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Research Article

Implicit Theories of Intelligence and Achievement Goal Orientations: How are they Associated with College Student Academic Achievement?

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Abstract: The present study considers social-cognitive theory constructs associated with implicit theories of intelligence and achievement goal theory concerning the academic achievement of first-time college students. We examined growth and entity mindsets along with mastery learning, performance-approach, and performance-avoidance achievement goals in relation to academic achievement. Furthermore, social-cognitive theory predictions were examined to determine whether achievement goals mediated relationships between growth and entity mindsets and academic achievement. We randomly sampled 2,000 college students from a large research-intensive public university in the United States, of whom 839 students provided complete data. Using an online survey, we collected self-reported baseline measures of students' implicit theories of intelligence and achievement goal orientations. We matched data from these measures with two years of college Grade Point Average (GPA). Multiple regression analyses of the baseline data partially supported the hypothesized relationships between growth and entity mindsets with learning and performance goal orientations. A growth mindset was a positive predictor of the mastery learning goal orientation. Unexpectedly, mastery learning positively predicted both performance goal orientations but, relative to entity mindset, was a weaker predictor of performance-avoidance goal orientation. Longitudinal analysis with college GPA as the dependent variable found that growth mindset negatively predicted end-of-year two GPA. This relationship was moderated by mastery goal orientation, with greater levels of mastery goal orientation associated with a larger negative relationship between growth mindset and end-of-year two GPA. Furthermore, the growth mindset by mastery goal orientation by time interaction was statistically significant, with students either high in both or low in both experiencing lower GPA over time. Exploration of the mediation hypotheses was partially supported by path analysis. Implications for theory, practice, and further research are discussed.

***Keywords*:** entity, growth, academic, achievement, implicit, theory, intelligence

1. Introduction

According to social-cognitive theory (Dweck, 1986; Dweck & Leggett, 1988), implicit theories of intelligence and achievement goals are important correlates of academic performance (Richardson et al., 2012). These psychological characteristics may explain student learning beyond cognitive processes and demographic characteristics. The research focused on these factors is influential in informing teaching practices as learner beliefs about intelligence and achievement goals may impact student engagement and subsequent learning (Pintrich, 2004). An explanation for the

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effects of beliefs about intelligence is they activate learners' achievement goals. Learners' achievement goals then foster or discourage engagement in learning activities. Students selecting beneficial achievement goals (e.g., mastery learning) are more likely to engage in learning approaches requiring deep cognitive processing (e.g., self-explanation) (Bisra et al., 2018) and those selecting maladaptive achievement goals (e.g., learning for grades) are more likely to engage in learning approaches that use superficial cognitive processing (e.g., memorization). Over the long term, individual differences in cognitive engagement during learning opportunities can result in variability in academic outcomes (Dweck, 1986). Furthermore, and of applied importance, learners' implicit theories of intelligence and achievement goals are malleable, providing intervention points for researchers and practitioners. The present study advances the debate on the relationships between implicit theories of intelligence and achievement goal orientations with academic achievement. We contribute to the debate by examining implicit theories of intelligence, operationalized in the literature as growth and entity mindsets as correlates of achievement goal orientations and academic achievement of college students (Dweck & Leggett, 1988; Pintrich, 2004).

1.1 *Implicit theories of intelligence*

Individuals' explanations of phenomena about themselves and others are implicit theories (Molden & Dweck, 2006). Unlike scientific theories, implicit theories are not subject to confirmation or disconfirmation via empirical testing; rather, they are individuals' beliefs in themselves based on experiences. Theory and evidence indicate learners' implicit theories of intelligence fall into growth and entity mindsets (Dupeyrat & Mariné, 2005; Dweck, 1986). Individuals with growth mindsets believe they can master challenging tasks through practice, effort and experience. Those possessing growth mindsets view ability as malleable, which facilitates persistence when encountering learning challenges. In contrast, learners with entity mindsets view the ability as an innate property that is resistant to change.

Depending on the relative strength of these two views of intelligence, learners' goals likely differ (Dinger & Dickhäuser, 2013; Dupeyrat & Mariné, 2005). For example, upon experiencing frustration while solving a challenging mathematics problem a growth mindset learner will embrace the belief that with the effort, they are capable of successfully mastering the concepts associated with the problem (Rattan et al., 2015). Accordingly, students with growth mindsets will persevere when failing to master difficult tasks. In contrast, possessors of entity mindsets are likely to ascribe successes and failures to their innate capacities. Learners with entity mindsets assume effort will prove futile in changing their future performances. Their belief that ability is predetermined may result in ego involvement and comparing their performance to their peers. Since their goals are concerned with social considerations rather than learning, possessors of entity mindsets are predicted to invest low effort, engage in superficial learning approaches, and quit upon encountering academic difficulties; all of which should result in low academic achievement (Vermetten et al., 2001).

Empirical evidence indicates students' implicit theories of intelligence respond to short targeted interventions (DeBacker et al., 2018; Sriram, 2014) and are associated with achievement goal orientations (Burnette et al., 2013) as well as academic outcomes (Paunesku et al., 2015). However, policy recommendations that mindset interventions improve student academic achievement (e.g., Rattan et al., 2015) may not be warranted given the known limitations of empirical education research (cf. Marley & Levin, 2011). Much remains unknown regarding the relationships between mindsets, achievement goal orientations and academic achievement. Therefore, further study across educational contexts and outcomes is required before making strong prescriptive statements about the efficacy of mindset interventions.

The literature associating mindsets with academic achievement is inconsistent. When domain-specific mindsets and outcomes are examined, positive relationships between growth orientation and academic achievement are observed (Blackwell et al., 2007; Dinger & Dickhäuser, 2013). For example, in a two-part study, Cury et al. (2006) found a growth orientation in mathematics positively predicted mathematics achievement. In a follow-up study, Cury et al. (2006) experimentally manipulated mindset instructions (growth vs. entity) after providing participants with a measure explained as an assessment of intelligence. Participants who received entity mindset instructions performed lower on a second administration of the measure relative to those who received growth mindset instructions. Comparable mindset intervention studies exist in the literature that demonstrates close alignment between intervention components and outcome measures. Tight alignment between intervention components and measures may positively bias the effects of growth mindset instructions (cf. Gersten et al., 2000).

