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Examining associations between intelligence mindset, mental health symptom severity, and academic self-efficacy and performance

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Abstract
Individuals possess different beliefs regarding the malleability of intelligence, also known as intelligence mindsets. Despite evidence demonstrating a link between a growth mindset of intelligence—the belief that intelligence can develop through effort—and academic achievement, this link has not been closely examined from a mental health perspective. Given the increasing prevalence of mental health conditions, such as anxiety and depression, among undergraduate students, an important question is whether the well-established link between mental health symptom severity and academic outcomes depends on the intelligence mindset beliefs that individuals possess. A growth mindset of intelligence might buffer the negative impact of anxiety and depression on academic outcomes, whereas a fixed mindset—the belief that intelligence cannot be changed—might exacerbate this negative relationship. The present study examined data collected from 660 undergraduate psychology students in the United States to test whether intelligence mindset beliefs moderated the relationship between mental health symptom severity and various indicators of academic outcomes: academic self-efficacy, GPA, and perceived academic standing. Results revealed that intelligence mindset beliefs did not moderate the observed negative association between mental health symptom severity and academic outcomes. Findings indicate that promoting a growth mindset of intelligence might not be a particularly effective strategy for buffering university students from the negative impact of anxiety and depression on academic outcomes. However, this conclusion is limited by the cross-sectional design of the study, and future prospective research is necessary to further clarify the relationship between intelligence mindset, mental health, and academic outcomes.

Keywords Implicit theories · Intelligence mindset · Anxiety · Depression · Academic success

Introduction

College students experience relatively high rates of mental health symptoms, including anxiety and depression. These mental health conditions can interfere with students' ability to deploy effective academic behaviors and earn high grades (Bruffaerts et al., 2018; Eisenberg et al., 2009). The present study examines the psychological concept known as implicit theories of intelligence, commonly known as intelligence mindset, which is defined as the beliefs that individuals possess regarding the malleability of intelligence. We propose that the negative association between mental health symptom severity and academic outcomes observed in the literature might depend on the intelligence mindset beliefs that students possess.

Implicit theories of intelligence

Implicit theories are the beliefs that individuals possess about the malleability of human attributes and characteristics (Dweck, 2011). There are two broad categories of implicit theories. A belief that human attributes cannot be developed and are largely fixed is known as entity theory (fixed mindset), whereas a belief that human attributes can be developed through effort is known as incremental theory (growth mindset). Research on implicit theories have examined these beliefs in wide-reaching domains such as personality and interest, and the evidence across these domains overwhelmingly indicates that a growth mindset is linked to

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better outcomes (see Dweck, 2011; Yeager & Dweck, 2020, for reviews).

Perhaps the most widely studied implicit theory concerns the beliefs that individuals possess about the nature of intelligence. In the present study, we examine implicit theories of intelligence (also known as intelligence mindsets), defined here as the beliefs that individuals possess regarding the malleability of intelligence (Yeager & Dweck, 2020). Some people believe that intelligence is a trait which cannot be meaningfully changed—a fixed mindset of intelligence. However, other individuals believe that intelligence can grow as a result of effort and hard work—a growth mindset of intelligence. Crucially, how students think about ability and effort can shape academic outcomes (Muenks & Miele, 2017). Experimental studies have demonstrated a positive causal relationship between intelligence mindsets and academic performance (e.g., Blackwell et al., 2007; Broda et al., 2018; Yeager et al., 2019). However, other work has cast some doubt on the link between growth mindset and better academic outcomes. One investigation failed to demonstrate a positive association between intelligence mindset beliefs and a measure of fluid intelligence (Macnamara & Rupani, 2017), while a separate study reported no significant relationship between growth mindset and grades across the high school to college transition (Li & Bates, 2020). A large meta-analysis revealed weak effects of intelligence mindsets on academic achievement, although individuals from low SES environments as well as students who are academically at-risk might benefit the most from growth mindset interventions (Sisk et al., 2018), consistent with the study by Yeager et al. (2019) described above. Recent research has also revealed that individuals may possess what is known as a *false growth mindset*, in which individuals who endorse a growth mindset do not exhibit corresponding growth-minded behaviors, which might in part explain null findings in this area (Barger et al., 2022). Taken together, results indicate that the strength of the effect of growth mindset beliefs on academic outcomes likely depends on specific features of the population and setting.

Intelligence mindsets and mental health

One important population and setting that has received less attention in the intelligence mindset literature are students with mental health conditions in college. Researchers have documented high rates of anxiety and depression within undergraduate student samples (Auerbach et al., 2016), which have increased during the COVID-19 pandemic (Son et al., 2020). Students who are clinically anxious and depressed show worse academic outcomes compared to their peers (Bruffaerts et al., 2018). Prior studies have examined the role of implicit theories in psychological dysfunction (see Howell, 2017, for a review), and individual differences in mindset have been linked to psychological distress (see Burnette et al., 2020, and Schleider et al., 2015 for reviews). For example, in a large sample of Filipino high school students, King et al. (2012) showed that an entity theory of intelligence (fixed mindset) was associated with increased anxiety and other negative emotions. However, previous work in this area have largely revolved around individuals' implicit beliefs about mental health symptoms themselves, also known as emotion mindsets. In one study of American college undergraduate students, participants were assessed on their mindset of anxiety by answering questions such as, "Your anxiety is something about you that you cannot change very much," with the word *anxiety* replacing the original word *intelligence*. Findings from this study demonstrated the moderating role of growth mindset of anxiety in explaining the relation between stressful life events and adverse psychological outcomes in undergraduate students (Schroder et al., 2017). In a separate experimental study, depressed individuals who were randomly assigned to a growth mindset intervention highlighting the malleability of depression (incremental condition) led to decreases in depression symptom severity and increases in favorable attitudes to treatment (Zimmermann et al., 2020). Other studies have related emotion mindset beliefs to mental health symptom severity (De Castella et al., 2014; Schroder et al., 2015).

