

Worried Sick: The Impact of Students' Stress Mindsets on Health and Academic Performance

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Abstract

The goal of this study was to evaluate how beliefs about stress as enhancing versus debilitating, also known as *stress mindsets*, relate to health and academic performance in an undergraduate sample. College students ($n=499$) were surveyed on their general and stressor-specific mindsets, and self-reported on their stress, health, coping, and GPA. Our findings suggest that beliefs about stress vary as a function of stressor type (acute versus chronic, and controllable versus uncontrollable), and that some stressor-specific mindsets may be more predictive of health than others. General mindsets were associated with health, consistent with prior findings. When stressor-specific mindsets were examined, chronic controllable mindsets were most pervasively related to health. Specifically, believing that chronic controllable stressors are harmful was related to worse mental and physical health. Consistent with prior findings, we found that measures of stress were associated with health, however this relationship was moderated by stress mindsets. Believing that stress is enhancing rather than debilitating appears to provide a psychological “buffer” against the negative effects of stress. Our work suggests that interventions which challenge students’ beliefs about stress may help students handle large amounts of stress with a lessened impact on their health. Interventions targeting chronic controllable mindsets may be more effective than current general stress mindset interventions. Future work calls for the development of student-oriented, stressor-specific stress mindset interventions.

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There is nothing either good or bad, but thinking makes it so. (Shakespeare, trans. 1992, 2.2.268–270).

A wealth of psychological research supports this statement, underscoring the power of beliefs in influencing behavior, achievement (e.g., Merton, 1948; Dweck & Leggett, 1988) and health outcomes (e.g., Kirsch & Weixel, 1988). Recently, research on the power of beliefs has turned to the domain of stress. People have varying beliefs about stress: some perceive it to be motivational, beneficial, and “good”; whereas others perceive stress to be harmful, taxing, and “bad.” Neither belief is unfounded—stress has been associated with increased focus, productivity, and psychological growth (Crum, Salovey, & Achor, 2013), but also with greater susceptibility to physical and mental illness and increased risk of mortality (Cohen & Wills, 1985; Keller, Litzelmann, Wisk, Maddox, Cheng, Creswell, & Witt. (2012); Lantz, House, Mero, & Williams, 2005). How might these beliefs matter? Does stress affect people differently based on their beliefs? Is stress neither “good” nor “bad,” but our perceptions “make it so”?

The goal of the present study was to examine how beliefs about stress, in its many forms, are associated with health and performance in a sample of people who experience especially high levels of stress: college undergraduates. In the sections that follow, we first summarize key findings regarding the importance of interpretations and beliefs about stress, including correlational and experimental work demonstrating the influence of stress mindsets on performance and on health. Next, we discuss the potential relevance of stress mindsets for college undergraduates, and introduce the student-oriented applications of stress mindset theory

that lead to the specific predictions of our research. Finally, we propose an approach to testing these predictions and describe the primary goals of the present study.

Stress Mindset Theory

In their landmark work, Lazarus and Folkman (1984) emphasized the importance of situation-specific appraisals of stress as crucial to understanding how people respond to stressful situations. Specifically, they argued that as people encounter stressors, their immediate thoughts about the stressor (i.e., Is it threatening? Is it manageable?) influence how they respond. More recently, researchers have expanded this conception beyond situation-specific appraisals to broad beliefs about stress, coined “stress mindsets.” Mindsets describe not the specific appraisals one makes about stress in a particular moment (for example, in response to a fast-beating heart and sweaty palms), but rather one’s general beliefs about stress as helpful or harmful (Crum et al., 2013). People who believe that stress is harmful to performance and well-being have a “stress-is-debilitating” mindset. Those who believe that stress is motivating and enhances productivity and performance have a “stress-is-enhancing” mindset. Prior work illustrates that stress mindsets shape stress response, with stress-is-enhancing mindsets predicting more positive responses to stress such as more adaptive cortisol response, increased desire for feedback (Crum et al., 2013), positive affect, and cognitive flexibility (Crum, Akinola, Martin, & Fath, 2017).

Research suggests that stress mindsets are not only measurable, but malleable (Crum et al., 2013). Using video interventions to manipulate mindset, researchers have demonstrated the importance of stress mindsets to productivity in a work context (Crum et al., 2017). Their findings suggest that when an individual was encouraged to view stress as enhancing (rather than debilitating), the negative effects of stress on various outcomes were mitigated, even when a situation is appraised as threatening (Crum et al., 2017). Furthermore, participants encouraged to

view stress as enhancing were more likely to demonstrate cognitive flexibility and appraise a stressor as a challenge—something they were capable of handling (Crum et al., 2017). Those with stress-is-enhancing mindsets also showed, on average, greater work performance and more adaptive cortisol response (Crum et al., 2013). Furthermore, interventions designed to help undergraduates reappraise a particular kind of stress, performance anxiety, as helpful rather than harmful have been shown to improve test performance on a first college midterm (Brady, Hard, & Gross, 2018), and on the GRE (Jamieson, Mendes, Blackstock, & Schmader, 2010), and in both cases, benefits to performance lingered over time. Taken together, research on stress-mindset and anxiety-reappraisal interventions suggest that perception is predictive of responses to stress, and that perception can be manipulated to help people respond more adaptively to stressful situations.

Furthermore, there is also evidence to suggest that stress mindset influences overall health as well as performance. High stress is related to increased susceptibility to illness and earlier mortality (Cohen & Wills, 1985; Lantz et al., 2005; Matthews & Gump, 2002), but this relationship may be influenced by a person's beliefs about stress. A study examining the effects of perceptions of stress on health found that stress only negatively impacted those who believed it to be harmful (Keller et al., 2012). People experiencing high levels of stress *who also believed that stress was harmful* tended to have higher mortality rates, independent of the effect of high stress alone (Keller et al., 2012). Although this study did not look at stress mindsets specifically, its findings support the idea that perception of stress influences the relationship between stress and health.

Stress Mindsets in College

Prior work on the effects of stress mindsets has largely focused on adult participants in work contexts. However, the research described earlier on the benefits of anxiety reappraisal on exam performances suggest that undergraduate students may be a group for whom stress mindsets are especially relevant. Undergraduates report high levels of stress, and their stress is associated with negative outcomes, such as poor physical and mental health (Bolger, DeLongis, Kessler, & Schilling, 1989; McEwen, 2004). Yet stress is also an important part of the undergraduate experience, contributing to self-discovery and growth; it may be neither possible nor desirable to eliminate stress from undergraduate students' lives. Thus, understanding the role of stress mindsets in shaping undergraduate performance and well-being offers a promising avenue for investigation.

Recently, Keech, Hagger, O'Callaghan, and Hamilton (2018) examined links between stress mindsets, physical and mental health, and academic performance in undergraduate students. They found that undergraduates who hold a stress-is-enhancing mindset experience better physical and psychological well-being, as well as stronger academic performance, supporting the idea that beliefs about stress are relevant to health and performance in a college setting. Although this research confirms that stress mindset is related to performance and well-being in a college sample, many questions remain, and these define the goals of the present study.

Goals of the Present Study

A broad goal of the present study was to conceptually replicate Keech et al.'s (2018) findings in an independent sample of undergraduate students. We examined links between stress, stress mindsets, mental and physical health, and academic performance in two new samples of undergraduate students: one from a single, selective private university, and an online

sample representing students from a wide range of backgrounds. Specifically, we examined whether there was a relationship between stress and physical and mental health, and whether holding a stress-is-enhancing mindset served as a buffer against the effects of stress on health. Previous research suggests that stress and health will be negatively related, such that higher levels of stress will predict poorer health (Cohen & Wills, 1985). We predicted that stress mindset would moderate this relationship, such that students with a stress-is-debilitating mindset would show a stronger relationship between stress and health outcomes: participants perceiving stress to be harmful (holding a stress-is-debilitating mindset) would be more negatively impacted by it (having worse mental and physical health). In addition to this broad goal, we pursued three specific goals.

General vs. specific beliefs about stress. An important limitation of previous research on stress mindsets leads to our first goal. Previously, researchers have focused on beliefs about *stress in general* as enhancing versus debilitating, but have not considered possible variability in mindsets as a function of type of stress. Sources of stress vary considerably in a number of features, including whether they are viewed as controllable or uncontrollable (e.g., Lazarus & Folkman, 1984), and whether they are more time-limited (acute) or unfold over a longer period of time (chronic). Given the immense variability in the types of stressors people encounter, it is possible that their views about stress as enhancing versus debilitating also vary. For example, students preparing to take a final exam (an acute, controllable stressor) may be more likely to think of their stress as motivational and enhancing. But can the same be said of students experiencing chronic, uncontrollable stress? Students may be more likely to view stress as debilitating when thinking about a chronic uncontrollable stress, such as enrolling in a semester-long class in which students are randomly called upon to answer unpredictable questions.

In the current study, we examined students' beliefs about stress in general as enhancing versus debilitating, but also whether beliefs about stress varied as a function of the controllability and time scale of the stressor, focusing specifically on stressors from the academic domain. We hypothesized that students would view controllable stress as more enhancing than uncontrollable stress, and acute stress as more enhancing than chronic stress. If beliefs about stress do vary across categories, there may be limits to the power of interventions suggesting that stress can be enhancing across all situations. Stress is not a monolithic experience, and there may be little benefit to believing specific types of stress are enhancing. In addition to examining variability in beliefs about stress across different types of stressors, we also examined whether stressor-specific mindsets were as predictive as (or more predictive than) general stress mindsets of health and performance outcomes.

History of stressful life events as a potential explanatory variable. Another important gap in the literature is in the link between previous experience of stress, stress mindsets, and health. Previous research has consistently shown that higher levels of stress are predictive of poorer health (e.g., Cohen & Wills, 1985), and research on stress mindsets shows that people who have experienced more stressful life events tend to endorse a more stress-is-debilitating mindset (Crum et al., 2013). What is unclear from previous research is whether the link between stress mindsets and health may be partially explained by the fact that people who view stress as more debilitating also have had more exposure to stress. In the current study, our second goal was to examine whether the link between stress mindsets and health remains once history of stressful life events is taken into account.

Coping and perceived stress as potential mediators of the links between stress mindsets and health. The third goal of the present study was to evaluate two potential

mediators of the relationship between mindsets and health: coping strategies and perceived stress.

Keech and colleagues (2018) found the effect of mindsets on mental health was explained by differences in the amount of proactive behavior, assessed with items developed for their study such as “In the last month, how often did you engage in planning your time to cope with stress?” In our study, we examine whether this finding replicates using a composite of items from the Brief COPE scale (Carver, 1997) to represent approach coping. Prior research has found that stress-is-enhancing mindsets are associated with increased use of approach coping using the Brief COPE composite (Crum et al., 2013), and our study will build on this work by evaluating if this difference in coping explains the relationship between stress mindset and health.

Similarly, enhancing mindsets have previously been associated with lower perceived stress (Crum et al., 2013), and perceived stress is related to health (Cohen & Wills, 1985). As such, if stress mindsets are found to be predictive of health, we will examine if differences in perceived stress may explain this association.

To summarize, the goals of the present study were to: (a) replicate prior work suggesting that student mindset is related to academic performance and well-being, (b) expand the current understanding of stress mindsets by exploring whether or not mindsets vary across stressor type, looking at acute versus chronic stressors and chronic versus controllable stressors, (c) evaluate whether mindsets are predictive of health, and if this relationship holds even when controlling for history of experienced stressful life events (which are known to be related to worse health and viewing stress as debilitating), (d) evaluate whether or not mindsets moderate the effects of stress on health, and, finally, to (e) explore approach coping and perceived stress as potential mediators of relationship between stress and health.