A paucity of evidence generalizable to domain-general academic measures (e.g., GPA, retention) exists in the

implicit theories of intelligence literature. Results from recent correlational studies testing theoretically proposed relationships between mindsets with domain-general measures of academic achievement are inconsistent. For instance, in a recent study with Chilean tenth graders, Claro et al. (2016) found a growth mindset positively predicted student achievement after statistically controlling for socioeconomic status. Additionally, a growth mindset buffered the relationship between socioeconomic status and achievement for low-income students. The authors concluded that a growth mindset mitigates the negative consequences of poverty on student achievement. A limitation of this study is that prior academic achievement was not considered in the analysis. Prior academic achievement is a predictor of subsequent academic achievement and should correlate with the theory of intelligence constructs. Failing to adjust for prior academic achievement may result in a positively biased estimate of the relationship between the growth mindset and academic achievement. In a related longitudinal study, negative relationships of both growth and entity mindsets with standardized achievement were apparent, but the decline was lower for students with predominantly growth mindsets relative to comparable students with entity mindsets (McCutchen et al., 2016).

1.2 *Achievement goal theory*

Research examining achievement goals suggests learners set their performance criteria according to social norms or learning processes and that achievement goals are determinants of learning (Burnette et al., 2013; Pintrich, 2000, 2004). For social criteria, learners often conceptualize their achievement goals in relationship to others, wanting to either display competence or avoid appearing incompetent. These goals are defined as performance approach and avoidance, respectively. In terms of criteria associated with processes of learning, these learner goals focus on improving and/or learning targeted skills to acquire competencies. Achievement goals associated with acquiring skills and competencies are mastery learning goals.

Theoretically, relative to performance goals, mastery learning goals should result in deeper cognitive engagement and superior performance on learning outcomes (Pintrich, 2000, 2004). For example, in university classes, students often have the option of developing a poster to demonstrate their learning. Performance-approach learners will embrace this situation as an opportunity to develop the best poster among classmates while performance-avoidance learners will strive to avoid public embarrassment. Both performance orientations may activate surface-level learning strategies, limited attempts at self-regulation, avoidance strategies and other maladaptive academic behaviors, rather than deep learner engagement and effective self-regulation (Kaplan et al., 2002; Wolters, 2003). In comparison, mastery learning goals are process-oriented and task-focused, emphasizing the acquisition of skills and successful accomplishment of tasks. In the poster context, learners holding mastery-learning goals will consider acquiring the target skills and concepts the objective of the assignment. As a result, mastery goal-oriented learners will cognitively engage in projects more deeply and exhibit greater levels of academic achievement. A meta-analysis of 113 studies by Burnette et al. (2013) confirms the theoretically proposed relationships between achievement goals and academic achievement. Burnette et al. (2013) found that across many populations, domains, contexts and outcomes, mastery learning is positively associated (r = 0.314) with academic achievement as is performance-approach (r = 0.157) and performance-avoidance (r = -0.221). However, there is considerable variability across studies and the relationships may differ based on sample characteristics, settings and outcomes.

1.3 *Achievement goals as mediators of mindsets*

The social-cognitive theory proposes that achievement goals mediate the relationships between mindsets and achievement (Burnette et al, 2013); (see Figure 1 for theoretically proposed relationships). According to Dweck (1986), learners with growth mindsets should exhibit greater mastery of goal orientations. Hence, growth theorists will set mastery goals in learning contexts, even when encountering difficulty, which will influence learner adoption of adaptive academic behaviors. This theoretical proposition suggests mastery goal orientations mediate the relationship between a growth mindset and academic achievement. The relationship between a growth mindset and achievement as mediated by a performance-approach goal orientation is less clear. A recent meta-analysis indicates a small positive relationship between performance-approach goals and academic achievement (Burnette et al., 2013) although these relationships are heterogeneous across studies. Entity theorists are likely to adopt performance-avoidance goals so we anticipate positive relationships between entity mindset and performance-avoidance goals. The reason for this prediction is that students

holding entity mindsets are more likely to set goals associated with a social appraisal. Therefore, we anticipate negative mediation by performance-avoidance goals of the relationship between entity mindset and academic achievement.

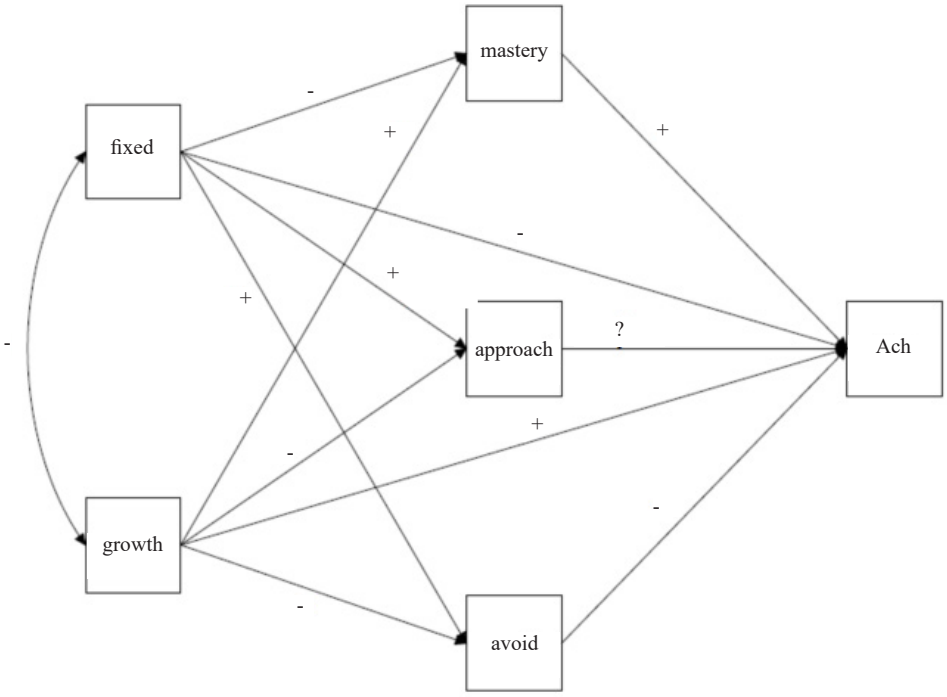

Figure 1. Path model with literature-based hypothesized relationships between mindsets, achievement goal orientations and achievement

2. The present study: Purposes and research questions

The present study examines the just-described predicted relationships among theories of intelligence constructs, achievement goals and GPA with a sample of first-year freshmen at a major university. Studies examining relationships among theories of intelligence constructs, achievement goal orientations, and college student GPA are necessary for several reasons. First, cumulative college GPA is unaligned with domain-specific interventions. Close alignment of mindset interventions with learning outcomes may result in positively biased estimates. GPA consists of the assessments of several faculty members across several domains of study and is less sensitive to targeted mindset and goal orientation measures. Second, college GPA is an ecologically valid outcome associated with student graduation rates, as low-performing students are more likely to drop out. Third, empirical evidence shows considerable heterogeneity in the direction and strength of relationships between growth and entity mindsets with academic outcomes (e.g., Hwang et al., 2016; McCutchen et al., 2016). Lastly, few studies have tested the social-cognitive theory anticipated relationships among mindsets, goal orientations and authentic measures of academic achievement.