Despite the growing evidence pointing to the benefits of possessing a growth mindset of emotion on mental health outcomes, what is less well understood is whether a growth mindset of *intelligence* might enhance academic outcomes for individuals with mental health conditions. In one study of French adolescents, depression was found to mediate the relationship between an entity theory of intelligence and academic performance (Da Fonseca, 2009). That is, youth who believe that their intelligence cannot improve are more likely to develop depressive symptoms, which in turn decreased academic performance. In a separate experimental study, adolescents with generalized anxiety disorder who were exposed to a brief incremental theory message were more likely to exhibit better performance on an IQ test compared to a control group (Da Fonseca, 2008).

In the present study, we build on this work and propose that the impact of anxiety and depression on student academic outcomes might depend on one's implicit beliefs about the malleability of intelligence. Our hypothesis rests on two ideas. First, attribution theory helps us understand how individuals perceive the causes of success and failure experiences (e.g., Abramson et al., 1978; Graham, 2020; Perry & Hamm, 2017). Depression has been associated with a fixed mindset (Da Fonseca et al., 2009), and individuals with depression tend to see their failures as stemming from internal, global, and unchanging factors (i.e., an entity theory of failure, aligning with a fixed mindset), rather than from external and situation-specific factors (i.e., an incremental

theory of failure, aligning with a growth mindset). On the other hand, individuals who possess incremental beliefs demonstrate more adaptive behaviors in challenging situations (e.g., greater persistence in a challenging educational game, see O'Rourke et al., 2014) and therefore experience better outcomes.

Second, a key theme underlying therapy and clinical practice is to encourage individuals to modify their beliefs (e.g., about their anxiety or depression, about their intelligence). Cognitive therapy, which is the most commonly applied model of psychotherapy reported by clinicians (Prochaska & Norcross, 2018), is based on the principle that challenging thoughts, restructuring thinking, and modifying core beliefs will lead to change and improved mental health within an individual (Wenzel, 2012). Extending this logic, we ask the following question: Is it possible that the observed link between anxiety or depression and worse academic outcomes *depends on* the beliefs that individuals possess about the malleability of intelligence? That is, it may be that the negative impact of mental health conditions on academic outcomes might be mitigated by a growth mindset of intelligence (i.e., a belief that intelligence can grow), or exacerbated by a fixed mindset of intelligence (i.e., a belief that intelligence cannot be changed). Our study also builds on work by Schroder et al. (2017) who found that a growth mindset of anxiety moderated the link between stressful life events and adverse psychological outcomes. We seek to extend this work by examining whether the link between mental health conditions, such as anxiety and depression, and academic outcomes is moderated not by emotion mindset beliefs, but by *intelligence* mindset beliefs. A better understanding of this link can potentially support a focus on intelligence mindset within cognitive psychotherapeutic interventions, with an emphasis on modifying beliefs about one's intelligence that may have the downstream benefit of improving academic outcomes.

Broadening our understanding of the link between intelligence mindsets and academic outcomes

Research on intelligence mindset has frequently examined its impact on academic performance through objective indicators such as test scores or grade point average (GPA), but the relationship between mindset and other indicators of academic functioning, such as academic self-efficacy, is less well understood. Although mindset and self-efficacy beliefs are conceptually similar, they are not identical and are only moderately correlated (e.g., Zander et al., 2018). Mindset reflects a broad, implicit theory of intelligence, whereas self-efficacy—derived from social cognitive theory (Bandura, 1986)—reflects one's beliefs in their capacity to successfully execute a particular set of tasks (Zander et al., 2018). We argue that a better understanding of the relationship between intelligence mindsets and academic outcomes requires broadening our understanding of academic performance to include one's beliefs in the ability to execute adaptive academic behaviors, such as notetaking, understanding textbooks, and managing time.

Research has shown that academic self-efficacy beliefs are positively correlated with, but not identical to, academic performance (Komarraju & Nadler, 2013; Pajares & Urdan, 2006; Usher et al., 2019). This is particularly important in the mental health context, as undergraduate students with anxiety or depression have reported lower academic self-efficacy compared to students without such mental health conditions (Karr & White, 2022). Attribution theory would also predict that incremental beliefs may not directly impact academic performance, but rather lead to increases in adaptive academic behaviors that in turn predict academic success. Although our study is not intended (nor equipped) to test such a mediation model, the theory indicates that incremental beliefs are likely to impact not just summative indicators of academic performance but also self-efficacy beliefs and other aspects of the mindset meaning system. In addition, given our focus on the mental health context, which focuses on the beliefs—adaptive and maladaptive—that individuals possess, it is important to define and operationalize academic outcomes broadly to also include beliefs in one's ability to successfully execute academic tasks. We expect that this broad conceptualization will help us determine whether the hypothesized link between a growth mindset of intelligence and better academic outcomes is robust to different ways of operationalizing academic outcomes (e.g., numerical grades, perceived academic standing, and self-efficacy beliefs), particularly among students with mental health conditions.