Method

Participants and Procedure

Participants were 499 undergraduate students aged 18 to 60 (median age 19–20; 90% of participants were between 18 and 29) from the United States (U.S.) and Canada, recruited from two sources; first, a psychology participant pool at a mid-sized, selective private university in the southeastern U.S., and second, from a panel of college students registered on Amazon Mechanical Turk (MTurk). After providing consent, participants completed study measures online via Qualtrics; the study took approximately 20 minutes to complete. The study was approved by the Duke University Campus Institutional Review Board, and all data were collected between October and December 2018. The hypotheses and analysis plan for the study were preregistered on the Open Science Framework, available here: <https://osf.io/xrmkn/>.

Psychology participant pool sample. Participants ($n = 299$; 64.8% women; 47.6% White, 29.1% Asian/Asian American, 6.4% Black/African American, 3.7% Hispanic/Latino, 12.2% multiracial, 1.0% other race/ethnicity) were recruited via an online experiment sign-up program and received course credit for participating. Participants were between 18 and 24 years of age (51.7% freshman, 31.8% sophomores, 9.4% juniors, 7.4% seniors). Participants were excluded for demonstrated lack of care and for responding to open ended questions with random strings of letters ($n=1$). The final sample included 298 participant pool participants.

MTurk sample. MTurk is an online task-completion system that allows users to complete tasks, including psychological research studies, in exchange for Amazon credit. The study was administered via the online research platform TurkPrime (www.turkprime.com). Through TurkPrime's panels, the study was advertised only to potential participants who had previously indicated that they were current college students. Participants were paid \$2.20, and a

total of 199 participants completed the study. Consistent with pre-registered exclusion criteria, participants were excluded from the final sample if they had been out of college for more than two years ($n = 4$), completed less than 75% of the measures in the study ($n = 0$), or provided a nonsensical response to a picture description task designed to identify careless or non-human responding ($n = 0$). The final sample included 195 participants (59.1% women; 58.9% White/Caucasian, 6.3% Asian/Asian American, 14.1% Black/African American, 11.5% Hispanic/Latino, 8.9% multiracial, 0.5% other race/ethnicity). Participants were between 18 and 60 years of age (7.0% freshman, 26.9% sophomores, 25.8% juniors, 40.3% seniors).

Measures

General stress mindsets. A revised 3-item version of the 8-item General Stress Mindset scale (Crum et al., 2013) was administered assessing participants' views of stress as enhancing versus debilitating. Three items rather than eight items were selected for the current study to reduce survey length, given that participants would be responding to the items both for stress generally and also for specific stressors, as described in the next section. Participants responded to the three items (i.e., "Experiencing stress facilitates my learning and growth," "Experiencing stress debilitates my performance and productivity," and "The effects of stress are positive and should be utilized") on a 5-point scale (0 = *strongly disagree*, 4 = *strongly agree*). Higher scores on this measure indicate a more stress-is-enhancing mindset.

Specific stress mindsets. To assess beliefs about stress with regard to specific types of stressors, four hypothetical stressful situations were generated varying in time scale (more short-term, or acute, stressors, versus more long-term, or chronic, stressors) and controllability (more controllable versus more uncontrollable stressors). Table 1 includes the full text of each situation. The hypothetical stressors were generated based on a focus group discussion which

took place in spring of 2018 with eight undergraduate students at the same university as the psychology participant pool sample. In an attempt to avoid introducing additional sources of variability, and to ensure that situations would be relevant to undergraduate students from a variety of backgrounds, all of the hypothetical stressful situations were in the academic domain.

For each situation, participants responded to the three items administered in the general stress mindsets measure, revised with the term “this kind of stress” in place of “stress.”

Perceived stressfulness of hypothetical stressful situation. After responding to the specific stress mindsets items, participants were presented again with each hypothetical stressful situation and asked to indicate on a 5-point scale how stressful they perceived each of the situations depicted in the vignettes to be (*1 = not at all stressful, 5 = extremely stressful*).

Self-report of physical health. The Health-Related Quality of Life Scale (HRQOL) is a four-item measure created by the Centers for Disease Control and Prevention (2000) to measure the health domain of quality of life, and it has been validated in college populations (Zullig, 2005). In the current study, we use the item “Would you say that in general your health is excellent, very good, good, fair, or poor?” as an indicator of perceptions of overall health (with higher scores indicating poorer perceived health); and the item “During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?” as an indicator of how often poor physical and mental health interfered with normal activities (higher scores indicate more days on which health interfered with normal activities).

Mental health symptoms. To assess symptoms of mental health problems, participants completed three subscales of the Symptom Checklist–90 (Derogatis, 1994), assessing how much symptoms of depression (12 items), anxiety (10 items), and somatization (12 items) had bothered

them in the past month (0 = *not at all*, 4 = *extremely*). Internal reliability was high for depression ($\alpha = .93$), anxiety ($\alpha = .93$), and somatic symptoms ($\alpha = .92$). For the purposes of data reduction, a single composite mental health symptoms score was created that was the average of the mean score for each of the subscales, with higher scores indicating higher levels of depression, anxiety, and somatic symptoms. The internal reliability of this 34-item composite was high ($\alpha = .96$).

Number of experienced stressful life events. To measure number of experienced stressful life events, we used an adapted version of the Life Events Scale for Students (LESS; Clements & Turpin, 1996), which asks participants whether they have ever experienced a series of potentially stressful events. Several events from the original measure were excluded due to lack of relevance for this college sample (e.g., vacation with friends), and additional events were included that were considered relevant (e.g., experiencing a natural disaster). The adapted version of the measure included 28 events. Each item was weighted on a scale from 0 (not at all stressful) to 100 (extremely stressful) based on ratings from undergraduates made in previous research (Clements & Turpin, 1996; Linden, 1984). New events added to the measure were weighted by the authors with reference to existing weights. A weighted sum score was created for each participant, with higher scores indicating more experienced stressful life events. Findings were similar using the weighted and unweighted versions of the scale.

Perceived stress. To assess current levels of experienced stress, participants responded to the 10-item Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983). Participants responded to items (e.g., “In the past month, how often have you felt nervous and ‘stressed’?” “In the past month, how often have you felt that you were unable to control the important things in your life?”) on a 5-point scale (0 = *never*, 4 = *very often*) indicating how often they thought or

felt a certain way over the past month ($\alpha = .86$). A sum score was created, with higher scores indicating greater perceived stress.

Coping. Participants completed a 26-item version of the Brief COPE (Carver, 1997), assessing 13 potential responses to stressful events (i.e., active coping [$\alpha = .77$], planning [$\alpha = .74$], positive reframing [$\alpha = .76$], acceptance [$\alpha = .49$], humor [$\alpha = .85$], religion [$\alpha = .89$], seeking emotional support [$\alpha = .84$], seeking instrumental support [$\alpha = .85$], self-distraction [$\alpha = .54$], denial [$\alpha = .72$], venting [$\alpha = .67$], behavioral disengagement [$\alpha = .65$], self-blame [$\alpha = .81$]). Items related to substance use were excluded to avoid asking about illegal behaviors in participants who were underage.

Participants indicated the current most stressful thing in their lives, and then rated how much they were using each coping strategy in response to that source of stress (1 = *I haven't been doing this at all*, 5 = *I've been doing this a lot*). To reduce the number of coping scales, we followed the method of Crum et al. (2013) to create four composites reflecting approach coping (active coping, planning, positive reframing, and acceptance; $\alpha = .75$), social coping (seeking emotional support, seeking instrumental support, venting; $\alpha = .83$), distractive coping (humor, religion, self-distraction; $\alpha = .52$), and avoidant coping (denial, behavioral disengagement, self-blame $\alpha = .75$).

Academic performance. As a measure of academic performance, students were asked to self-report their cumulative undergraduate grade point average (GPA) on a four-point scale. Because data were collected before the end of the first semester of the academic year, first-year students were asked to estimate GPA to the best of their ability. For analyses including GPA, analyses were conducted with and without first-year students because their reports may have

been more inaccurate as at the time of the survey freshman had not yet completed a full semester of college.

Results

Zero-order correlations among study variables are presented in Table 2 (below the diagonal). As described in later sections, many key variables, including stress mindsets, perceived stress, history of stressful life events, mental and physical health, and GPA varied as a function of sample (psychology participant pool, mTurk) and, to a lesser extent, gender. Thus, sample and gender were included as control variables in all subsequent analyses. Partial correlations, partialling out the variance associated with sample and gender, are also included in Table 2 above the diagonal.

General versus Specific Stress Mindsets

Recall that a broad goal of this study was to replicate prior findings that stress mindsets may serve as a buffer of the link between stress and health. But first, it was important to examine the psychometric properties of the newly developed specific stress mindsets measures, and how they relate to the measure of general stress mindsets typically used in the field (Crum et al., 2013). Internal reliability for the three-item general stress mindset scale was adequate ($\alpha = .69$) but generally lower than is typically found for the 8-item General Stress Mindsets measure ($\alpha = .80$, Crum et al., 2013). With regard to the specific stress mindsets scales, internal reliability was similarly adequate, and strongest for the chronic uncontrollable situation (acute controllable $\alpha = .76$, chronic controllable $\alpha = .79$, acute uncontrollable $\alpha = .70$, chronic uncontrollable $\alpha = .83$). Correlations among the general and specific stress mindsets measures were very modest (r s ranging from .01 to .33, see Table 2), and in some cases non-significant, indicating that participants' mindsets did vary as a function of the features of stressful situations, and that views

about stress in general as enhancing or debilitating do not necessarily predict views about stress as enhancing versus debilitating in specific potentially stressful situations.

Using the stressfulness ratings participants provided for each of the hypothetical stressful situations, we examined whether mindsets were associated with the perceived stressfulness of each situation (see Table 3). We also examined the association between participants' stressfulness rating for their primary stressor and their general stress mindset. Overall, mindsets and stressfulness ratings were moderately negatively correlated, indicating that participants viewed stress as more enhancing in situations that they perceived to be less stressful. General and chronic controllable stress mindsets were related to how stressful participants reported their primary stressors, again with participants who endorsed more of a stress-is-enhancing mindset viewing their primary stressor as less stressful.

Views of stress as enhancing versus debilitating. The next step in our analyses was to examine students' overall views of stress as enhancing versus debilitating, and to examine whether views of stress varied as a function of time scale (acute versus chronic) and controllability (controllable versus uncontrollable; see Figure 1 for overall sample means for general and specific stress mindset measures). With regard to the first question, consistent with previous research (Crum et al., 2013; Keech et al., 2018; Park et al., 2017), students in our sample viewed stress in general as more debilitating than enhancing ($M = 1.90$, $SD = 0.82$, on a 0 to 4 scale).

Differences as a function of type of stressor. To examine whether stress mindsets varied as a function of stressor type, a multivariate analysis of variance (MANOVA) was conducted with time scale (acute versus chronic) and controllability (controllable versus uncontrollable) as within-subjects factors, and gender and sample as between-subjects factors, included as controls.

We found significant multivariate effects of time scale (Wilks' $\lambda = .961$, $F(1, 481) = 19.34$, $p < .001$, partial $\eta^2 = .037$) and controllability (Wilks' $\lambda = .531$, $F(1, 483) = 424.96$, $p < .001$, partial $\eta^2 = .468$). Consistent with expectations, participants rated uncontrollable stressors ($M = 1.52$, $SD = .91$) as more debilitating than controllable stressors ($M = 2.40$, $SD = .85$). However, in contrast to expectations, participants rated acute stressors ($M = 1.88$, $SD = .82$) as more debilitating than chronic stressors ($M = 2.04$, $SD = .95$). The effect of controllability was much larger than the effect of time scale, as indicated by the larger partial η^2 value.

The main effects of time scale and controllability were qualified by a significant multivariate interaction (Wilks' $\lambda = .989$, $F(1, 483) = 5.55$, $p = .019$, partial $\eta^2 = .011$). Simple effects tests indicated that acute stress was perceived as more debilitating than chronic stress for uncontrollable stressors (Wilks' $\lambda = .961$, $F(1, 483) = 19.33$, $p < .001$, partial $\eta^2 = .039$), but not for controllable stressors (Wilks' $\lambda = .994$, $F(1, 483) = 2.88$, $p = .091$, partial $\eta^2 = .006$). This interaction seemed driven by the rating of the acute uncontrollable situation (waiting for a test grade after you have completed the test) as especially debilitating ($M = 1.39$, $SD = .80$).