The focus of the present study is on college students' implicit theories of intelligence in relation to achievement goal orientations and achievement. Specifically, we investigated two core sets of relationships specified in the implicit theories of intelligence and achievement goal literature. First, we examine relationships between the implicit theory of intelligence constructs and achievement goal orientation constructs. Second, we investigate relationships between the implicit theory of intelligence constructs and a beneficial postsecondary outcome after accounting for key demographic characteristics. We anticipated that examining mindsets and achievement goal orientations will provide a deeper understanding of antecedents and correlate of academic outcomes. Furthermore, with an exploratory analysis, we examine achievement goals as theoretically specified mediators of relationships between mindsets and second-year college achievement as measured by GPA. We addressed the following research questions with a sample of first-time college students over two years.

RQ1. Are growth and entity mindsets predictive of achievement goal orientations?
RQ2. Are mindsets and achievement goals longitudinally predictive of college GPA?
RQ2.1 Do goal orientations moderate the relationships between mindsets and college GPA?
RQ3. Do achievement goal orientations mediate relationships between students' mindsets and college GPA?

3. Method

3.1 *Participants*

Participants were from a large research-intensive public university in the southwestern United States. We randomly sampled racial and ethnic groups to assure valid inferences. We recruited 2,000 first-time freshmen from institutional records and 869 students provided data for analysis, resulting in a final response rate of 43.45%. Due to a small number of Native American participants (n = 30), we excluded their data. This resulted in a final analytical sample of 839 participants. The final sample was 22.2% Asian (n = 186), 21.2% African/African American (n = 177), 30.3% Hispanic (n = 254) and 26.5% White (n = 222). Participants mean age was 19.026 years (SD = 1.277 years) and their mean high school GPA was 3.36 (SD = 0.450). Mean expected family contribution was $16,949.20 ($SD$ = $28,635.54) and 44% of the respondents were male (see Table 1 for descriptive statistics).

Table 1. Baseline demographic mean scores (standard deviations in parentheses), frequencies (percentages in parentheses) by race/ethnicity

					Academic Division			
	N (% total)	Age in Years	High School GPA	Expected Financial Contribution in dollars	Social and Behavioral Sciences	Math and Physical Sciences	Humanities	Health and Life Sciences
Race/Ethnicity								
African American	177 (21.2)	19.093 (1.969)	3.143 (0.414)	12,251 (28,204)	73 (41.2)	55 (35.1)	15 (8.5)	34 (19.2)
Asian	186 (22.2)	18.966 (0.801)	3.478 (0.430)	19,000 (34,229)	79 (42.5)	45 (24.2)	13 (7.0)	49 (26.3)
Hispanic	254 (30.3)	19.003 (1.398)	3.280 (0.436)	10,984 (19,603)	111 (43.7)	63 (24.8)	26 (10.2)	54 (21.3)
White	222 (26.5)	19.019 (0.557)	3.438 (0.446)	26,017 (30,285)	99 (44.6)	51 (23.0)	24 (10.8)	48 (21.6)
Total	839	19.026 (1.277)	3.336 (0.450)	16,949 (28,635)	362 (43.1)	214 (25.5)	78 (9.3)	185 (22.1)

3.2 *Instruments*

With the exception of academic achievement, all instruments were self-reports completed by participants using an online survey program. The self-report measures are established scales with considerable evidence supporting their construct validity. In addition, we confirmed the multidimensional factor structure and tested for measurement invariance of the measures with the present data.

Academic Achievement. The study includes cumulative GPA as an objective indicator of college achievement. The primary advantage to testing theoretically derived relationships with college GPA is that it is a domain-general measure, an authentic outcome with social validity, and is non-reactive like self-reported measures. We gathered GPA from institutional records at the end of each semester for two years, resulting in four measurement occasions (see Table 2 for descriptive statistics).

Table 2. Retention rates and mean GPA by race/ethnicity

	Fall Semester 1	Spring Semester 2	Fall Semester 3	Spring Semester 4
Retention Status (percent retained in each group in parentheses)				
African American	177	173 (97.7)	160 (90.4)	145 (81.9)
Asian	186	186 (100.0)	176 (94.6)	176 (94.6)
Hispanic	254	252 (99.2)	230 (90.9)	219 (86.2)
White	222	219 (98.6)	200 (90.1)	195 (87.8)
Total	839	830 (91.3)	766 (91.5)	735 (89.00)
GPA (standard deviations in parentheses)				
African American	2.985 (0.665)	2.905 (0.635)	2.841 (0.655)	2.849 (0.627)
Asian	3.389 (0.600)	3.376 (0.544)	3.339 (0.538)	3.327 (0.492)
Hispanic	3.175 (0.565)	3.072 (0.581)	3.035 (0.585)	3.013 (0.575)
White	3.379 (0.587)	3.321 (0.592)	3.300 (0.600)	3.288 (0.597)
Total	3.217 (0.644)	3.150 (0.635)	3.109 (0.644)	3.100 (0.625)

Table 3. Baseline demographic frequencies (percentages in parentheses) and mean scores (standard deviations in parentheses) on focal constructs by race/ethnicity

	Entity Mindset	Growth Mindset	Performance Approach	Performance Avoid	Mastery
Race/Ethnicity					
African American	2.354 (1.064)	4.651 (1.086)	2.839 (1.362)	3.239 (1.415)	5.133 (0.979)
Asian	2.858 (1.134)	4.404 (1.101)	3.301 (1.372)	3.683 (1.314)	5.151 (0.894)
Hispanic	2.469 (1.127)	4.422 (1.149)	2.942 (1.380)	3.297 (1.351)	5.178 (0.835)
White	2.731 (1.192)	4.037 (1.228)	3.151 (1.350)	3.469 (1.303)	5.001 (0.976)
Total	2.596 (1.147)	4.365 (1.165)	3.056 (1.375)	3.416 (1.352)	5.116 (0.919)