Research questions and hypotheses

Given the increased focus on developing and implementing growth mindset interventions in educational settings, it is important to examine whether intelligence mindsets might be the key to unlocking a better understanding of how we might improve academic outcomes for students with mental health conditions. Accordingly, the present study examined the relation between anxiety and depression symptom severity, intelligence mindset beliefs, and academic outcomes. We operationalized academic outcomes using three separate variables—two measures of academic performance (self-reported GPA and perceived academic standing) and academic self-efficacy. After examining the relation between intelligence mindset beliefs and mental health symptoms, we examined whether there was a relationship between anxiety or depression symptom severity and academic outcomes, and if so, whether intelligence mindset beliefs moderated

this relationship. We predicted that greater symptom severity would be associated with weaker academic self-efficacy beliefs and worse academic performance. We also predicted that growth mindset beliefs would be associated with greater academic self-efficacy and better academic performance. Our central hypothesis was that intelligence mindset beliefs would moderate the relationship between anxiety and depression symptom severity and academic self-efficacy and performance. Specifically, we predicted that the hypothesized negative association between mental health symptoms and academic self-efficacy and performance would be reduced for those individuals who possess a growth mindset of intelligence. However, this hypothesized negative association would be further exacerbated for those individuals who possess a fixed mindset of intelligence.

Method

Participants and procedure

Participants were 660 undergraduate students (M_{age} = 19.02; SD = 1.01) enrolled in three introductory psychology courses at a large public research university in the United States during the spring of 2021. Data from this study come from students' responses to an online subject pool prescreening survey, which was reviewed and approved by the University of Kentucky Institutional Review Board. A total of 741 students completed the survey. However, after removing individuals who did not provide consent, were under the age of 18 or over the age or 22, and did not correctly answer the embedded validity questions, the sample dropped down to 660 individuals. We focused on students aged 18 to 22, as students outside of this age range are not representative of the four-year college population in the United States (NCES, 2022). See Table 1 for a summary of the demographics of the sample.

Table 1 Demographic statistics for study sample

Variable	N	Percent
Gender identity		
Woman	518	78.5%
Man	142	21.5%
Class level		
Freshman	382	57.9%
Sophomore	178	27.0%
Junior	70	10.6%
Senior	28	4.2%
Other	2	0.3%
Race/ethnicity		
White	527	80.5%
Black or African American	53	8.1%
Asian	33	5.0%
Native American or Alaska Native	3	0.5%
Multiracial	32	4.9%
Other	7	1.1%
Hispanic/Latino	42	6.4%
English not primary language	33	5.0%

Measures

Anxiety symptom severity was measured using the seven-item Generalized Anxiety Disorder questionnaire (GAD-7), which includes questions asking participants how often anxiety-related symptoms bothered them in the last two weeks (e.g., feeling nervous, anxious, or on edge). Each item is rated on a four-point scale (range: 0 to 3) with items summed to arrive at a total symptom score, with a higher score indicative of greater anxiety severity. A cutoff of ≥10 is used to identify participants with moderate or greater anxiety (Spitzer et al., 2006). Internal consistency was high (Cronbach's alpha = .91).

Depression symptom severity was measured using the eight-item Patient Health Questionnaire (PHQ-8), which asks participants to rate how much symptoms of depression have bothered them over the prior two weeks (e.g., little interest or pleasure in doing things). The items are rated on a four-point scale (range: 0 to 3) and summed to produce a total symptom score. Higher scores are indicative of greater depression severity, with a cutoff of ≥10 used to identify participants with moderate or greater depression (Kroenke et al., 2009). Internal consistency was high (Cronbach's alpha = .88).

Intelligence mindset was measured using a two-item scale adapted from the original eight-item scale described in Dweck (1999). In study contexts where survey space is limited (as was the case in the present study), researchers have successfully used streamlined measures of mindset (Yeager & Dweck, 2020). Participants were given the following instructions: "Think about whether you agree or disagree with the following two statements. There are no right or wrong answers. Select one answer for each statement." Participants then rated their agreement, using a six-point Likert-type scale (1 = Strongly disagree to 6 = Strongly agree), with the following two statements: "A person has a certain amount of intelligence, and they can't really do much to change it" and "A person's intelligence is something about them that they can't change very much." Scores were averaged across the two items to yield a single intelligence mindset score. Higher values indicate a fixed mindset, whereas lower values indicate a growth mindset.

We operationalized academic outcomes in three different ways in order to understand whether the hypothesized link between intelligence mindset and academic outcomes

depends on the nature of the outcome as well as differences in measurement. Academic self-efficacy was measured using the Course/Academic subscale of the College Self-Efficacy Instrument (CSEI-C; Gore Jr. et al., 2006). This seven-item subscale has participants rate their confidence at managing different tasks related to academic coursework, such as understanding a textbook or doing well on exams. The item ratings (range: 0 to 10) are averaged to arrive at a total score of perceived self-efficacy in coursework. Internal consistency was high (Cronbach's alpha = .88).

Academic performance was assessed using two different measures. Participants self-reported their college grades by providing their GPA for the Fall 2020 semester, as well as their current cumulative GPA. The GPA scale at this university ranged from 0.00 to 4.00. We were not able to obtain GPA from administrative university records; however, research has shown a high correlation (r = .90) between self-reported GPA and actual GPA (Kuncel et al., 2005).