Differences as a function of gender and sample. To examine whether beliefs about stress varied as a function of gender and sample, a 2 (gender) x 2 (sample) MANOVA was conducted with gender and sample as between-subjects factors and the five stress mindsets measures as repeated measures (see Table 4A and 4B for means, standard deviations, F ratios, and effect sizes). Beliefs about stress varied by gender, with women viewing stress as more debilitating than men, both generally and for each of the specific stressors (Table 4A). Beliefs about stress also varied by sample (Table 4B), with the participant pool students reporting more enhancing general mindsets than MTurk students. Participant pool students viewed controllable

stressors as more enhancing than did MTurk students, but uncontrollable stressors as more debilitating.

Links between Stress, Stress Mindsets, and Physical and Mental Health

In this section, we examine links between stress (both history of stressful life events and current perceived stress), stress mindsets (both general and specific), and physical and mental health. Consistent with prior research (Rawson, Bloomer, & Kendall, 1994), zero-order and partial correlations (presented in Table 2) showed significant and sizeable associations between amount of stress (life events and perceived stress) and poorer physical and mental health. Also consistent with previous research (Crum et al., 2013; Keech et al., 2018), stress-is-debilitating mindsets were related to higher levels of perceived stress and to poorer health (links between stress mindsets and history of stressful life events are explored in more detail in a following section).

We understand that both levels of stress and viewing stress as more debilitating are each associated with poorer health. This next set of analyses examined whether stress mindsets moderate the link between stress and physical and mental health. Our hypothesis was that viewing stress as enhancing would buffer the negative effects of stress on health. To address these questions, we performed several sets of four-step hierarchical multiple regression analyses. In each set of analyses: (a) gender (with men coded as 0 and women coded as 1) and sample (with subject pool coded as 0 and MTurk coded as 1) were entered as control variables in the first step of the model, (b) the two mean-centered stress variables (history of stressful life events [weighted sum] and perceived stress) were entered in the second step of the model, (c) the mean-centered stress mindset variable was entered in the third step of the model, and (d) interaction terms between the stress mindset and each of the stress variables were included in the fourth step

of the model. To build a thorough understanding of the relationship between stress mindset and health, we estimated 15 separate models: we estimated a set of models for general stress mindset and each of the four specific stress mindsets, separately for each of the three health measures (mental health symptoms, general self-reported poor health, and number of days health interfered with normal activities). Results are summarized in Table 5.

With regard to main effects, history of stressful life events and perceived stress were each uniquely related to health measures after controlling for sample and gender. The two stress measures explained a significant proportion of variance in each outcome—48.3% of the variance in mental health symptoms, 24.6% of the variance in general self-reported poor health, and 22.2% of the variance in number of days health interfered with normal activities (Table 5). For stress mindsets, however, there were no significant main effects of general stress mindsets, acute controllable stress mindsets, acute uncontrollable stress mindsets, or chronic uncontrollable mindsets once sample, gender, and stress variables were taken into account. The only mindset for which there were significant main effects was the chronic controllable mindset, such that viewing stress as more enhancing in that situation was related to fewer days on which health interfered with normal activities, and marginally lower levels of mental health symptoms.

With regard to interaction effects, there was evidence that mindsets moderated the association between stress and health for some measures of health, but not others. When significant interaction effects were observed, they were probed using the Preacher, Curran, and Bauer (2006) online interaction utility. Simple slopes were calculated for participants at the 20th, 50th, and 80th percentile on the mindset variables. For ease of interpretation, a summary of model results is presented in Table 6, with a focus on significant interaction effects indicating moderation of stress effects by stress mindsets.

With respect to mental health symptoms, the relationship between stressful life events and health did not vary as a function of mindsets, but the relationship between perceived stress and health did. For all but acute controllable mindsets, the effect of perceived stress on mental health varied as a function of mindset. In each case of moderation, the effect of mindsets on health was significant at each level of mindset, but the effect was stronger for participants at the 20th percentile (i.e., for participants with more debilitating mindsets). However, enhancing mindsets did not fully buffer the effect of perceived stress on mental health (see Table 6 or Figures 2-3 for a summary of results).

With respect to general self-reported poor health, mindsets did not moderate the relationship between stress and health; the effect of stressful life events or perceived stress on self-reported general health did not vary as a function of mindset.

Finally, with respect to number of days health interfered with normal activity, there was no evidence of moderation for the link between perceived stress and number of days health interfered with normal activity. Mindset did, however, act as a moderator in the link between history of stressful life events and number of days health interfered with normal activity for general stress mindsets, chronic controllable stress mindsets, and chronic uncontrollable stress mindsets. Stress enhancing mindsets again acted to partially buffer participants from the effect of a history of stressful life events. The effect was significant for all levels of mindsets for chronic controllable mindsets, and significant for participants in the 20th and 50th percentile for general and acute uncontrollable mindsets (see Table 7 or Figures 4-6 for a summary of results).

Links between Stress Mindset and Academic Performance

To address the question of whether stress mindsets (both general and specific) are linked to academic performance, we examined zero-order and partial correlations between stress

mindsets and self-reported GPA (see Table 2). Based on previous research, we hypothesized that students who viewed stress as more enhancing would also report stronger academic performance. This hypothesis was supported for general mindsets, which were positively associated with GPA ($r = .31, p = .002$). In contrast, however, acute uncontrollable mindsets were negatively associated with GPA, such that believing acute uncontrollable stressors to be *debilitating* was related to better GPA ($r = -.12, p = .007$). Controlling for sample and gender, the relationship between mindset and GPA was marginally significant for general mindsets ($r = .10, p = .055$), and non-significant for acute uncontrollable stressors ($r = -.03, p = .565$).

When first-year students were removed from the analyses to remove possible unreliable reports of GPA; correlations between mindsets and GPA remained significant for general mindsets ($n = 315, r = .14, p = .016$), but were low and non-significant for specific mindsets (r s ranging from $-.08$ for acute uncontrollable stress mindset, to $.15$ for chronic uncontrollable mindsets).

History of Stressful Life Events as a Potential Explanatory Variable in the Link between Stress Mindsets and Health

Previous research has shown that participants who have experienced more stressful life events tend to view stress as more debilitating and also tend to have poorer health. To address the question of whether history of life events may serve as a potential explanatory variable in the link between mindsets and health we first examined correlations among history of stressful life events, stress mindsets, and health. Next, hierarchical multiple regression analyses were conducted to examine whether there would be a significant association between mindsets and health once history of stressful life events was taken into account.

Consistent with previous research, participants who had experienced more lifetime stress also reported poorer mental and physical health, even controlling for sample and gender (see Table 7). Also consistent with previous research, general stress mindsets were significantly associated with a history of stressful life events ($r = -.16, p < .001$; see Table 2), such that participants with more lifetime exposure to stress viewed stress as more debilitating. Associations between specific stress mindsets and history of stressful life events, however, were generally modest and non-significant. The only exception was specific mindset in the acute, uncontrollable situation, which was positively associated with history of stressful life events ($r = .14, p = .003$). Furthermore, once variance associated with sample and gender was partialled out, no significant associations remained between any of the stress mindset measures and history of stressful life events, suggesting that stressful life events were unlikely to act as an explanatory variable in the link between stress mindsets and health.

Still, to address our preregistered question of whether the link between stress mindsets and health remains once history of stressful life events is taken into account, a series of hierarchical multiple regression analyses was conducted; one predicting mental health symptoms, one predicting general self-reported poor health, and one predicting the number of days health interfered with normal activities. In each analysis: (a) gender and sample were entered as control variables in the first step of the model, (b) the stressful life events weighted sum score was entered in the second step of the model, and (c) the set of five stress mindset variables (general stress mindsets plus each of the four specific stress mindsets) was entered in the third step of the model. The five stress mindset variables are only moderately correlated with one another (r s ranging from .05 to .35), and multicollinearity diagnostics indicated no significant problems with multicollinearity, so the five mindsets variables were considered

simultaneously in a single step in these models. Results of these analyses are presented in Table 7.

Across the three models, stress mindsets as a group did predict health over and above the prediction of stressful life events, suggesting that history of stressful life events is not an explanatory variable in the link between stress mindsets and health. Stress mindset in the chronic, controllable stressful situation (having a quiz every class for which you feel you can adequately prepare) was the most pervasively related to health, such that an enhancing mindset was associated with better mental and physical health, controlling for history of stressful life events and the other mindsets. Stress mindset in the acute, controllable and acute, uncontrollable stressful situations were also significantly associated with health, but less pervasively so. A more enhancing mindset in the acute, controllable situation was related to lower mental health symptoms and marginally fewer days in which health interfered with normal activities, but not general self-reported health. A more enhancing mindset in the acute, uncontrollable situation was related to better overall perceived health, and lower mental health symptoms. Interestingly, general stress mindset was not uniquely associated with any of the health outcomes once the specific mindsets were taken into account. Across the three models, stress mindsets as a group accounted for between 4.0% and 7.7% of the variance in health measures.

Coping and Perceived Stress as Potential Mediators of the Link between Stress Mindset and Health

Our findings show that stress-is-enhancing mindsets are related to better health. Yet we also see that stress-is-enhancing mindsets are related to coping and perceived stress, two factors known to influence health. Do people who endorse more stress-is-enhancing mindsets also engage in more active coping in the face of stress, and in turn, experience better health?

Similarly, do people who believe stress to be *less* debilitating also perceive less distress in the face of stress, and in turn, experience better health? To address these exploratory questions, a set of mediational analyses using Hayes's (2013) PROCESS macro for SPSS 24.0 was conducted to calculate indirect effects of mindsets on health through coping and perceived stress. Indirect effect estimates were calculated with 95% bias-corrected bootstrap confidence intervals (with 10,000 resamples). It is important to emphasize that data for this study were collected at a single point in time and so we cannot examine the hypothesized temporal process whereby stress mindsets lead to more adaptive coping and/or decreased perceived stress, which in turn leads to better physical and mental health. We can only examine whether the statistical relations among these variables are consistent with such a hypothesized process, and, if they are, suggest that future research employ longitudinal and/or experimental methods to provide data that can more directly address questions of causality.

Mediation by coping. Keech et al. (2018) found that stress mindsets impacted health through proactive behavior, defined as engaging in more planning and less procrastination, most similar to the approach coping composite in our study. A summary of indirect effects of mindsets on mental and physical health through approach coping is presented in Table 8.

We observed inconsistent evidence for indirect effects of mindsets on health through approach coping. With regard to mental health symptoms, a significant indirect effect through approach coping was observed for acute controllable mindsets, but not for any others. With regard to general self-reported poor health, significant indirect effects of mindsets through approach coping were observed for acute controllable and chronic uncontrollable mindsets. Finally, with regard to number of days health interfered with normal activity, a significant

indirect effect through approach coping was observed for chronic uncontrollable mindsets, but not for any others.

Mediation by perceived stress. In contrast to the findings for approach coping, we found much more consistent evidence of indirect effects of mindsets on health through perceived stress (see Table 8). For effects on mental health symptoms, general self-reported poor health, and number of days health interfered with normal activity, significant indirect effects of mindsets through perceived stress were found for every mindset except chronic uncontrollable, suggesting that examining perceived stress as a mediator of the link between stress mindsets and health is likely a fruitful avenue for future research.

Discussion

The overarching goal of this research was to evaluate how stress mindsets relate to health and performance in an undergraduate sample, not just for stress in general, but also for beliefs about specific types of stress. To our knowledge, this is the first study to examine stress mindsets as a function of type of stress.