Entity and Growth Mindsets. The *Theories of Intelligence Scale - Self Form for Adults* (Dweck & Leggett, 1988) was used to measure participants' domain-general perceptions of the nature of intelligence. Specifically, the scale contains eight items with anchors of 1 (Strongly Disagree) to 6 (Strongly Agree) asking the level of endorsement of the entity (e.g., "You have a certain amount of intelligence, and you really cannot do much to change it") and growth (e.g., "You can always substantially change how intelligent you are") mindset statements. The scale produces subscores for entity and growth orientations. With the present sample, the mean entity and growth mindset scores were 2.59 (SD = 1.15) and 4.38 (SD = 1.16), respectively, and Cronbach's αs > 0.90 on both scales. There is some question as to whether

the mindsets are distinct constructs or are best characterized by a general mindset with growth and entity mindsets on either end of a continuum (Murphy & Dweck, 2010). To examine if the scores produced by the measure represent two separable constructs, we performed a confirmatory factor analysis. Results indicated two correlated factors X^2_{19} = 193.886 fit the data better than a general factor X^2_{20} = 867.893, ΔX^2_1 = 674.007 and $p < 0.001$. Therefore, subsequent analyses examined growth and entity mindsets in relation to achievement goals and academic achievement (see Table 3 for descriptive statistics).

Achievement Goal Orientations (Midgley et al., 1998). To measure domain-general mastery learning, performance-approach, and performance-avoid achievement goal orientations students completed the *Patterns of Adaptive Learning Scales* (PALS). The PALS is an established measure with considerable evidence supporting construct validity across contexts and populations (Jagacinski & Duda, 2001; Midgley et al., 1998; Ross et al., 2002). The scales have anchors of 1 (Strongly Disagree) to 6 (Strongly Agree). Mastery learning included five items to assess participant goals to develop competence and understanding (e.g., "It's important to me that I learn a lot of new concepts this year."). The five items assessing performance-approach goal orientation included questions associated with a desire to display competency in front of others (e.g., "It's important to me that other students in my class think I am good at my class work."). Performance-avoid goal orientation is the desire to avoid appearing foolish or incompetent (e.g., "It's important to me that I don't look stupid in class."). Cronbach's αs for each of these three scales with our sample were 0.927, 0.932 and 0.887, respectively. To examine if the scores produced by the measure represent three constructs, we performed a confirmatory factor analysis contrasting the fit of a one-factor with a three-factor model. Results indicated three correlated factors X^2_{74} = 627.694 fit better than a general factor X^2_{77} = 4587.988, ΔX^2_3 = 3,960.294 and $p < 0.001$. Subsequent analyses examined the goal orientation subscores in relationship to other variables.

3.3 *Procedure*

We sent an email inviting participation in an online survey at the beginning of students' first year of college. The online survey, developed for completion on a computer or mobile device, required 10-15 minutes to complete. We matched institutional records containing demographic information, high school GPA and cumulative semester GPA for four semesters to participants' survey responses. To reduce nonresponse, participants were contacted by email with participation requests five times and provided a token incentive for participating (Dillman, 2011).

3.4 *Analysis approach*

Before the analysis, we examined all variables to check statistical assumptions. Table 4 contains the means, standard deviations, and correlations of the focal variables. We addressed RQ1 with hierarchical multiple regression (Cohen et al., 2002) with achievement goal orientations as dependent variables. In the first step, we entered demographic characteristics of race/ethnicity, gender, expected family contribution and high school GPA, followed by noting variance accounted for and statistical significance. In the second step, growth and entity mindsets were included to ascertain if the change in variance accounted for by the two factors was statistically significant. All continuous independent variables were transformed to z-scores to ease interpretation of the y-intercept and coefficients (i.e., a unit increase represents a standard deviation). The categorical variables of race/ethnicity, gender and area of study were dummy coded with white female social science students as the reference group. This coding scheme, along with the z-scored continuous variables, resulted in the intercept representing the covariate-adjusted predicted score of white females in the social sciences at the mean of the continuous independent variables.

RQ2 was examined with a hierarchical linear model with intercepts and slopes as outcomes (Raudenbush & Bryk, 2001). At level one, GPA was measured on four measurement occasions and nested within individuals at level two. Using the notation of Raudenbush and Bryk (2001), the level one model is described by equation 1.

$$GPA_{ti} = \pi_{0i} + \pi_{1i} Time_{ti} + e_{ti} \quad (1)$$

Where:

GPA_{ti} is cumulative college GPA at the time t of student i.

π_{0i} is the intercept parameter for when $Time_{ti}$ equals zero. For this analysis, time is coded as -3 for semester one, -2 for semester two, -1 for semester three and 0 for semester four; resulting in the intercept representing the GPA of students at the end of year two.

π_{1i} is the growth rate for a person during a fixed unit of time.

e_{ti} is the level one error term.

At level two, four additional models were specified with demographics and motivational constructs as predictors of the level one intercept and time slope. As with the prior analysis, all continuous independent variables were converted to z-scores. The four additional models are as follows: (a) M2 contained demographic characteristics; (b) M3 added entity and growth mindsets; (c) M4 added achievement goal orientations and (d) M5 included interactions of mastery orientation with growth and entity mindsets (see equations 2 and 3 for full level two models).

$$\begin{aligned}\pi_{0i} = {} & \beta_{00} + \beta_{01}(Gender) + \beta_{02-04}(Race) + \beta_{05}(SES) + \beta_{06}(HSGPA) + \beta_{07}(Age) \\ & + \beta_{08-010}(Academic\ Division) + \beta_{011}(Growth) + \beta_{012}(Entity) \\ & + \beta_{013}(Mastery) + \beta_{014}(Approach) + \beta_{015}(Avoid) \\ & + \beta_{016}(Mastery * Growth) + \beta_{017}(Mastery * Entity) + r_{0i} \end{aligned} \quad (2)$$

$$\begin{aligned}\pi_{1i} = {} & \beta_{10} + \beta_{11}(Gender) + \beta_{12-14}(Race) + \beta_{15}(SES) + \beta_{16}(HSGPA) + \beta_{17}(Age) \\ & + \beta_{18-120}(Academic\ Division) + \beta_{121}(Growth) + \beta_{122}(Entity) \\ & + \beta_{123}(Mastery) + \beta_{124}(Approach) + \beta_{125}(Avoid) \\ & + \beta_{126}(Mastery * Growth) + \beta_{127}(Mastery * Entity) + r_{1i} \end{aligned} \quad (3)$$

Where:

β_{00} is the mean intercept.