Participants also completed a four-item measure of perceived academic standing used in Sheffler and Cheung (2020) and adapted from the General Perceptions of Academic Self-Competence measure (Wigfield et al., 1991). Participants were given the following instructions, "Compared to other students in the same major, will you be better or worse in the following subjects?" Then, participants rated their performance on four subjects—math, science, writing, and reading—using a five-point Likert-type scale (1 = A lot worse than others to 5 = A lot better than others). Because we did not have a domain-specific hypothesis (i.e., we did not expect our results to vary by academic domain), we intended to calculate the mean of the four subject areas to yield a single score of perceived academic self-competence. However, internal consistency was very low (Cronbach's alpha = .19), indicating that averaging the scores of the four subject areas was not an appropriate method for assessing general perceived academic self-competence. Therefore, we examined perceived self-competence in reading and writing combined (Cronbach's alpha = .71), and math and science combined (Cronbach's alpha = .61), to align with recent work examining self-efficacy in humanities and quantitative-focused majors separately (Han et al., 2021). In summary, assessing different aspects of academic outcomes, such as GPA, academic self-efficacy, and perceived academic standing, somewhat mitigated our reliance on self-reported measures in the current study.

Power analysis

Because data were drawn from an undergraduate subject pool, the total number of observations was already known to us. Therefore, we conducted a sensitivity power analysis in G*Power 3.1 to determine the minimum detectable effect size (Faul et al., 2009). Assuming a two-tailed alpha error probability of 0.05, 80% power, four model predictors (one covariate, two main effects, and one interaction term), and 660 participants, the minimum detectable effect size was $f^2 = 0.012$ (i.e., we had sufficient power to detect a small effect, if present).

Statistical analyses

First, basic descriptive statistics on mindset as a function of anxiety and depression symptom severity were examined. Then, using ordinary least squares regression, academic self-efficacy and academic performance served as dependent variables in separate analyses. These variables were regressed on student gender (covariate) and the following three predictors: (a) mental health symptom severity (i.e., either anxiety or depression in separate analyses), (b) mindset beliefs, and (c) interaction between mental health symptom severity and mindset beliefs. We controlled for student gender due to research showing significant differences in the diagnosis of anxiety and depression as a function of gender (e.g., Nolen-Hoeksema & Hilt, 2009; Vesga-Lopez et al., 2008). The continuous values of the predictors were retained in the calculation of the interaction term (i.e., we did not dichotomize the anxiety and depression variables based on the clinical cutoff used to determine moderate or greater condition severity). Our prespecified significance threshold was $p < .05$. Missing data were handled using multiple imputation to maintain statistical power and reduce bias in the estimates. This plan was preregistered prior to data analysis (https://osf.io/wfjak); apart from the decision to examine perceived academic competence separately by subject area, there were no deviations to the preregistration plan. Analyses were conducted using Stata 13.1.

Missing data

A missing data analysis revealed that 15.6% of students had missing Fall 2020 GPA information, and 25.3% of students had missing cumulative GPA information. All other variables in the analysis had very low missing data rates (2.1% or less). Accordingly, we employed the following approach to missing data. For sum scale scores (i.e., PHQ-8 and GAD-7), we adjusted the score by a constant scalar that varied depending on the number of nonmissing values in that scale. For example, if a participant completed six out of the eight PHQ-8 items, that person's sum score was multiplied by 8/6, or 1.33. This ensured that all sum scores were comparable. For mean scale scores (i.e., mindset, perceived academic competence, and self-efficacy), we took the mean of the nonmissing values within each scale. For participants who did not provide any valid responses on a scale (i.e., all eight PHQ-8 items were missing), that participant was removed from the analysis.

Multiple imputation was used to address missing GPA data. Prior to imputation, we found that two participants reported a fall 2020 GPA of over 4.00; these impossible values were deleted so that these values could be imputed. (We suspected that these students may have been transfer students from a different university that used a different GPA scale.) Perceived relative academic standing and perceived relative socioeconomic standing were used as auxiliary variables. (Auxiliary variables are variables that are associated with missingness; inclusion of auxiliary variables to the imputation model can improve the quality of the imputed values generated from the multiple imputation process [Woods et al., 2021].) Correlations between the auxiliary variables and both GPA variables (r = .34 to .35 for perceived relative academic standing; r = .11 for perceived relative SES) indicated that both auxiliary variables were moderately correlated with our GPA variables that had a substantial amount of missing data. Ten data sets were imputed using multivariate normal regression. Upon imputation, we noticed that some of the imputed GPA values were implausible (i.e., above 4.00). Therefore, any imputed GPA values above 4.00 were reassigned a value of 4.00.

Table 2 Descriptive statistics for predictors and outcome variables

Variable	N	Mean	SD	Range
Mindset	650	2.55	1.10	1–6
Anxiety (GAD-7)	651	7.65	5.77	0–21
Depression (PHQ-8)	651	8.09	5.79	0–24
Fall 2020 GPA	557	3.53	0.54	0.70–4.00
Cumulative GPA	493	3.57	0.47	1.31–4.00
Perceived academic competence: Math/Science	648	3.15	0.89	1–5
Perceived academic competence: Reading/Writing	648	3.43	0.89	1–5
Academic self-efficacy	656	7.15	1.62	2.14–10.00

Results

Descriptives

Table 2 presents descriptive statistics of the predictors and outcome variables of interest from the unimputed data set. Means for Fall 2020 GPA and Cumulative GPA were calculated from the imputed data set using the method described in Lachenbruch (2010); means were virtually identical (Fall 2020 GPA: 3.52 imputed vs. 3.53 unimputed; Cumulative GPA: 3.53 imputed vs. 3.57 unimputed).