Our results confirmed that mindsets did vary as a function of stressor type, and that participants did view controllable stressors as more enhancing than uncontrollable stressors. Acute stressors, however, were not viewed as more enhancing than chronic stressors. To our knowledge, this is the first research to examine stress mindsets as a function of type of stress.

Second, our hypothesis that stress mindsets would moderate the relationship between stress and health was supported for some measures of health, but not others. Mindsets moderated the relationship between stress and health for mental health symptoms and the number of days health interfered with normal activity, but not for general self-reported health. Moderation also depended on type of stress (perceived stress versus history of stressful life

events) and was true for some mindsets, but not others. As hypothesized, when mindsets did moderate the relationship between stress and health, stress-is-enhancing mindsets were related to better mental and physical health with increasing stress, as compared to stress-is-debilitating mindsets. This suggests that a stress-is-enhancing mindsets can lessen the negative effects of stress on health.

Third, we found that stress mindsets were related to health over and above history of stressful life events. This finding suggests that the relationship between stress mindset and health cannot be explained by amount of previously experienced stress.

Understanding Beliefs About Stress: General versus Specific Beliefs

Mindsets vary across stressor type. Our findings broaden the understanding of stress mindset theory as outlined in previous research (Crum et al., 2013; Keller et al., 2012; Park et al., 2017). Prior work examined broad stress mindsets and assumed that mindsets about stress are stable across stressor type. Our work is the first to challenge this assumption. We found relatively weak correlations between general and specific stressor types, suggesting that stress mindsets are not uniform across different types of stressors. Consistent with our predictions, students viewed controllable stressors as more enhancing than uncontrollable stressors. This finding is consistent with the existing literature on stress: in terms of Lazarus and Folkman's (1984) description of stress response, stressors that people feel capable of handling are interpreted as "challenges" rather than "threats" and result in more productive stress responses (i.e., problem solving rather than avoidance). This finding also aligns with the discussion generated in a focus group conducted prior to beginning our study. Students in the focus group agreed that certain stressors could be enhancing: they thought controllable stressors, such as stress about an upcoming exam, may be enhancing because the stress motivates proactive

behavior (e.g., studying to reduce worries about getting a bad grade). In contrast, students found it hard to believe that stressors that were out of their control could be enhancing, and could not view uncontrollable stress as something to be harnessed. Although they could cope with uncontrollable stressors, there was nothing the students felt they could do to respond to the source of the stress. The stress thus could not enhance their performance, and they did not believe it could facilitate growth.

We did not find significant differences in beliefs about acute versus chronic stressors. This suggests that students' beliefs are shaped by the extent to which they can do something to respond to the stressor (e.g., studying), rather than the time-frame and pervasiveness of the stressor.

Not only did stress mindsets vary across stressor types, but some mindsets were more predictive of health than others. Our findings suggest that beliefs about controllable stressors may be more predictive of health and coping than beliefs about uncontrollable stressors. This finding makes intuitive sense: if beliefs influence behavior, beliefs about controllable stressors (stressors which can be alleviated with action) should impact behavior more than beliefs about uncontrollable stressors (stressors for which, beyond emotion-focused coping, there is not much one can do).

Future directions for investigating the nature of stress mindsets.

When is a stress is enhancing mindset truly helpful? The lack of observed relationship between beliefs about chronic uncontrollable stressors and health reflects some boundary conditions for when a stress-is-enhancing mindset can be helpful. It is possible, however, that the stress-mindset theory could be modified to broaden the picture of an enhancing mindset. Rather than thinking of stress as good because it “facilitates learning and growth” or can

“enhance performance and productivity” (items from the Stress Mindset Scale, Crum et al. (2013)), what if stress was thought of as a signal from your body? Just as people know to eat when they feel hungry, and sleep when they feel tired, might they also think to take a step back or engage in self-care when feeling stress? When dealing with an uncontrollable stressor, viewing stress as a signal, rather than something to “harness,” could perhaps be beneficial in motivating proactive behavior. Similarly, uncontrollable stress might be thought of as signaling importance and reflecting personal values. Focusing on what stress is telling you, rather than the experience of the stress itself, may be useful in reappraising stress as an adaptive response.

How do these findings extend to non-academic stressors and to other populations? It is also important to note that, because the present research focused on an undergraduate population, specific mindsets were assessed with academic vignettes. Whether our findings regarding mindsets for different kinds of stressors extend to thinking about non-academic stressors, and to non-student populations remains to be seen. Future research should extend the concept of stressor-specific mindsets to other populations and other types of stressors, to examine whether specific types of mindsets (e.g., mindsets for controllable versus uncontrollable stressors) seem to be particularly relevant for stress and health.

We also did not examine how beliefs about stress may vary between interpersonal and academic stressors. This may be an important differentiation to make; students may be able to view academic stress as enhancing and motivating, but not stress surrounding relationships with family and friends. More importantly, it remains unclear whether perceiving interpersonal stress as enhancing would have beneficial impacts on health and productivity. It seems interpersonal stressors are inherently less controllable than academic stressors, as they often depend on the actions of another, and thus these mindsets may have relationships to health and productivity

more similar to those observed with uncontrollable stress mindsets in the present study. On the other hand, perhaps interpersonal stressors could be viewed as motivating to engage in relationship maintenance and repair strategies, rather than withdrawal or relationship termination.

Another potential area of future research is non-undergraduate populations. The two student populations we surveyed varied significantly in both demographics and institution type, representing a broad range of typical students. Consistent with our understanding of the typical college experience, participants in our sample reported high levels of perceived stress, particularly the MTurk participants. Future research might examine how might mindsets influence the decisions people make about whether to approach or avoid stress, and what impact this has on their lives. Are these higher individuals sensation seeking? Neuroticism? A potential population to study might be those who have intentionally chosen to deal with high levels of stress professionally, for example, air-traffic controllers. Might they find stress exceptionally enhancing? If so, do their mindsets protect them from the negative impacts of health?

Would these findings replicate with a more robust Stress Mindset Scale? We surveyed participants on their beliefs about four different types of stress, in addition to stress in general. To avoid having participants respond to the same eight questions about five different categories of stress, we used a shortened-version, three-item stress mindset scale. The three-item stress-mindset scale had lower reliability than the previously validated eight-item scale (Crum et al., 2013), making it more difficult to find associations between variables. Future studies might continue use of the original 8-item scale, modifying it for specific mindsets. Presenting the same eight questions for general and specific mindsets may be repetitive for participants, but would

likely provide a more reliable measurement of stress mindsets and increase the likelihood of detecting true associations between variables.

Understanding the Consequences of Beliefs about Stress

Stress mindsets predicted health even when controlling for a history of stressful life events. As with prior work, we observed zero-order relationships between stress-mindset and health (Keech et al., 2018). Previous research has shown that greater exposure to stressful life events is associated with viewing stress as more debilitating (Crum et al., 2013). Given the prior relationship between stressful life events and stress mindset, we were interested in testing whether stress mindsets would predict health, even controlling for this factor. However, in the present sample, we found no significant association between a history of stressful life events and a stress-is-debilitating mindset when controlling for gender and sample. As such, the relationship between stress mindsets and health held when controlling for a history of stressful life events. These findings suggest that believing stress to be enhancing is related to fewer mental health symptoms, better self-reported health, and fewer days health interferes with normal activity.

Stress mindsets do predict perceived stress. In our sample, stress-is-enhancing mindsets were associated with lower perceived stress, and with ratings of how stressful participants found the specific stressor vignettes and their own primary sources of stress to be. This finding supports the notion that the more debilitating a particular stressor is believed to be, the more stressful the situation will seem. The relationship may, however, also work in reverse: people who have greater stress-reactivity may view stress as more debilitating as a result of perceived more stress. Future directions might include asking people to indicated their beliefs about stressors that vary, for example, on controllability, but are viewed as equally stressful.

Stress mindsets predict GPA and coping. We found significant relationships between GPA and mindset, such that believing general stress to be enhancing was related to a higher GPA. This supports recent work linking student performance and stress mindset and may be due to differences in test taking (Jamieson, Peters, Greenwood, & Altose, 2016) and procrastination (Keech et al., 2018). In line with previous work, we found that holding a stress-is-enhancing mindset was related to increased use of approach coping (Crum et al., 2013), which may suggest less procrastination, as found by Keech et al. (2018). Similarly, holding a stress-is-enhancing mindset may buffer students from exam anxiety, as has been suggested by anxiety-reappraisal interventions, and thus improve academic testing (Jamieson et al., 2016).

In contrast, a stress-is-debilitating mindset was related to higher GPA for acute uncontrollable stressors. This again supports the notion that the benefits of a stress-is-enhancing mindset may be limited to thinking about specific stressor types and suggests that viewing stress as debilitating may actually be beneficial in some cases, and encourage not focusing on the stressor. Trying to actively cope with an acute uncontrollable stressor (i.e., waiting for a test grade), may result in excessive effort and worry (for example, trying to guess the awaited test grade). In contrast, the relationship may be explained by people who viewed waiting for a test grade as more debilitating also being more invested in their academic performance and thus putting more effort into maintaining a high GPA. Additionally, the GPA measured here was self-reported, which is likely not as accurate as GPA from institutional records. More research is needed to evaluate how stressor-specific mindsets are related to students' academic success, what role coping plays in this relationship, and whether stress-mindset-interventions might help improve test scores and prevent procrastination.

Chronic controllable stress mindsets are most predictive of health. Overall, the chronic controllable mindset was most pervasively related to health measures in our study. This type of stress was exemplified by the situation of having a quiz every class (chronic) for which one could prepare (controllable). General and controllable mindsets showed greater correlations to measures of health, coping, and perceived stress than uncontrollable mindsets. These findings suggest that adopting a stress-is-enhancing mindset may be beneficial for some types of stress, but not others. When it comes to controllable stress (stress something can be done about), adopting a more enhancing mindset may allow for more productive coping, less perceived stress, and fewer impacts on physical and mental health.

Understanding that some mindsets are more predictive of health than others is an important step in developing population-relevant stress-mindset interventions. Beliefs about chronic controllable stressors were most pervasively related to health, in our sample, and these stressors are especially pervasive in college, with midterms and then finals, papers, group projects, job interviews, etc. Although these stressors are semester-limited, they reflect chronic controllable stressors as measured in our study, with the example of having a quiz every class, all semester long. Interventions targeted toward these specific mindsets may help students harness their stress productively and healthily.

There are many exciting potential responses to this research. One simple step is for professors to provide mini “stress-mindset-interventions” by telling students that their stress during in-class-exams will not hurt them. Similar of the work of Jamieson et al. (2016), professors could provide this information in exam instructions, and hopefully mitigate the negative effects of test-taking anxiety. Another potential direction is to modify existing video interventions, developed by Crum et al (2013) to be specific to a college environment. This

intervention might focus on controllable stressors, such as studying for exams and writing final papers, and emphasize how students can view their stress as motivation to engage in proactive behavior (e.g., starting the paper earlier).

An important limitation of these findings is that all measures of health in the present study were self-reported, which are subject to bias, and ideally health would be measured more objectively, perhaps through susceptibility to the common cold (Cohen & Wills, 1985) or through the presence or absence of particular conditions, such as hypertension. Similarly, amount of experienced stress could be measured through cortisol response rather than reported perceived stress. Crum et. al (2013) found that stress mindsets were related to cortisol response, such that stress-mindset interventions lowered cortisol response for individuals with high cortisol reactivity to stress, and raised it for those with low response. As perceived stress mediated the relationship between mindsets and health, and mindsets interacted with perceived stress to influence health, future research might evaluate if changes in cortisol play a similar role to perceived stress in mediating and/or moderation the relationship between mindset and health.

Additionally, our measure of number of days health interfered had a lower response rate than the other measures. We suspect this is due to a survey design flaw: the question was presented with a slider, ranging from 0 to 30 days (during the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?). It appeared that the slider was set at zero until participants moved it. It is possible that participants who intended to respond “0 days” may have not touched the slider and thus been counted as not responding. If this measure is included in future studies, it should instead perhaps be presented with a drop down option of responses, or additional instructions to ensure that participants clicked on the slider if they intended to give a response of zero.