β_{10} is the mean growth rate.

r_{0i} is the level two random effect for the intercept.

r_{1i} is the level two random effect for the time slope.

To test model fit, each model was compared to the prior model using the deviance test in -2 log likelihoods and compared to a chi-square distribution based on the difference in the number of parameters estimated (for details see, Snijders & Bosker, 2011). The type I error rate for all of the effects was set at 0.05. As a measure of effect size, we report the percentage of variance accounted for by the last model in the intercept and slope relative to the unconditional growth model.

As an exploratory analysis, for RQ3 we examined, if achievement goal orientations mediated the relationships between growth and entity mindsets with GPA. Due to the design of the study, the independent and theoretically proposed mediators were collected simultaneously. This design characteristic limits the strength of the study to make strong conclusions about mediation. However, the tests of mediation provide an initial examination of social-cognitive theory hypotheses (Dweck, 1986) and are worth noting for future research. Therefore, we tested a path model (see Figure 1) to examine the direct and indirect effects of growth and entity mindsets on second-year GPA. The type I error rate was established at 0.05.

Table 4. Correlations of study variables, means on diagonal and standard deviations in parentheses

Variable	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16
V1. High school GPA	3.33 (0.44)															
V2. Age in years	-0.078*	19.02 (1.33)														
V3. Estimated family contribution	0.06	-0.05	16,491 (28,286)													
V4. Cumulative GPA fall14	0.527*	0.03	0.06	3.21 (0.64)												
V5. Cumulative GPA spring 15	0.549*	-0.01	0.06	0.887*	3.14 (0.63)											
V6. Cumulative GPA fall 15	0.575*	-0.04	0.098*	0.854*	0.948*	3.10 (0.64)										
V7. Cumulative GPA spring 16	0.578*	-0.03	0.100*	0.806*	0.900*	0.972*	3.10 (0.62)									
V8. Cumulative credit hours Fall 14	0.399*	-0.152*	0.05	0.467*	0.490*	0.520*	0.479*	13.91 (2.83)								
V9. Cumulative credit hours Spring 16	0.463*	-0.185*	0.106*	0.542*	0.585*	0.612*	0.585*	0.770*	28.53 (4.99)							
V10. Cumulative credit hours Fall 15	0.454*	-0.150*	0.122*	0.587*	0.647*	0.668*	0.633*	0.593*	0.785*	42.48 (8.55)						
V11. Cumulative credit hours Spring 16	0.440*	-0.152*	0.104*	0.556*	0.623*	0.661*	0.646*	0.525*	0.720*	0.940*	55.92 (12.80)					
V12. Entity mindset	0.077*	-0.02	0.095*	0.06	0.06	0.092*	0.06	0.090*	0.07	0.05	0.06	2.59 (1.15)				
V13. Growth mindset	-0.094*	0.01	-0.155*	-0.104*	-0.128*	-0.152*	-0.131*	-0.124*	-0.108*	-0.088*	-0.083*	-0.632*	4.36 (1.17)			
V14. Mastery	0.01	0.01	-0.113*	0.080*	0.088*	0.075*	0.06	0.05	0.107*	0.081*	0.087*	-0.146*	0.251*	5.12 (0.91)		
V15. Performance-approach	-0.03	-0.076*	0.04	0.03	0.05	0.03	0.01	0.01	0.02	0.04	0.02	0.106*	0.04	0.156*	3.06 (1.38)	
V16. Performance-avoid	0.04	-0.07	0.04	0.087*	0.108*	0.106*	0.093*	0.06	0.074*	0.105*	0.092*	0.217*	-0.078*	0.131*	0.630*	3.42 (1.35)

*$p < 0.05$

4. Results

RQ1. After accounting for demographic characteristics, are growth and fixed mindsets associated with achievement goal orientations*?*

Theory suggests a growth mindset is associated with greater learning goals and lower performance goals. Conversely, entity mindsets were anticipated to exhibit lower mastery learning goals and greater performance orientations (Burnette et al., 2013; Dweck, 1986).

Table 5. Hierarchical regression results of goal orientations on demographics and mindsets (standard errors in parentheses)

	Mastery Learning		Performance Approach		Performance Avoid	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Independent Variables						
Intercept	5.075 (0.078)**	5.145 (0.077)**	3.131 (0.116)**	3.204 (0.116)**	3.472 (0.114)**	3.509 (0.113)**
Demographics Race/Ethnicity (ref = White)						
African American	0.080 (0.098)	-0.014 (0.096)	-0.356 (0.146)*	-0.397 (0.146)*	-0.226 (0.144)	-0.199 (0.142)
Hispanic	0.136 (0.088)	0.080 (0.085)	0.229 (0.130)	-0.245 (0.129)	-0.154 (0.128)	-0.128 (0.126)
Asian	0.127 (0.093)	0.053 (0.092)	0.191 (0.138)	0.078 (0.139)	0.246 (0.136)	0.158 (0.135)
Gender (ref = female)	-0.066 (0.067)	-0.070 (0.065)	-0.081 (0.100)	-0.120 (0.099)	-0.242 (0.098)*	-0.291 (0.096)
Age	0.026 (0.043)	0.020 (0.042)	-0.100 (0.064)	-0.100 (0.063)	-0.097 (0.063)	-0.092 (0.061)
Expected Family Contribution	-0.095 (0.033)*	-0.067 (0.032)*	0.038 (0.049)	0.048 (0.049)	0.048 (0.049)	0.037 (0.048)
High School GPA	0.019 (0.034)	0.033 (0.033)	-0.095 (0.051)	-0.092 (0.050)	-0.005 (0.050)	-0.012 (0.049)
Academic Division (ref = Social Sciences)						
Math and Physical Sciences	0.036 (0.080)	0.012 (0.078)	0.029 (0.119)	0.018 (0.118)	0.090 (0.117)	0.097 (0.115)
Humanities	-0.174 (0.116)	-0.199 (0.113)	0.356 (0.173)*	0.335 (0.171)*	0.184 (0.170)	0.176 (0.166)
Health and Life Sciences	-0.038 (0.084)	-0.055 (0.082)	0.093 (0.126)	0.053 (0.124)	0.194 (0.124)	0.155 (0.121)
Mindsets						
Entity		0.014 (0.041)		0.257 (0.062)**		0.378 (0.060)**
Growth		0.235 (0.041)**		0.275 (0.062)**		0.140 (0.061)*
R_c^2		0.057**		0.028**		0.050**
R^2	0.022	0.079**	0.030*	0.059**	0.030*	0.080**