Correlations

Table 3 shows the bivariate correlation matrix between the predictors and outcome variables from the unimputed data set. Fixed intelligence mindset was associated only with lower self-efficacy beliefs; mindset did not correlate with any other variable. Anxiety and depression were strongly correlated in our sample. Anxiety was negatively related to self-reported GPA, perceived academic competence in math/science and reading/writing, and academic self-efficacy. Depression correlated only with fall 2020 GPA at a small magnitude and was not significantly correlated with cumulative GPA; depression was also negatively related to perceived academic competence in math/science and academic self-efficacy. Stronger perceived academic competence in math/science was associated with higher overall fall 2020 GPA and cumulative GPA, as well as higher symptom severity in anxiety and depression. Stronger perceived academic competence in reading/writing was associated with higher overall fall 2020 GPA and cumulative GPA, as well as higher symptom severity in anxiety but not depression. Academic self-efficacy beliefs were significantly associated with all predictors and outcome variables.

Table 3 Bivariate correlation matrix for variables in the models

	Fixed Mindset	Anxiety	Depression	GPA Fall 2020	GPA Cumulative	PAC-MS	PAC-RW	ASE
Fixed Mindset	–							
Anxiety	0.06	–						
Depression	0.07	**0.74**	–					
GPA Fall 2020	−0.03	**−0.19**	**−0.10**	–				
GPA Cumulative	−0.02	**−0.20**	−0.08	**0.87**	–			
PAC-MS	−0.02	**−0.19**	**−0.18**	**0.23**	**0.22**	–		
PAC-RW	−0.04	**−0.09**	−0.06	**0.09**	**0.09**	−0.01	–	
ASE	**−0.15**	**−0.45**	**−0.37**	**0.22**	**0.22**	**0.30**	**0.24**	–

PAC-MS Perceived academic competence in math and science, *PAC-RW* Perceived academic competence in reading and writing, *ASE* Academic self-efficacy. Bolded values represent significant correlations at the .05 level

Anxiety symptom severity and mindset beliefs predicting academic outcomes

After data sets were imputed, OLS regression was conducted on the pooled data set. In Table 4, we present results for the regression models of anxiety symptom severity and mindset predicting self-reported fall 2020 GPA and cumulative GPA, perceived academic competence in math/science and reading/writing, and academic self-efficacy. For all models, the beta weights correspond to conditional main effects due to the inclusion of an interaction term in the model, and can be interpreted as a significant relationship between the predictor and the criterion when all other predictors in the model have a value of zero. The interaction term between anxiety symptom severity and mindset was not significant in any of the four models. That is, the negative association between anxiety symptom severity and academic outcomes was not moderated by intelligence mindset beliefs. The adjusted R-squared for the model predicting academic self-efficacy ($R^2 = .15$) was much larger than the other models (R^2 range: .01 to .05). Interaction terms remained non-significant when listwise deletion was used.

Depression symptom severity and mindset beliefs predicting academic outcomes

In Table 5, we present results for the regression models of depression symptom severity and mindset predicting self-reported fall 2020 GPA and cumulative GPA, perceived academic competence in math/science and reading/writing, and academic self-efficacy. As before, the interaction term between depression symptom severity and mindset was not significant in any of the four models. That is, the negative association between depression symptom severity and academic outcomes was not moderated by intelligence mindset beliefs. The adjusted R-squared for the model predicting academic self-efficacy ($R^2 = .22$) was much larger than the other models (R^2 range: .01 to .06). Interaction terms remained non-significant when listwise deletion was used.

Table 4 Anxiety and mindset predicting GPA, perceived academic competence, and academic self-efficacy

	N	*F*	Adj R^2	*B*	Std *B*	*SE*	*p*	95% CI	
Fall 2020 GPA									
Female Sex	639	(4, 383.6) = 1.61	0.01	0.07	0.06	0.06	.21	−0.04	0.19
Fixed Mindset				−0.01	−0.01	0.04	.85	−0.08	0.06
Anxiety				−0.01	−0.11	0.01	.35	−0.03	0.01
Mindset x Anxiety				0.00	0.01	0.10	.97	−0.01	0.01
Cumulative GPA									
Female Sex	638	(4, 302.2) = 1.71	0.01	0.09	0.07	0.05	.11	−0.02	0.19
Fixed Mindset				−0.01	−0.02	0.03	.84	−0.07	0.06
Anxiety				−0.01	−0.16	0.01	.18	−0.03	0.01
Mindset x Anxiety				0.00	0.06	0.00	.66	−0.01	0.01
Perceived academic competence: Math/science									
Female Sex	643	(4, 636) = 10.64	0.05	**−0.38**	**−0.17**	0.08	<.001	−0.55	−0.21
Fixed Mindset				−0.03	−0.04	0.05	.53	−0.13	0.07
Anxiety				**−0.03**	**−0.20**	0.01	.04	−0.06	0.00
Mindset x Anxiety				0.00	0.07	0.01	.54	0.00	0.01
Perceived academic competence: Reading/writing									
Female Sex	643	(4, 636) = 0.84	<0.01	0.03	0.01	0.09	.77	−0.15	0.20
Fixed Mindset				−0.05	−0.06	0.05	.38	−0.15	0.06
Anxiety				−0.02	−0.10	0.02	.32	−0.05	0.01
Mindset x Anxiety				0.00	0.05	0.01	.66	−0.01	0.01
Academic self-efficacy									
Female Sex	646	(4, 639) = 30.53	0.15	0.25	0.06	0.15	.09	−0.04	0.53
Fixed Mindset				**−0.23**	**−0.15**	0.09	.01	−0.4	−0.05
Anxiety				**−0.12**	**−0.43**	0.03	.00	−0.17	−0.07
Mindset x Anxiety				0.01	0.07	0.01	.51	−0.01	0.02