Understanding How Beliefs Shape the Consequences of Stress

One of the guiding motivations of this research was to better understand how beliefs about stress influence health. As with prior research, we found that stress-is-enhancing mindsets were related to better reported mental and physical health (Crum et al., 2013; Keech et al., 2018). We extended the understanding of previous work by evaluating the potential mechanisms through which mindset may influence health.

Stress mindsets moderate the effect of stress on health. Prior work suggests that mindsets act as a buffer to experienced stress, with those with stress-is-enhancing mindsets experiencing less distress with increasing adversity (Park et al., 2017). This study examined stress mindsets as a moderator between the relationship between stress and health. Our findings suggest that stress has less of an impact on health for those who believe stress to be enhancing. In other words, if two people are experiencing the same level of perceived stress, those with a stress-is-debilitating mindset will experience a greater increase in symptoms of poor mental health, as compared to a person with a stress-is-enhancing mindset at the same level of stress. Similarly, if two people have experienced a similar amount of lifetime stress, the history of stressful events will take a greater toll on the person who believes stress to be more debilitating.

It is important to note that our research found no moderation for general self-reported health, but did for number of days health interfered with normal activities. Additionally, mindset interacted with different measures of stress depending on the health outcome. For the effect of stress on number of days health interfered, mindset only interacted with stressful life events; yet, for the effect of stress on mental health, mindset only interacted with perceived stress. It may be that accrued life history of stress is more likely to have an effect on physical health because it is a longer-term outcome, and stressful events have had a longer time to impact physical health

than current levels of perceived stress. In contrast, current perceived stress by more reasonably relate to current mental health symptoms.

Perceived stress and coping play some mediating role. Prior work suggests that general stress mindsets influence health through coping, such that people with more enhancing mindsets are more likely to engage in active coping, which in turn is predictive of better health (Keech et al., 2018). For the most part, we did not observe this in our sample. Although there were few cases of mediation, we observed more direct effects of mindset on health than indirect effects through coping. This varies somewhat from the work of (Keech et al., 2018), which found complete mediation. Keech et al. (2018) used a measure of “proactive behavior” which asked specifically about procrastination and planning. It may be that their measure is more reflective of coping measured by the subscale of “planning,” rather than the composite of approach coping which we used. Our composite also includes items of acceptance and reframing, which seem less related to their measure.

We also examined mediation through perceived stress, and found that perceived stress mediated the relationship between mindset and all three variables of health, for all but chronic uncontrollable mindsets (which overall showed little effect on health). These findings suggest that stress mindsets may act to influence health through changes in perceived stress, with stress-is-debilitating mindsets perhaps increasing levels of perceived stress and leading to poorer mental and physical health. One future avenue of research might evaluate how stress-is-debilitating mindsets are increasing perceived stress. Are people with strong stress-is-enhancing mindsets less in-tune to their physical responses to stress (increasing heart rate, palms sweating, etc.), leading to lower perceived stress? Or is their physical response actually lessened? Crum et al. (2013) found that experimentally encouraging stress-is-enhancing mindsets lead to more

adaptive cortisol responses to a stressor task, suggesting that differences are occurring on the level of the sympathetic nervous system. Stress response can be uncomfortable, and if people experience fewer of these symptoms when stressed, it makes sense that they would view stress as less debilitating.

Conclusion

We found that beliefs about stress vary as a function of stressor type (acute versus chronic, and controllable versus uncontrollable), and that beliefs about controllable stress may be more predictive of health than beliefs about uncontrollable stressors. Believing that controllable stress is enhancing rather than debilitating appears to provide a psychological “buffer” against the negative effects of stress.

Our work suggests that interventions which encourage students to think about their stress as enhancing may be useful in student populations, improving both health and productivity. Stress-mindset (Crum et al., 2013) and anxiety reappraisal interventions (Jamieson et al., 2016) have shown success in improving work and testing performance, respectively. Our findings suggest that these interventions may also buffer students from the negative impacts of stress on health, especially if the interventions are stressor specific, rather than targeted to general stress. Our findings also suggest that these interventions may be of limited effectiveness for students dealing with chronic, uncontrollable stress, because viewing stress as enhancing in these situations seems to be relatively unrelated to health and does not appear to act as a buffer of the link between stress and health. Developing stressor-specific interventions may increase the effectiveness of intervention by improving believability and targeting stressors which are more pervasively related to health. These interventions are an important next step for research, with

the potential to help students more healthfully and productively face the stress integral to their college experience.

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Table 1

Specific Stress Mindset Hypothetical Situations for Acute Controllable, Chronic Controllable, Acute Uncontrollable, and Chronic Uncontrollable Mindsets

	Controllable	Uncontrollable
Acute	One type of potentially stressful experience is <i>acute</i> and <i>controllable</i> . This is a short-term experience for which you can in some way prepare. For example, imagine having to give a class presentation that you are really dreading. You may experience stress over the days leading up to the presentation. However, you know the date of the presentation, and you know what the requirements are to do well.	One type of potentially stressful experience is <i>acute</i> and <i>uncontrollable</i> . This is a short-term experience which you cannot prepare for or do anything about. For example, imagine waiting to find out how you did on an important exam/assignment. You may feel stressed awaiting your score, which should arrive in just a few days. There is nothing you can do at this point to change your score or to determine when it will be released; all you can do is wait.
Chronic	One type of potentially stressful experience is <i>chronic</i> and <i>controllable</i> . This is a long-term experience for which you can in some way prepare. For example, imagine taking a class that has a difficult quiz at the beginning of every class period. You may experience stress about these quizzes each week, all semester. The quizzes are challenging, but you know what they will cover.	One type of potentially stressful experience is <i>chronic</i> and <i>uncontrollable</i> . This is a long-term experience for which you can not prepare. For example, imagine taking a class in which the instructor practices the Socratic method (where students are called on by the professor and asked a series of difficult, probing questions to assess their understanding and assumptions). You may experience stress fearing you will be called on each class, all semester. You have no idea when you will be called on, and because of the difficult and unpredictable nature of the questions it is difficult to adequately prepare beforehand.

Table 2
Zero-Order and Partial (Controlling for Gender and Sample) Correlations among Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Gender	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2. Sample	-.06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3. SM-G	-.11*	-.30***	—	.37***	.33***	.21***	.29***	-.22***	-.03	-.19***	-.12*	-.07	.20***	-.01	.10*	-.08	.10
4. SMS-AC	.03	-.09	.33***	—	.27***	.01	.09	-.13*	.03	-.14**	-.06	-.09	.20***	.05	.04	-.08	-.04
5. SMS-CC	-.10*	-.04	.33***	.25***	—	.15**	.19***	-.21***	-.05	-.20***	-.15**	-.18*	.21***	.01	-.01	-.21***	-.05
6. SMS-AU	.01	.23***	.09	.01	.10*	—	.06	-.18**	.06	-.16**	-.12*	-.03	.21***	-.03	.09	.00	-.03
7. SMS-CU	-.15**	-.03	.27**	.05	.19***	.05	—	-.06	.04	-.04	-.04	.06	.15*	.15**	.13**	.04	.00
8. Perceived Stress	.14**	.12**	-.24***	-.16**	-.23***	-.14**	-.08	—	.27***	.70***	.50***	.46***	-.14**	.15**	.14*	.59***	-.20***
9. Stressful Life Events-Weighted	.01	.45***	-.16***	-.02	-.06	.14**	.01	.30**	—	.35***	.28***	.27**	.12*	.07	.10*	.13**	-.13**
10. Mental Health Composite	-.18**	-.21***	-.25***	-.17***	-.24***	-.10*	-.08	.72**	.40***	—	.38***	.50***	-.11*	.12*	.14**	.51***	-.10*
11. Self-Reported Health	.10*	.22***	-.18***	-.09	-.16***	-.08	-.05	.52***	.32***	.46**	—	.40***	-.09	.05	.00	.28***	-.09
12. Days health interfered	.13**	.14**	-.13**	-.12**	-.20***	.00	.01	.48***	.31***	-.54***	.43***	—	-.03	.17**	.16**	.36***	-.10
13. Approach Coping	-.04	.02	.19***	.19***	.20***	.18***	.13**	-.14**	.11*	-.12**	-.11*	-.05	—	.35***	.32***	-.13*	-.09
14. Social Coping	.16**	-.10	-.02	.03	-.02	-.06	.12**	.16***	.04	.14**	.04	.15**	.32***	—	.36***	.22**	-.04
15. Distractive coping	.02	-.07*	.12**	.03	.01	.05	.14**	-.11*	.05	.11*	-.04	-.12*	.30***	.35***	—	.30***	-.13**
16. Avoidant coping	.12*	.06	-.10*	-.09	-.21***	-.01	.04	.59***	.16***	.53***	.31***	.37**	-.15**	.22***	.27***	—	-.21***
17. GPA	.12*	-.31***	.14**	-.01	-.03	-.12**	.01	-.19***	-.22***	-.14**	-.14**	-.11*	-.10*	.02	-.08	-.19***	—

Note. Correlations presented below the diagonal are zero-order correlations; correlations presented above the diagonal are partial correlations partialling out gender (0 = men, 1 = women) and sample (0 = psychology participant pool, 1 = Amazon Mechanical Turk). Table abbreviations are as follows: SM-G = Stress Mindsets Scale-General, SMS-AC = Specific Stress Mindsets Scale – Acute Controllable situation, SMS-CC = Specific Stress Mindsets Scale – Chronic Controllable situation, SMS-AU = Specific Stress Mindsets Scale – Acute Uncontrollable situation, SMS-CU = Specific Stress Mindsets Scale – Chronic Uncontrollable situation * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 3

Correlations among Stress Mindsets and Stressfulness Ratings

	1	2	3	4	5	6	7	8	9	10
Mean	1.90	2.37	2.42	1.39	1.65	5.79	3.41	3.09	3.19	4.06
(SD)	(.81)	(.83)	(.87)	(.80)	(1.03)	(1.14)	(1.08)	(1.09)	(1.20)	(1.05)
1. General Stress Mindset	—									
2. Specific Stress Mindset – Acute Controllable	.33***	—								
3. Specific Stress Mindset – Chronic Controllable	.33***	.25***	—							
4. Specific Stress Mindset – Acute Uncontrollable	.09*	.01	.11*	—						
5. Specific Stress Mindset – Chronic Uncontrollable	.27***	.05	.19***	.05	—					
6. Stressfulness Rating – Primary Stressor	-.12**	-.06	-.13**	-.04	.00	—				
7. Stressfulness Rating – Acute Controllable	-.08	-.28***	-.07	.01	-.07	.17***	—			
8. Stressfulness Rating – Chronic Controllable	-.09	-.04	-.32***	.01	-.10*	.23***	.10*	—		
9. Stressfulness Rating – Acute Uncontrollable	-.05	-.02	-.05	-.22***	.05	.21***	-.03	.07	—	
10. Stressfulness Rating – Chronic Uncontrollable	-.14**	.05	-.05	.01	-.46***	.08	.25***	.19***	.01	—

Note. Stressfulness ratings are on a 5-point scale (1 = *not at all stressful*, 5 = *extremely stressful*); for the primary stressor, participants listed the current most stressful thing in their life and rated its' stressfulness; for the specific stress mindsets situations, participants rated the perceived stressfulness of each situation after they had provided all the mindset ratings. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 4A

Gender Differences in Stress Mindsets, Perceived Stress, Stressful Life Events, Coping, and Mental and Physical Health

