in the context used? Are there other stressful circumstances where a stress-mindset intervention is more effective than a situation-targeted intervention, as when goal attainment is more uncertain and/or individuals have to experience extended waiting and recovery stages of stress rather than primarily anticipation stages? These questions highlight promising avenues for future research.

It is notable that the positive benefits detected in students receiving the mindset and management interventions occurred 10 months after the initial intervention workshop with one booster workshop in between. Future studies should seek to understand the duration

of stress-intervention effects and the breadth of sessions needed to sustain these effects. Could an intervention that generates and sustains a higher stress-is-enhancing mindset than observed here (58% of the scale maximum) better benefit well-being and possibly performance? Since both of the interventions exhibited some benefit (relative to the comparison condition), and people naturally tend to combine multiple strategies when confronting real-world stress (Folkman & Lazarus, 1985), our findings suggest that additional benefits might be gained through an intervention that integrates both stress-mindset and stress-management approaches and optimizes stress responses (Crum et al., 2020; Jamieson et al., 2018; see also Troy et al., 2018). An integrated intervention could be critical to helping individuals thrive and sustain coping during stress that is more extreme or chronic than a final exam week.

Conclusion

Every day, millions of students are affected by stress, especially when they face social and/or economic disadvantage in important goal-related contexts. When unaddressed, stress can take a toll on mental and emotional health as well as performance. Yet, our research provides preliminary evidence that once students understand and accept the nature of stress and are trained in techniques to effectively respond to it, a stressful experience can be enhancing, even when it is associated with high or ongoing negative affect.

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