Notes: All continuous independent variables are in z-scores. Last statistically significant block reported. Betas are unstandardized. Interactions of demographic characteristics with mindsets considered in a third block but did not account for significant variance
*$p \leq 0.05$
**$p < 0.001$

Mastery Goal Orientation. The first step including demographic characteristics as predictors of mastery goal

orientation was not statistically significant, $F(10, 807) = 1.822$, $R^2 = 0.022$, $p = 0.053$. The addition of growth and entity mindsets resulted in a significant change in explained variance, $F_c(2, 805) = 24.883$, $R^2_c = 0.057$, $p < 0.001$; resulting in a statistically significant, $F(12, 805) = 5.755$, $R^2 = 0.079$, $p < 0.001$, overall regression model (see Table 5 for complete results of all models). In terms of demographics, economic status was a statistically significant negative predictor of mastery learning goal orientation in the final regression model, $B = -0.067$, $p = 0.039$, 95% CI [-0.131, -0.003]. In addition, growth mindset $B = 0.235$, $p < 0.001$, 95% CI [0.154, 0.316] was a statistically significant positive predictor of mastery goal orientation as theoretically anticipated.

Performance-Approach. The first step including demographic characteristics as predictors was statistically significant, $F(10, 807) = 2.528$, $R^2 = 0.030$, $p = 0.005$. The addition of growth and entity mindsets explained additional variance, $F_c(2, 805) = 12.183$, $R^2_c = 0.029$, $p < 0.001$; resulting in a statistically significant overall regression model $F(12, 805) = 4.195$, $R^2 = 0.059$, $p < 0.001$. Inspection of significant beta coefficients revealed that relative to their white counterparts, African American participants had lower performance-approach scores, $B = -0.397$, $p = 0.007$, 95% CI [-0.684, -0.111] and humanities participants reported greater scores, $B = 0.335$, $p = 0.050$, 95% CI [0.001, 0.670] than social science participants. Verifying theoretical expectations, entity mindset was a positive predictor, $B = 0.292$, $p < 0.001$, 95% CI [0.171, 0.414]. However, contrary to theory, a growth mindset was a positive predictor of performance approach as well, $B = 0.257$, $p < 0.001$, 95% CI [0.134, 0.379].

Performance-Avoid. Demographic characteristics entered in the first block accounted for a statistically significant amount of variance, $F(10, 807) = 2.512$, $R^2 = 0.030$, $p < 0.001$. The addition of growth and entity mindsets accounted for an additional 5% of the variance, $F_c(2, 805) = 22.014$, $p < 0.001$; resulting in a statistically significant, $F(12, 805) = 5.871$, $R^2 = 0.080$, $p < 0.001$, overall regression model. Examination of significant beta coefficients revealed a significant effect for sex with males scoring lower than females, $B = -0.291$, $p = 0.002$, 95% CI [-0.479, -0.103]. In addition, growth and entity mindsets were positive predictors $Bs = 0.140$ and 0.378, $ps = 0.022$ and < 0.001, 95% CIs [0.020, 0.259] and [0.260, 0.497]. Theory predicts entity mindset should be a positive predictor and growth, a negative predictor of performance-avoidance goal orientation. At a minimum, an entity mindset should be a stronger predictor of performance-avoidance goal orientation. Therefore, to determine if entity mindset was a larger predictor, we tested the two beta coefficients for equality. The difference, $b_E - b_G = 0.238$, was statistically significant, Wald's $Z = 5.360$, $p < 0.001$, 95% CIs [0.151, 0.325] indicating entity mindset is a stronger predictor than growth mindset of performance-avoidance goal orientation.

RQ2. Are mindsets and achievement goals longitudinally predictive of college GPA?
RQ2.1 Do goal orientations moderate the relationships between mindsets and college GPA?

It is possible, if not likely, that mindsets and goal orientations work in tandem to promote academic achievement. Therefore, we examined whether baseline mindsets and achievement goal orientations interact to predict change in and final GPA over two years.

Cumulative Grade Point Average. In comparison to prior models, consecutive models were statistically significant (see Table 6). In addition, a final model (M5) testing all possible interactions of mindsets, goal orientations and time was statistically significant. After eliminating nonsignificant interactions from Model 5, mastery orientation moderated the relationship between growth mindset and change over time and final GPA. The final model accounted for 41.28% and 6.25% of the variance in the intercept and slope, respectively. However, M2 consisting of student demographic characteristics accounted for 38.61% of the intercept and 5% of slope variances. In other words, the inclusion of the mindsets and achievement goal orientations accounted for an additional 2.67% and 1.25% of intercept and slope variance beyond basic demographic characteristics. In the following paragraphs, we interpret the statistically significant coefficients from model five.

The y-intercept representing end of year two GPA was statistically significant, $\beta_{00} = 3.251$, $p < 0.001$, 95% CI [3.16, 3.33]. Demographic characteristics of gender $\beta_{01} = -0.080$, $p = 0.019$, 95% CI [-0.15, -0.01] and high school GPA $\beta_{06} = 0.332$, $p < 0.001$, 95% CI [0.296, 0.368] were statistically significant predictors of end of second year GPA. Further, relative to comparable white peers, African American students $\beta_{03} = -0.257$, $p < 0.001$, 95% CI [-0.30, 0.15] and Hispanic students $\beta_{04} = -0.178$, $p < 0.001$, 95% CI [-0.27, -0.08] had lower GPAs.