	Wilks' λ	Men		Women		<i>F</i>	<i>d</i>
		Mean (<i>SD</i>)					
<i>Stress Mindsets</i>	.963					(5,478) 4.49**	
General		2.02 (.82)		1.83 (.81)		8.41**	.24
Acute Controllable		2.34 (.86)		2.39 (.82)		.08	-.08
Chronic Controllable		2.53 (.83)		2.36 (.89)		7.37**	.22
Acute Uncontrollable		1.38 (.88)		1.40 (.76)		.08	-.03
Chronic Uncontrollable		1.85 (1.05)		1.53 (.99)		12.28***	.32
<i>Stress</i>	.977					(2,482) 4.21**	
Perceived Stress		18.95 (7.30)		20.98 (7.39)		11.59**	-.28
Stressful Life Events		549.84 (320.18)		558.18 (300.93)		1.15	-.03
<i>Coping</i>	.965					(4,468) 4.21**	
Approach Coping		7.60 (1.34)		7.50 (1.30)		.63	.07
Social Coping		6.01 (1.87)		6.61 (1.86)		10.14**	-.32
Distractive Coping		5.69 (1.46)		5.79 (1.49)		.87	.35
Avoidant Coping		4.21 (1.46)		54.59 (1.65)		7.49**	-.24
<i>Health</i>	.956					(3, 426) 6.52	
Mental Health Symptoms		1.07 (.72)		1.38 (.85)		18.02***	-.39
Self-Reported Poor Health		2.44 (1.00)		2.64 (.98)		5.87*	-.21
Number of Days Health Interfered		5.33 (5.86)		7.02 (6.69)		9.84**	-.27

Note. Results are from four multivariate analyses of variance examining differences in study variables as a function of gender and sample (for group differences by sample see Table 4B). Positive effect sizes indicate that the men were higher on a particular variable, negative effect sizes indicate that the women sample was higher on a particular variable. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 4B

Sample Differences in Mindsets, Perceived Stress, Stressful Life Events, Coping, and Mental and Physical Health

	Wilks' λ	Participant Pool		<i>F</i>	<i>d</i>
		Sample	MTurk Sample		
		Mean (<i>SD</i>)			
<i>Mindsets</i>	.834			(5,476) 18.74***	
General		2.10 (.75)	1.60 (.82)	47.01***	.64
Acute Controllable		2.42 (.78)	2.30 (.90)	1.36	.14
Chronic Controllable		2.46 (.82)	2.38 (.94)	.09	.34
Acute Uncontrollable		1.24 (.71)	1.61 (.089)	28.26***	-.47
Chronic Uncontrollable		1.68 (1.01)	1.61 (1.05)	.067	.05
<i>Stress Measures</i>	.816			(2,482) 55.10**	
Perceived Stress		19.51 (7.15)	21.32 (7.70)	5.42*	-.25
Stressful Life Events		445.76 (213.92)	727.02 (354.84)	108.92***	-1.01
<i>Coping</i>	.980			(4, 468) 2.45*	
Approach Coping		7.52 (1.21)	7.58 (1.47)	.66	-.08
Social Coping		6.52 (1.79)	6.15 (2.02)	2.63	.18
Distractive Coping		5.82 (1.41)	5.65 (1.58)	2.33	.12
Avoidant Coping		4.40 (1.55)	4.53 (1.64)	.59	-.08
<i>Health</i>	.972			(3, 426) 4.05	
Mental Health Composite		1.16 (.73)	1.41 (.91)	8.57**	-.31
Self-Reported Health Number of Days Health Interfered		2.43 (.97)	2.74 (.10)	8.30**	-.32
		5.66 (5.869)	7.33 (7.20)	4.12*	-.27

Note. Results are from four multivariate analyses of variance examining differences in study variables as a function of gender and sample (for group differences by gender see Table 4A). Positive effect sizes indicate that the participant pool sample was higher on a particular variable, negative effect sizes indicate that the MTurk sample was higher on a particular variable. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 5

Hierarchical Multiple Regression Analyses Predicting Health Measures from History of Stressful Life Events, Perceived Stress, and General Stress Mindset

Predictor	Mental Health Symptoms			General Health			Number of Days Health Interfered with Activities		
	ΔR^2	<i>b</i> (<i>se</i>)	<i>sr</i> ²	ΔR^2	<i>b</i> (<i>se</i>)	<i>sr</i> ²	ΔR^2	<i>b</i> (<i>se</i>)	<i>sr</i> ²
Step 1	.076**			.056***			.034**		
Control variables ^a									
Step 2	.483***			.246***			.222***		
Stressful life events (weighted)		.000 (.000)***	.020		.000 (.00)***	.014		.003 (001)**	.020
Perceived stress		-.07 (.00)***	.382		.06 (.01)***	.187		.37 (.04)***	.151
Step 3A and 4A: General Stress Mindset									
Step 3A	.002			.000			.000		
Stress mindset (general)		-.05 (.03)	.002		-.03 (.05)	.001		.17 (.36)	.000
Step 4A	.07*			.000			.017**		
Life events x mindset		.000 (.000)	.003		.000 (.000)	.000		-.003 (.001)**	.015
Perceived stress x mindset		-.01 (.00)**	.007		.01 (.01)	.006		.08 (.05)	.005
Adjusted <i>R</i> ²		.561***			.294***			.261***	
Step 3B and 4B: Specific Stress Mindset – Acute Controllable									
Step 3B	.004			.000			.002		
Stress mindset (acute controllable)		-.06 (.03)*	.003		.00 (.05)	.000		-.35 (.33)	.002

Predictor	Mental Health Symptoms			General Health			Number of Days Health Interfered with Activities		
	ΔR^2	<i>b</i> (<i>se</i>)	<i>sr</i> ²	ΔR^2	<i>b</i> (<i>se</i>)	<i>sr</i> ²	ΔR^2	<i>b</i> (<i>se</i>)	<i>sr</i> ²
Step 4B	.000			.000			.003		
Life events x mindset		.000(.000)	.001		.000 (.000)	.000		-.001 (.001)	.002
Perceived stress x mindset		.00(.00)	.000		.00 (.01)	.000		.04 (.04)	.002
Adjusted <i>R</i> ²		.556***			.295***			.249***	
Step 3C and 4C: Specific Stress Mindset – Acute Uncontrollable									
Step 3C	.003			.004			.001		
Stress mindset (acute uncontrollable)		-.06 (.03)	.003		-.08 (.05)	.004		.31 (.35)	.001
Step 4C	.009**			.002			.009		
Life events x mindset		.000 (.000)	.001		.000 (.000)	.000		-.002 (.001)*	.009
Perceived stress x mindset		.01 (.00)**	.010		.01(.01)	.002		.02 (.04)	.000
Adjusted <i>R</i> ²		.565***			.300***			.256***	
Step 3D and 4D: Specific Stress Mindset – Chronic Controllable									
Step 3D	.004*			.002			.008*		
Stress mindset (chronic controllable)		-.06 (.03)*	.003		-.05 (.05)	.002		-.65 (.31)*	.007
Step 4D	.001			.003			.022*		
Life events x mindset		.000 (.000)	.000		.000 (.000)	.002		-.003 (.001)**	.019

Predictor	Mental Health Symptoms			General Health			Number of Days Health Interfered with Activities		
	ΔR^2	$b (se)$	sr^2	ΔR^2	$b (se)$	sr^2	ΔR^2	$b (se)$	sr^2
Perceived stress x mindset		.00 (.00)	.000		.00 (.01)	.000		-.02 (.04)	.000
Adjusted R^2		.558***			.297***			.273***	
Step 3E and 4E: Specific Stress Mindset – Chronic Uncontrollable									
Step 3E	.000			.000			.003		
Stress mindset (chronic uncontrollable)		-.01 (.03)	.000		-.02(.04)	.000		.37 (.27)	.003
Step 4E	.000			.003			.006		
Life events x mindset		.000 (.000)	.000		.000 (.000)	.003		.000 (.001)	.000
Perceived stress x mindset		.00 (.00)	.000		.00 (.01)	.000		-.07 (.04)	.005
Adjusted R^2		.553***			.297***			.253***	

Note. Each column represents a separate hierarchical multiple regression analysis, with the dependent variable listed in the column header. ^a control variables are gender (0 = men, 1 = women) and sample (0 = psychology participant pool, 1 = Amazon Mechanical Turk). sr^2 = squared semi-partial correlation. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 6

Simple Intercepts and Simple Slopes for Significant Interaction Effects Between Perceived Stress and Stress Mindsets Predicting Mental Health and Days Health Interfered with Normal Activity

	More Debilitating Mindset (20 th percentile)		Average Mindset (50 th percentile)		More Enhancing Mindset (80 th percentile)	
	Simple Intercept	Simple Slope	Simple Intercept	Simple Slope	Simple Intercept	Simple Slope
<i>Predicting Mental Health Symptoms</i>						
Moderated by General Mindset	1.08 (.11)	.08 (.01)	1.03 (.09)	.07 (.01)	.99 (.09)	.06 (.01)
Moderated by Acute Uncontrollable Mindset	.99 (.90)	(.08) (.00)	.94 (.09)	.07 (.00)	.89 (.10)	.06 (.01)
<i>Predicting Days Health Interfered with Normal Activity</i>						
Moderated by General Mindset	4.24 (.1.15)	.01 (.00)	4.48 (1.01)	.003 (.00)	4.65 (.98)	.00 (.00) ^{ns}
Moderated by Acute Uncontrollable Mindset	5.09 (.98)	.01 (.00)	5.36 (1.00)	.00 (.00)	5.64 (1.07)	.00 (.00)
Moderated by Chronic Controllable Mindset	5.19 (1.01)	.01 (.00)	4.76 (.96)	.00 (.00)	4.62 (.97)	.00 (.00) ^{ns}

Note. The superscript *ns* indicates that the simple slope was not significantly different from zero; all other simple intercepts and simple slopes are significantly different from zero at $p < .05$.

Table 7

Hierarchical Multiple Regression Analyses Predicting Health Measures from History of Stressful Life Events and Stress Mindset

Predictors	Mental Health Symptoms			General Health			Number of Days Health Interfered with Activities		
	ΔR^2	<i>b</i> (<i>se</i>)	<i>sr</i> ²	ΔR^2	<i>b</i> (<i>se</i>)	<i>sr</i> ²	ΔR^2	<i>b</i> (<i>se</i>)	<i>sr</i> ²
Step 1	.074^{***}			.055^{***}			.033^{**}		
Control variables ^a									
Step 2	.109^{***}			.062^{***}			.067^{***}		
Stressful life events (weighted)		.001 (.000) ^{***}	.102		.001 (.000) ^{***}	.063		.006 (001) ^{***}	.069
Step 3: Mindsets	.077^{***}			.039^{**}			.040^{**}		
General		-.07 (.05)	.003		-.05 (.06)	.001		-.06 (.44)	.000
Acute Controllable		-.09 (.04) [*]	.007		-.02 (.06)	.000		-.41 (.39)	.002
Chronic Controllable		-.12 (.04) ^{**}	.015		-.12 (.05) [*]	.008		-1.25 (.36) ^{**}	.003
Acute Uncontrollable		-.15 (.04) ^{**}	.020		-.16 (.06) ^{**}	.015		-.16 (.39)	.000
Chronic Uncontrollable		.00 (.03)	.000		-.01 (.04)	.000		.44 (.31)	.004
Adjusted <i>R</i> ²		.254 ^{***}			.141 ^{**}			.123 ^{***}	

Note. Each column represents a separate hierarchical multiple regression analysis, with the dependent variable listed in the column header. ^a control variables are gender (0 = men, 1 = women) and sample (0 = psychology participant pool, 1 = Amazon Mechanical Turk). *sr*² = squared semi-partial correlation. * *p* < .05, ** *p* < .01, *** *p* < .001.