B: Unstandardized beta coefficient. Std *B*: Mean standardized coefficient over 10 imputations based on Fisher's z transformation using the mibeta command with the fisherz option (Harel, 2009). All other statistics are drawn from the unstandardized multiple imputation estimates. Bolded coefficients are significant at the .05 level

Table 5 Depression and mindset predicting GPA, perceived academic competence, and academic self-efficacy

	N	*F*	Adj R^2	*B*	Std *B*	*SE*	*p*	95% CI	
Fall 2020 GPA									
Female Sex	639	(4, 369.8) = 5.80	0.04	0.09	0.07	0.06	.11	−0.02	0.20
Fixed Mindset				0.02	0.04	0.04	.55	−0.05	0.09
Depression				−0.01	−0.12	0.01	.26	−0.03	0.01
Mindset x Depression				0.00	−0.10	0.00	.41	−0.01	0.00
Cumulative GPA									
Female Sex	668	(4, 287.4) = 5.40	0.04	0.10	0.08	0.05	.06	0.00	0.20
Fixed Mindset				0.01	0.03	0.03	.68	−0.05	0.08
Depression				−0.01	−0.18	0.01	.10	−0.03	0.00
Mindset x Depression				0.00	−0.03	0.00	.80	−0.01	0.01
Perceived academic competence: Math/science									
Female Sex	643	(4, 636) = 10.67	0.06	**−0.38**	**−0.18**	0.08	<.001	−0.55	−0.21
Fixed Mindset				0.12	0.01	0.04	.82	−0.07	0.08
Depression				**−0.02**	**−0.12**	0.01	.02	−0.03	0.00
Mindset x Depression				0.00	−0.04	0.00	.48	−0.01	0.00
Perceived academic competence: Reading/writing									
Female Sex	643	(4, 636) = 1.33	<0.01	0.03	0.01	0.09	.76	−0.14	0.20
Fixed Mindset				0.01	0.01	0.04	.86	−0.07	0.09
Depression				0.00	−0.01	0.01	.90	−0.02	0.02
Mindset x Depression				0.00	−0.09	0.00	.14	−0.01	0.00
Academic self-efficacy									
Female Sex	646	(4, 639) = 47.65	0.22	0.27	0.07	0.14	.05	0.00	0.54
Fixed Mindset				−0.09	−0.06	0.09	.29	−0.26	0.08
Depression				**−0.10**	**−0.36**	0.02	<.001	−0.15	−0.05
Mindset x Depression				−0.01	−0.13	0.01	.20	−0.03	0.01

B: Unstandardized beta coefficient. Std *B*: Mean standardized coefficient over 10 imputations based on Fisher's z transformation using the mibeta command with the fisherz option (Harel, 2009). All other statistics are drawn from the unstandardized multiple imputation estimates. Bolded coefficients are significant at the .05 level

Discussion

The present study sought to test whether intelligence mindset beliefs and mental health symptom severity were associated with academic performance and academic self-efficacy beliefs in a sample of undergraduate students. Our primary hypothesis was that intelligence mindset beliefs would be a moderator of the relation between symptom severity and academic outcomes, such that students experiencing anxiety or depression who possess a growth mindset would exhibit stronger academic outcomes compared to students who possess a fixed mindset about intelligence. Contrary to our hypothesis, intelligence mindset did not emerge as a significant moderator of the relationship between mental health symptom severity and academic outcomes.

First, zero-order correlations revealed that possessing a fixed mindset was modestly associated with weaker academic self-efficacy beliefs, but not self-reported GPA or perceived academic competence in math/science or reading/writing. Our results are broadly consistent with previous research showing that a growth mindset of academic ability is associated with enhanced self-efficacy (e.g., Chen & Pajares, 2010; Davis et al., 2011). However, our results relating mindset and other academic outcomes such as GPA should be considered in the context of the literature reporting mixed results in this area. Prior research examining the association between mindset on academic achievement have shown a positive association (e.g., Blackwell et al., 2007; Costa & Faria, 2018; Yeager et al., 2019), whereas other studies, including meta-analyses, have shown no meaningful relationship (e.g., Bahník & Vranka, 2017; Li & Bates, 2020; Sisk et al., 2018). These and other mindset studies differ along many different dimensions; studies represent a variety of research designs (correlational and experimental), span both cross-sectional and longitudinal analyses, and reflect different age groups and learning contexts. Therefore, a single definitive answer regarding the link between intelligence mindset and academic outcomes remains elusive. Yet, there are several potential explanations that might better account for this relationship. For example, growth mindset interventions might not shape incremental theories per se, but rather a broader *mindset*

meaning system—situated within heterogeneous educational cultures—that includes goal orientations and helpless attributions (Yeager & Dweck, 2020), indicating that a sole focus on incremental theories of intelligence might be misplaced. Another potential explanation comes from a study pointing to the phenomenon known as a *false growth mindset*, where a growth mindset endorsement is accompanied by contradictory behavioral indicators, as a potential explanation for these mixed results (Barger et al., 2022). That is, if students who endorse growth mindset statements do not actually engage in academic behaviors commonly associated with a growth mindset, such as increased effort, the nature of the association between mindset and academic outcomes is likely to be misspecified.