In terms of change in GPA over time, the main effect of time was not statistically significant, $\beta_{10} = -0.0013$, $p = 0.159$,

95% CI [-0.03, 0.005]. However, several demographic characteristics were predictive of the slope for time. Gender was a positive predictor of the time slope with males earning lower grades over time β_{11} = -0.017, p = 0.034, 95% CI [-0.033, -0.001] than females. Relative to white college students, African American β_{13} = -0.028, p = 0.020, 95% CI [-0.05, -0.004] and Hispanic β_{14} = -0.025, p = 0.016, 95% CIs [-0.047, -0.004] students experienced greater GPA decrements over time. High school GPA was a positive predictor, β_{16} = 0.009, p = 0.027, 95% CI [0.001, 0.017] and age was a negative predictor of change over time, β_{17} = -0.011, p = 0.030, 95% CI [-0.021, -0.001].

Table 6. Growth models predicting cumulative gpa from demographics, theories of intelligence and goal orientations (standard errors in parentheses)

	M1	M2	M3	M4	M5
Fixed Effects					
Year two status, π_{0i}					
Intercept, β_{00}	3.094 (0.022)	3.247 (0.044)**	3.247 (0.043)**	3.239 (0.042)**	3.251 (0.042)**
Demographics					
Gender (ref = female), β_{01}		-0.099 (0.036)**	-0.093 (0.036)*	-0.080 (0.036)*	-0.084 (0.036)*
Race (ref = white)					
Asian, β_{02}		-0.004 (0.050)	0.002 (0.051)	-0.007 (0.050)	-0.004 (0.050)
African American, β_{03}		-0.264 (0.050)**	-0.259 (0.054)**	-0.254 (0.053)**	-0.257 (0.053)**
Hispanic, β_{04}		-0.167 (0.047)**	-0.173 (0.047)**	-0.175 (0.047)**	-0.178 (0.047)**
Socio Economic Status, β_{05}		0.022 (0.017)	0.025 (0.018)	0.028 (0.180)	0.022 (0.018)
High School Grade Point Average, β_{06}		0.339 (0.018)**	0.335 (0.018)**	0.333 (0.018)**	0.332 (0.018)**
Age, β_{07}		-0.007 (0.023)	-0.003 (0.023)	-0.002 (0.023)	0.0001 (0.023)
Academic Division (ref = Social Sciences)					
Math and Physical Sciences, β_{08}		0.006 (0.043)	0.009 (0.043)	0.005 (0.043)	0.006 (0.042)
Humanities, β_{09}		-0.020 (0.062)	0.003 (0.062)	0.007 (0.062)	0.023 (0.062)
Health and Life Sciences, β_{010}		-0.037 (0.045)	-0.029 (0.046)	-0.031 (0.045)	-0.019 (0.045)
Theory of Intelligence					
Growth Mindset, β_{011}			-0.037 (0.023)	-0.056 (0.023)*	-0.060 (0.023)*
Entity Mindset, β_{012}			-0.020 (0.022)	-0.033 (0.023)	-0.041 (0.023)
Goal Orientations					
Mastery, β_{013}				0.059 (0.018)*	0.044 (0.018)*
Performance Approach, β_{014}				-0.008 (0.022)	-0.005 (0.022)
Performance Avoid, β_{015}				0.048 (0.022)*	0.040 (0.022)
Mastery by Mindset Interactions					
Mastery by Growth Mindset, β_{016}					-0.051 (0.017)*
Mastery by Entity Mindset, β_{017}					0.006 (0.019)
Growth Rate, π_{1i}					
Intercept, β_{110}	-0.039 (0.003)**	-0.016 (0.001)**	-0.016 (0.009)	-0.016 (0.009)	-0.013 (0.009)
Demographics					
Gender (ref = female), β_{111}		-0.017 (0.008)*	-0.016 (0.008)*	-0.016 (0.008)*	-0.017 (0.008)*
Race (ref = white)					
Asian, β_{112}		-0.012 (0.011)	-0.011 (0.011)	-0.010 (0.011)	-0.009 (0.011)

African American, β_{113}		-0.022 (0.011)	-0.026 (0.012)*	-0.027 (0.012)*	-0.028 (0.121)*
Hispanic, β_{114}		-0.023 (0.010)*	-0.024 (0.107)*	-0.025 (0.010)*	-0.025 (0.010)*
Socio Economic Status β_{115}		0.008 (0.003)*	0.008 (0.004)*	0.008 (0.004)*	0.007 (0.004)
High School Grade Point Average, β_{116}		0.009 (0.004)*	0.009 (0.004)*	0.009 (0.004)*	0.009 (0.004)*
Age, β_{117}		-0.011 (0.005)	-0.011 (0.005)	-0.011 (0.005)*	-0.011 (0.005)*
Academic Division (ref = Social Sciences)					
Math and Physical Sciences, β_{118}		-0.001 (0.009)	-0.001 (0.005)	-0.001 (0.009)	-0.001 (0.009)
Humanities, β_{119}		-0.012 (0.014)	-0.013 (0.014)	-0.010 (0.014)	-0.007 (0.014)
Health and Life Sciences, β_{120}		-0.003 (0.010)	-0.003 (0.010)	-0.003 (0.010)	-0.001 (0.010)
Theory of Intelligence					
Growth Mindset, β_{121}			-0.004 (0.005)	-0.056 (0.023)*	-0.005 (0.005)
Entity Mindset, β_{122}			0.001 (0.005)	-0.033 (0.023)	0.0009 (0.005)
Goal Orientations					
Mastery, β_{123}				0.004 (0.005)	0.003 (0.005)
Performance Approach, β_{124}				-0.0002 (0.004)	-0.003 (0.004)
Performance Avoid, β_{125}				-0.008 (0.005)	-0.008 (0.005)
Mastery by Mindset Interactions					
Mastery by Growth Mindset, β_{126}					-0.010 (0.003)*
Mastery by Entity Mindset, β_{127}					0.003 (0.004)
Random Effects					
Year two status	0.396 (0.0190)**	0.2431 (0.0122)**	0.2409 (0.012)**	0.2352 (0.0120)**	0.2325 (0.0118)
Growth rate	0.008 (0.0007)**	0.0076 (0.0007)**	0.0076 (0.001)**	0.0076 (0.007)**	0.0075 (0.0007)
Model Fit					
DF	8	28	32	38	42
-2LL	951.411	500.889	480.988	458.389	440.038
Deviance		450.522	19.901	22.599	18.352
		$p < 0.001$	$p = 0.005$	$p < 0.001$	$p = 0.001$