Table 8

Indirect Effects of Stress Mindsets on Health through Approach Coping and Perceived Stress

	Mental Health Symptoms	General Self-Reported Health	Number of Days Health Interfered
	Point Estimate (95% CI)	Point Estimate (95% CI)	Point Estimate (95% CI)
<i>Indirect effects of mindset on health through approach coping</i>			
General	-0.017 (-.042, .004)	-0.022 (-.052, .001)	-0.031 (-.201, .135)
Acute Controllable	-0.134 (-.218, -.050)	-0.022 (-.050, -.001)	-0.025 (-.175, .137)
Acute Uncontrollable	-0.016 (-.04, .003)	-0.019 (-.045, .002)	-0.053 (-.225, .128)
Chronic Controllable	-0.013 (-.035, .005)	-0.018 (-.045, .004)	.012 (-.146, .191)
Chronic Uncontrollable	-0.011 (-.028, -.000)	-0.013 (-.032, -.000)	-0.037 (-.142, .063)
<i>Indirect effects of mindset on health through perceived stress</i>			
General	-0.138 (-.203, -.074)	-0.121 (-.178, -.065)	-0.832 (-1.264, -.453)
Acute Controllable	-0.098 (-.161, -.034)	-0.087 (-.142, -.030)	-0.480 (-.851, -.115)
Acute Uncontrollable	-0.121 (-.187, -.056)	-0.106 (-.166, -.049)	-0.687 (-1.095, -.302)
Chronic Controllable	-0.138 (-.193, -.084)	-0.120 (-.174, -.071)	-0.728 (-1.068, -.424)
Chronic Uncontrollable	-0.034 (-.085, .061)	-0.030 (-.074, .014)	-0.186 (-.477, .096)

Note. Confidence intervals are 95% bias-corrected bootstrap confidence intervals with 10,000 resamples calculated using Hayes's (2013) PROCESS macro for SPSS (v 24); indirect effects are significantly different from zero when the associated confidence interval does not contain zero (bold).

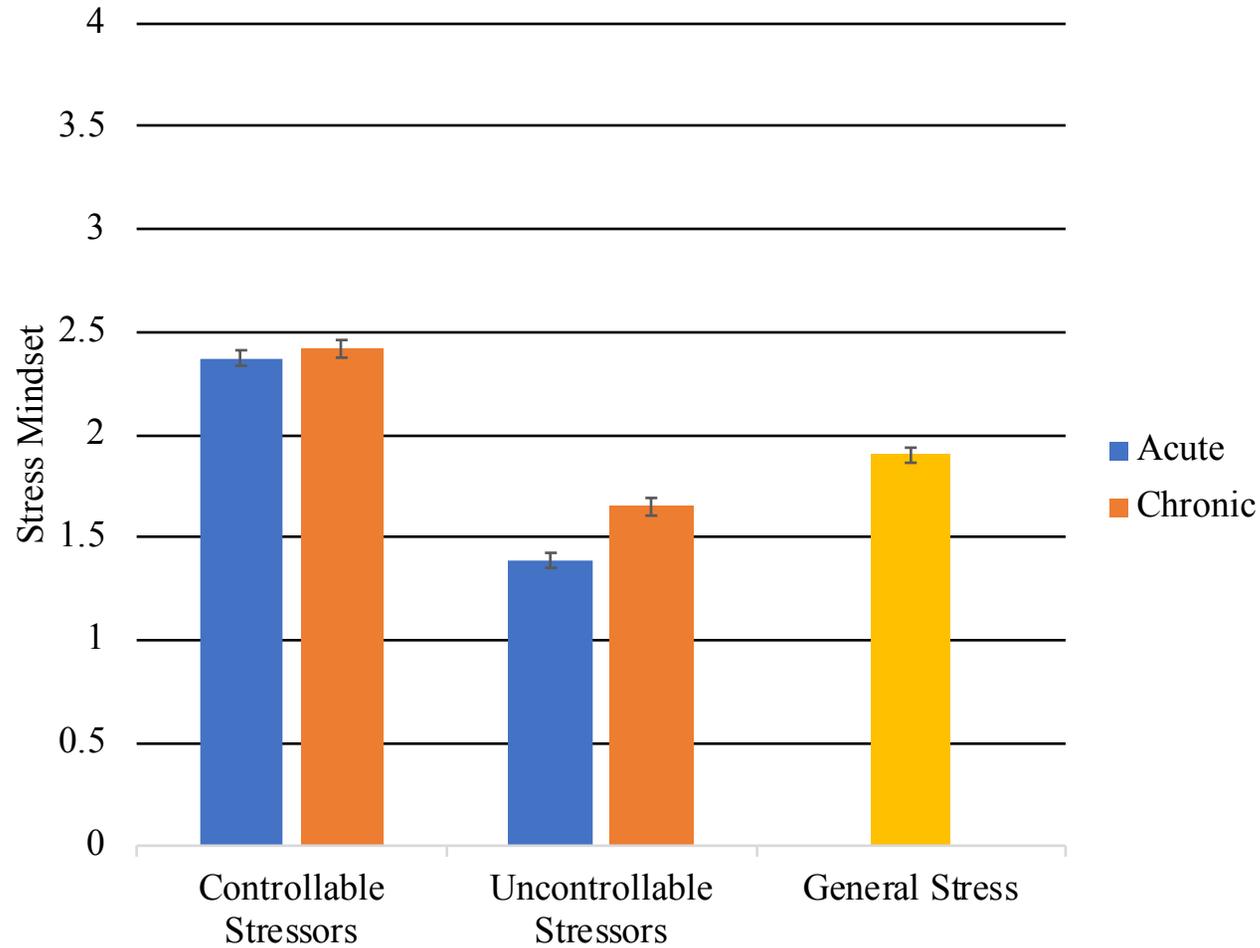


Figure 1

Average Mindset Scores for Stressor Specific and General Stress Mindsets

Note. Means presented are overall sample means, with error bars representing +/- one standard error. Higher means represent a more enhancing mindset.

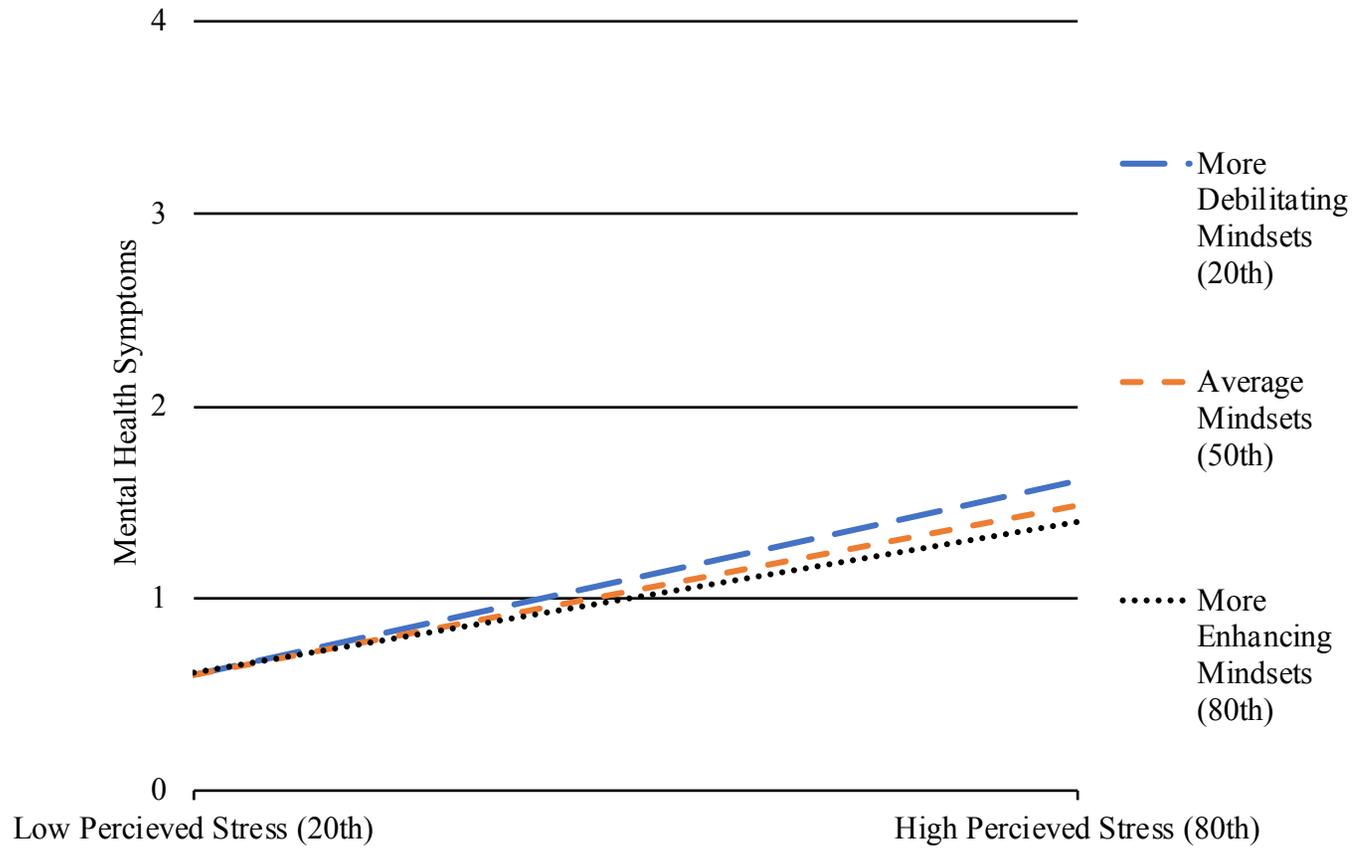


Figure 2
Graphical Representation of Interaction Effect Between Perceived Stress and General Stress Mindset Predicting Mental Health Symptoms

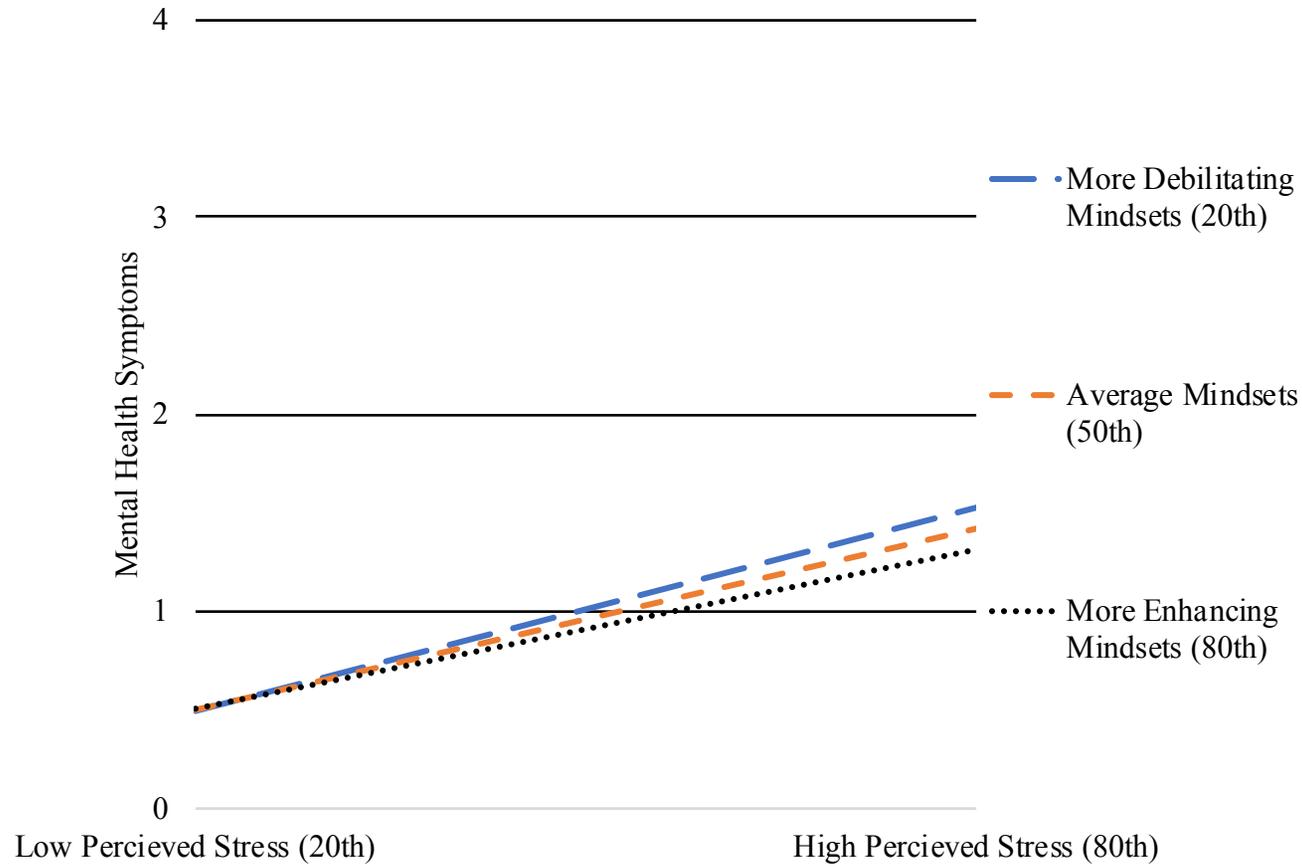


Figure 3
Graphical Representation of Interaction Effect Between Perceived Stress and Acute Uncontrollable Stress Mindset Predicting Mental Health