The present study adds to this literature by examining the link between intelligence mindset and various indicators of academic outcomes, including self-efficacy, within a mental health context. The present study conceptualized college self-efficacy as a domain-general construct focused on coursework-related beliefs. However, research in post-secondary contexts has shown that self-efficacy beliefs may be domain-specific, with some studies revealing an increase in self-efficacy over the course of a semester among first-year college students (e.g., biology self-efficacy: Ainscough et al., 2016; quantitative and humanities self-efficacy: Han et al., 2021). Future research could extend our findings by examining how change over time in students' intelligence mindset beliefs relates to academic performance and academic self-efficacy beliefs as a function of different majors or areas of study.

Second, we found that mental health symptom severity was negatively associated with GPA, academic self-efficacy, and perceived competence in math, consistent with research showing that anxiety and depression are associated with adverse academic outcomes (Bruffaerts et al., 2018; Eisenberg et al., 2009; Hunt et al., 2010). Specifically, students with higher levels of anxiety and depression were more likely to possess weaker beliefs about their ability to manage different tasks related to academic coursework (academic self-efficacy), which is consistent with previous research demonstrating that psychological distress corresponds to reduced academic self-efficacy (Solberg et al., 1993; Solberg & Villarreal, 1997; Coffman & Gilligan, 2002). Zero-order correlations showed that GPAs were negatively associated with anxiety, but less so with depression. Specifically, anxiety symptom severity was associated with cumulative and prior semester GPA, as opposed to depression symptom severity, which was associated with just prior semester GPA. Our pattern of results is consistent with research showing that anxiety symptoms are commonly understood as more trait-like negative affectivity (Knowles & Olatunji, 2020) whereas depression is more commonly episodic (i.e., short-term) rather than long-term (Angst et al., 2009).

Interestingly, students with higher levels of anxiety and depression reported lower perceived competence in math/science, but only students with higher levels of anxiety—but not depression—reported lower perceived competence in reading/writing. Recall that our original, preregistered hypothesis was that greater levels of symptom severity would be associated with worse perceived academic competence averaged across four subject areas—math, science, reading, and writing. However, after revising our plan to examine perceived academic competence in math/science and reading/writing separately, our results indicate that the link between mental health and academic outcomes may be better characterized as domain-specific (i.e., depends on subject area).

Therefore, our null findings between intelligence mindset and mental health symptom severity might be explained in part by how intelligence mindset was defined and operationalized in the present study. Students were asked to reflect on their implicit beliefs about intelligence rather than subject-specific ability. How would our results change if we examined growth mindsets of math or growth mindsets of reading (e.g., "You have a certain amount of math ability, and you can't really do much to change it"), rather than examining the broader (and more commonly adopted) construct of growth mindsets of intelligence? Because college is a time of increasing academic specialization, students might perceive their abilities as being qualitatively different depending on the subject area in question. Fortunately, mindset research is increasingly adopting domain-specific approaches by examining growth mindsets of math (e.g., Degol et al., 2017) and mindsets in undergraduate STEM contexts (e.g., Canning et al., 2021). Further exploring the domain-specificity of intelligence mindset beliefs would be an important direction for future research. Similarly, we examined generalized anxiety and depression in the present study, but other studies have examined constructs such as math anxiety—a domain-specific conceptualization of anxiety in a particular academic domain—and its link with intelligence mindset (e.g., Gunderson et al., 2018). Further exploring the domain-specificity in academic anxiety would also be an important direction for future investigation.

Third, we found that the relationship between mental health symptom severity and academic outcomes was not moderated by intelligence mindset. According to attribution theory, individuals who are depressed tend to see their failures as stemming from internal, global, and unchanging factors. Our primary hypothesis was that intelligence mindset beliefs would be a moderator of the relation between mental health symptom severity and academic outcomes, such that students experiencing anxiety or depression who possess a growth mindset of intelligence would exhibit stronger academic outcomes compared to students who possess a fixed mindset of intelligence. Therefore, at least for depression, we would expect a significant correlation between depression

and fixed mindset. Surprisingly, we did not find a significant correlation between depression severity and mindset beliefs. Anxiety severity and mindset beliefs were also not significantly correlated with each other. Added evidence comes from the non-significant interaction terms—we hypothesized that the negative link between symptom severity and academic outcomes would be (a) exacerbated by a fixed mindset and (b) buffered by a growth mindset, but this was not supported by the data.

This finding is important from both a scientific and a clinical perspective. From a scientific perspective, it suggests that the attributions that depressed individuals make about failures are distinct from the attributions that they make about whether their intelligence can grow. This is consistent with a growing body of research that reflects the domain-specificity of implicit theories and beliefs. Because we did not collect data on attribution style regarding failures, we cannot conclude this from the present study; this could be tested in future research. From a clinical perspective, this finding indicates that individuals experiencing depression or anxiety are not more likely to possess fixed mindsets of intelligence than peers that are not experiencing depression or anxiety. Therefore, our results indicate that students with depression or anxiety may not have fixed mindsets at a higher rate than students without these conditions; and mindset does not moderate the relationship between depression or anxiety symptoms and academic outcomes. As such, interventions to enhance growth mindset may improve academic self-efficacy regardless of current anxiety or depression; and reduced academic self-efficacy among students with anxiety or depression may be attributable to other mental health variables requiring intervention (e.g., poor sleep and fatigue, self-reproach, problems with concentration or organization). Furthermore, our findings must be considered against previous studies that have demonstrated significant associations between intelligence mindset and anxiety (Da Fonseca et al., 2008; King et al., 2012) and depression (Da Fonseca et al., 2009). Of course, our data are limited by our cross-sectional and correlational design, which precludes our ability to make causal claims. Accordingly, addressing some of the limitations of the present study—which we outline below—may elucidate the particular circumstances under which growth mindset interventions for anxious or depressed university students may or may not be effective.