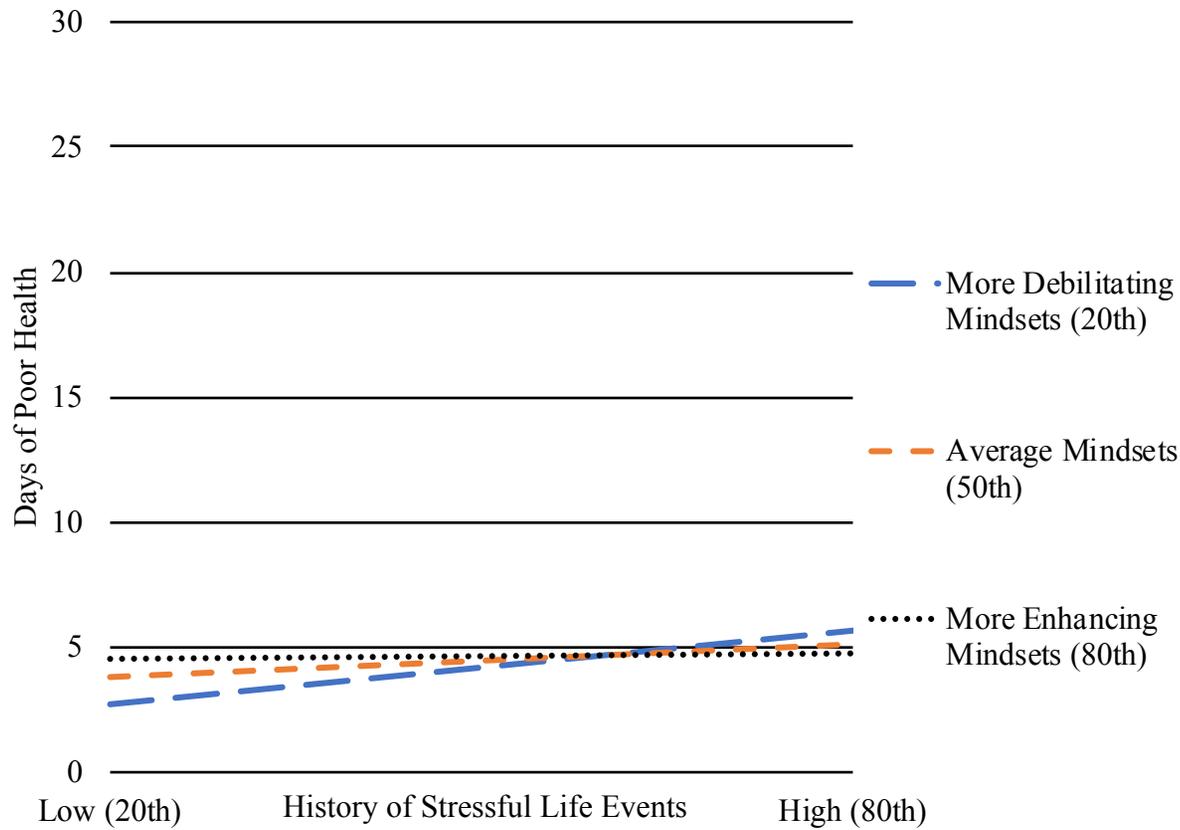


Figure 4
 Graphical Representation of Interaction Effect Between History of Stressful Life Events and General Stress Mindset Predicting Days Health Interfered with Normal Activity

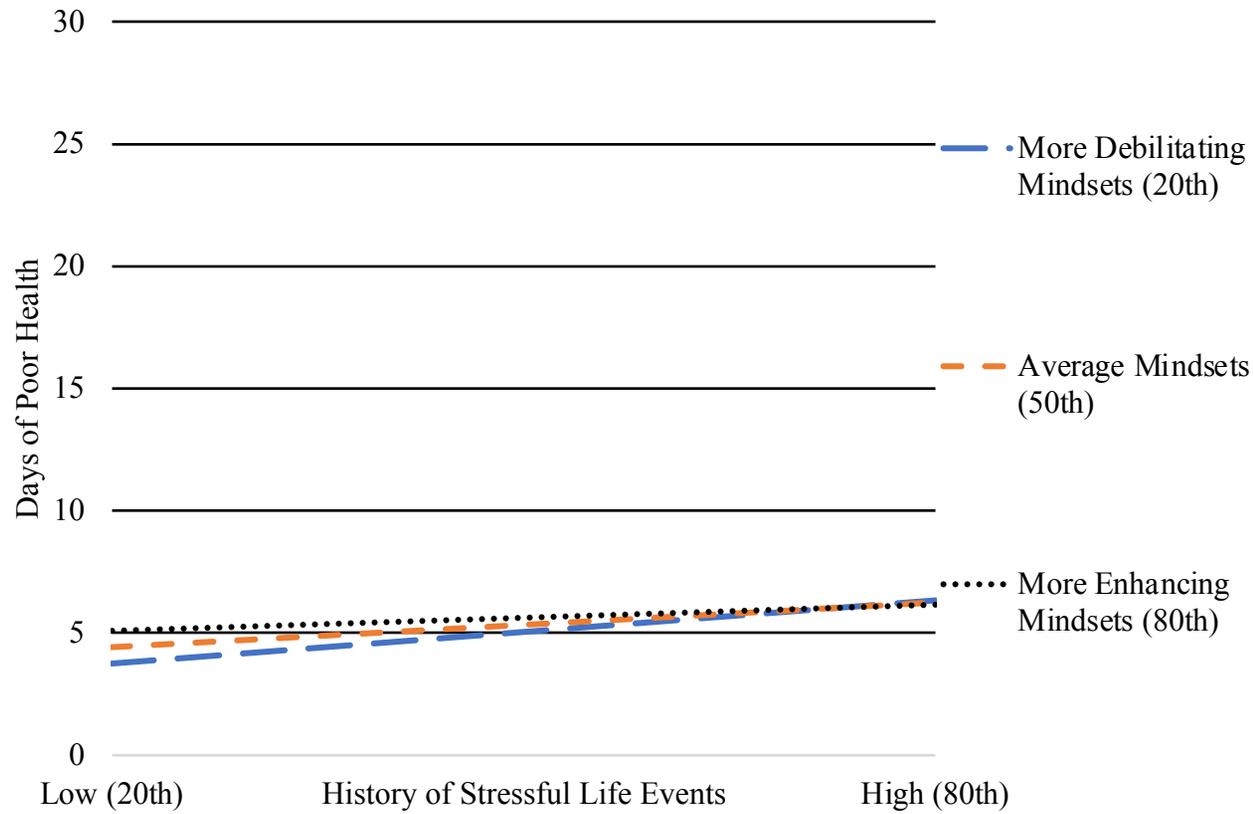


Figure 5
Graphical Representation of Interaction Effect Between History of Stressful Life Events and Acute Uncontrollable Stress Mindset Predicting Days Health Interfered with Normal Activity

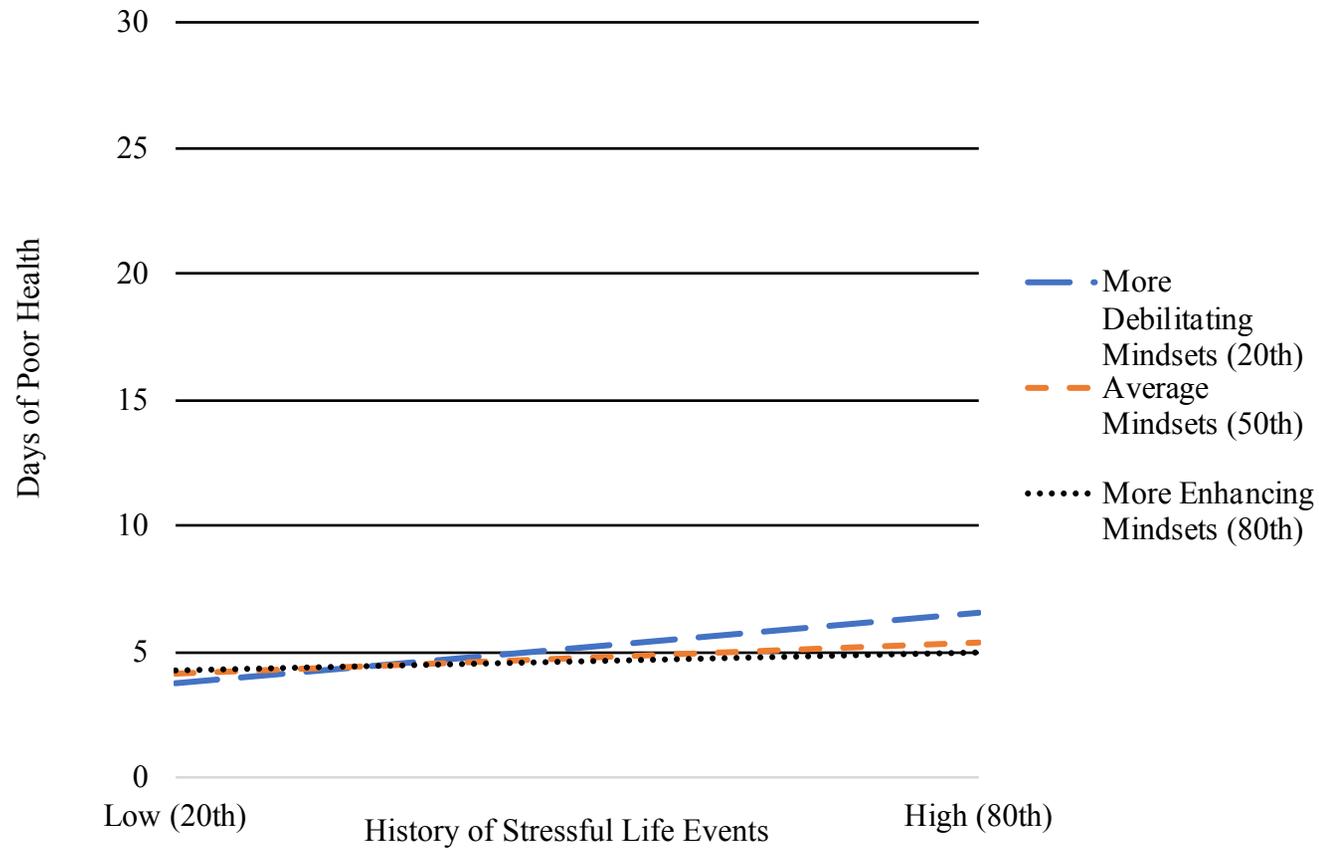


Figure 6
Graphical Representation of Interaction Effect Between History of Stressful Life Events and Chronic Controllable Stress Mindset Predicting Days Health Interfered with Normal Activity