Limitations and directions for future research

There were several limitations of the present study. Although research shows a high correlation ($r = .90$) between self-reported GPA and actual GPA, self-reported college grades may not accurately reflect the actual scores of students at the lower end of the GPA distribution (Kuncel et al., 2005). In addition, although all participants were enrolled in one of three introductory psychology classes, more than two-thirds of participants reported having a major other than psychology, with neuroscience, biology, and nursing being among the most common majors. Given the phenomenon of lower GPAs in the natural sciences (e.g., Arcidiacono et al., 2012), using GPA as an outcome variable to characterize individual differences in academic achievement might not be prudent. Future research could seek to replicate and extend these findings by analyzing university administrative records rather than just self-reported GPA.

Our cross-sectional data limits our ability to make directional inferences. We hypothesized that mental health symptom severity and intelligence mindset beliefs would be associated with academic performance, such as GPA and academic self-efficacy. However, it is possible that the opposite direction is also true—that academic performance could also predict mental health outcomes and intelligence mindset beliefs. That is, doing well academically could lead students to report fewer instances of anxious or depressive episodes. In fact, the broader mindset literature suffers from a relative paucity of longitudinal studies compared to correlational and pre-post designs (however, please see Shively & Ryan, 2013, and Dai & Cromley, 2014, for examples of longitudinal studies in this area), yet such studies would allow us to elucidate the bidirectional and cross-lagged links between intelligence mindset beliefs and academic performance. This would be an important direction for future research.

Our sample of undergraduate psychology students in the United States limits our ability to generalize across a broader population of individuals. However, our study makes an important contribution to the literature on mindset beliefs by examining these learning-related cognitions in both STEM- and non-STEM-related majors, and by examining these beliefs through the lens of undergraduate mental health. As noted previously, because introductory psychology classes are often taken by students pursuing different fields of study, examining the intersection of intelligence mindset and mental health among this group might yield a more generalizable set of results compared to studies that focus on specific academic domains. That said, given the likelihood of different grade distributions between majors, analyzing a larger university sample could help us understand whether our results might be affected by areas of study.

The wording of the mindset questions used in the present study differs from other studies. For example, Dweck (1999) uses the opening stem, "You have a certain amount of intelligence" in contrast to the present study's stem of "A person has a certain amount of intelligence." Research has focused on whether differences in the referent (e.g., first-person or third-person pronouns) could lead participants to

interpret and answer these questions differently (e.g., De Castella & Byrne, 2015). An in-depth examination of the assessment of mindset beliefs is beyond the scope of this study, but the present measure exhibited good reliability; internal consistency was high (Cronbach's alpha = .88) and compares favorably with the original eight-item scale used in a recent study with undergraduate students (Cronbach's alpha = .94; Burgoyne & Macnamara, 2021). Our results should be interpreted in light of the ongoing debate in the field regarding the assessment of intelligence mindset beliefs.

Our study operationalized both intelligence mindset and academic self-efficacy as domain-general constructs. We asked students to reflect on the malleability of intelligence in general, rather than subject-specific ability. It would be important to examine whether our results would be affected if we have used the term *academic ability* instead of *intelligence* in our implicit beliefs measure. Although while many college students tend to define intelligence in academic terms, a significant number of students also describe social, emotional, and interpersonal dimensions of intelligence (Kim, 2021). Therefore, although research in this area often use the term *intelligence* as synonymous with *academic ability*, future research could examine whether our results are sensitive to differences in the wording of the survey items. This would also allow us to examine whether subject-specific ability mindsets are associated with the domain-specific perceived academic competence variables (math/science and reading/writing) we used in the present study. We also asked students to indicate their beliefs in their ability to manage various aspects of college coursework, rather than work in a particular subject or course. Yet, as described above, self-efficacy has often been studied from a domain-specific perspective. It would therefore be important in future research to examine whether adopting a domain-specific approach to intelligence mindset and self-efficacy would alter our findings.

Finally, data were collected during the spring of 2021 at a university where a large proportion of classes were occurring remotely due to the COVID-19 pandemic. Research has revealed increases in mental health concerns due to the pandemic (e.g., Copeland et al., 2021). Therefore, it is possible that our sample was characterized by higher than usual rates of anxiety and depression compared to before the pandemic. It is also possible that the unique effects of the pandemic—illness, mortality, and lack of social connections—might have altered the nature of students' anxiety and depression in qualitative ways. Our results should therefore be interpreted considering the unprecedented sociohistorical moment during which data collection occurred.

Conclusion

The present study extends previous research on intelligence mindset beliefs—beliefs about the malleability of intelligence—by examining these learning-related cognitions among students with varying levels of self-reported anxiety and depression. In a large sample of university students taking introductory psychology courses in the United States, this observational study revealed that intelligence mindset beliefs did not moderate the observed negative link between mental health symptom severity and academic outcomes, as measured by academic self-efficacy, GPA, and perceived academic standing. Findings indicate that promoting a growth mindset of intelligence might not be a particularly effective strategy for buffering university students from the negative impact of anxiety and depression on academic outcomes. Nonetheless, young adults commonly experience mental health conditions and often experience academic difficulties associated with these conditions, warranting future research on factors contributing to reduced academic competence and performance and mechanisms for improving academic success in this population.

Data availability This plan was preregistered prior to data analysis. The preregistration, as well as the raw data, analysis code, and materials used in this study, are available athttps://osf.io/wfjak.

Declarations

Informed consent Informed consent was obtained from all individual participants included in the study.

Conflict of interest The authors have no interests to declare.

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