In terms of the focal variables, several main effects and interactions were statistically significant predictors of end of year-two GPA. First, and contrary to theoretical expectations, a growth mindset was negatively associated with the end of year two GPA β_{011} = -0.060, p = 0.010, 95% CI [-0.10, -0.01]. Second, and as expected, mastery learning goal orientation positively predicted end of year-two GPA, β_{013} = 0.044, p = 0.020, 95% CI [0.007, 0.08]. However, a statistically significant interaction of growth mindset and mastery goal orientation tempered these two main effects, β_{016} = -0.051, p = 0.003, 95% CI [-0.08, -0.01]. To examine the interaction, we calculated and tested simple intercepts and slopes for cumulative GPA on growth mindset at a standard deviation below, at the mean and a standard deviation above the mean of mastery learning goal orientation. At one standard deviation below the mean the simple intercept and slope for growth were 3.210 and -0.009, *ps* < 0.001 and 0.749, 95% CIs [3.11, 3.33] and [-0.05, 0.04], respectively. At the mean of mastery, the simple intercept and slope for growth were 3.251 and -0.060, p < 001 and 0.009, 95% CIs [3.16, 3.33] and [-0.10, -0.01], respectively. One standard deviation above the mean of mastery the simple intercept was 3.29, p < 0.001, 95% CI [3.19, 3.38] and the slope was -0.11, p < 0.001, 95% CI [-0.16, -0.05]. To understand the interaction, we plotted the simple intercepts and slopes at the three values of mastery (see Figure 2). Based on the graph, mean and high levels of mastery were associated with a negative slope of GPA on growth mindset.

The mastery orientation by growth mindset interaction was also a statistically significant predictor of change in GPA over time β_{126} = -0.010, p = 0.005, 95% CI [-0.017, -0.003]. To explore this interaction, we calculated and plotted the simple intercepts of combinations one standard deviation below and above the mean on both variables (i.e., low growth/low mastery, low growth/high mastery, high growth, low mastery, and high growth/high mastery) in relation to time. For low growth/low mastery, the simple intercept was 3.22, $p < 0.001$, 95% CI [3.12, 3.31] and the slope for time was -0.02, p = 0.04, 95% CI [-0.04, -0.0004]. With low growth/high mastery, the simple intercept and slope were 3.41 and -0.007, $p < 0.01$ and p = 0.52, 95% CIs [3.31, 3.50] and [-0.02, 0.01], respectively. The simple intercept and slope for high growth/low mastery were 3.20 and 0.001, $p < 0.001$ and p = 0.94, 95% CIs [3.08, 3.32] and [-0.02, 0.02], respectively. For participants who were high on both constructs, the intercept was 3.18, $p < 0.001$, 95% CI [3.08, 3.28] and the slope was -0.02, p = 0.04, 95% CI [-0.03, -0.0004]. To examine the interaction, we plotted the four combinations with time on the x-axis and GPA on the y-axis (see Figure 3). Based on the graph, holding high or low perceptions of both constructs simultaneously is related to greater loss in GPA over time and having mixed growth and mastery orientations is associated with the nonsignificant change in GPA over time.

RQ 3. Do goal orientations mediate the relationships between students' mindsets and college GPA?

Social-cognitive theory suggests learning goals mediate the relationship between growth mindset and achievement and performance goals mediate the relationship between entity mindset and achievement. As an exploratory test, we tested the path model in Figure 1 with second-year GPA as the dependent variable.

The standardized total indirect effect of growth mindset on second-year cumulative GPA was statistically significant β = 0.029, p = 0.027, 95% CI [0.009, 0.04] (see Figure 4 for path model with significant paths included). In terms of specific indirect effects, mastery was a significant mediator of the relationship between growth mindset and GPA, β = 0.026, p = 0.012, 95% CI [0.006, 0.04]. The indirect effects of a growth mindset on academic achievement via performance- approach and avoidance pathways were not statistically significant, βs = -0.01 and 0.014 and ps = 0.22 and 0.06, respectively. Additionally, performance-avoid goal orientation was a statistically significant mediator of entity mindset with GPA, β = 0.038, p = 0.008, 95% CI [0.01, 0.06]. Mastery and performance-approach goal orientations were not significant mediators of entity mindset with βs = 0.001 and -0.013 and ps = 0.76 and 0.22.

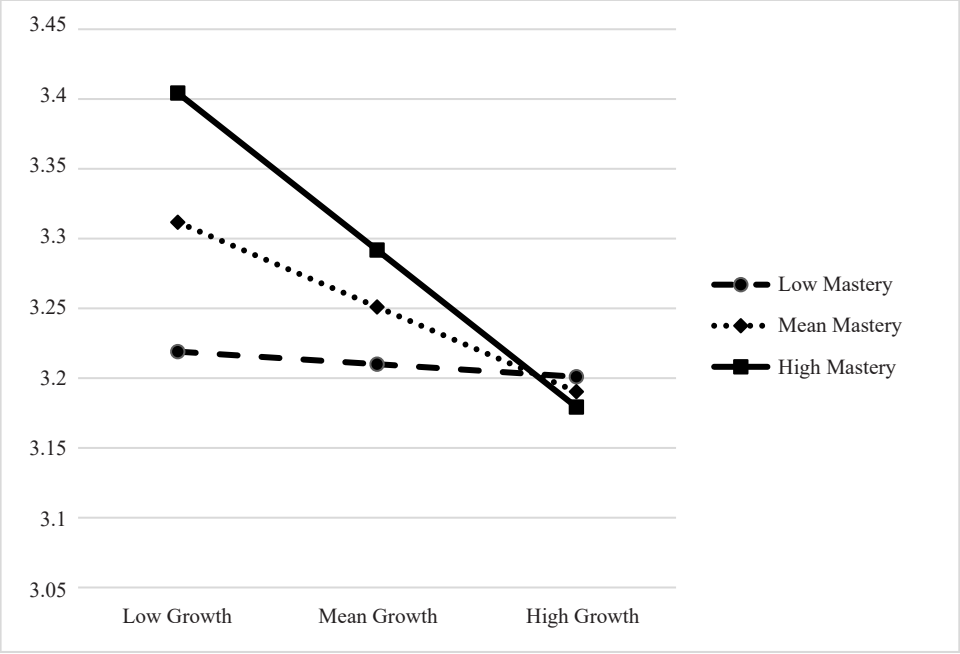

Figure 2. Simple slopes for growth mindset by mastery learning goals interaction on GPA

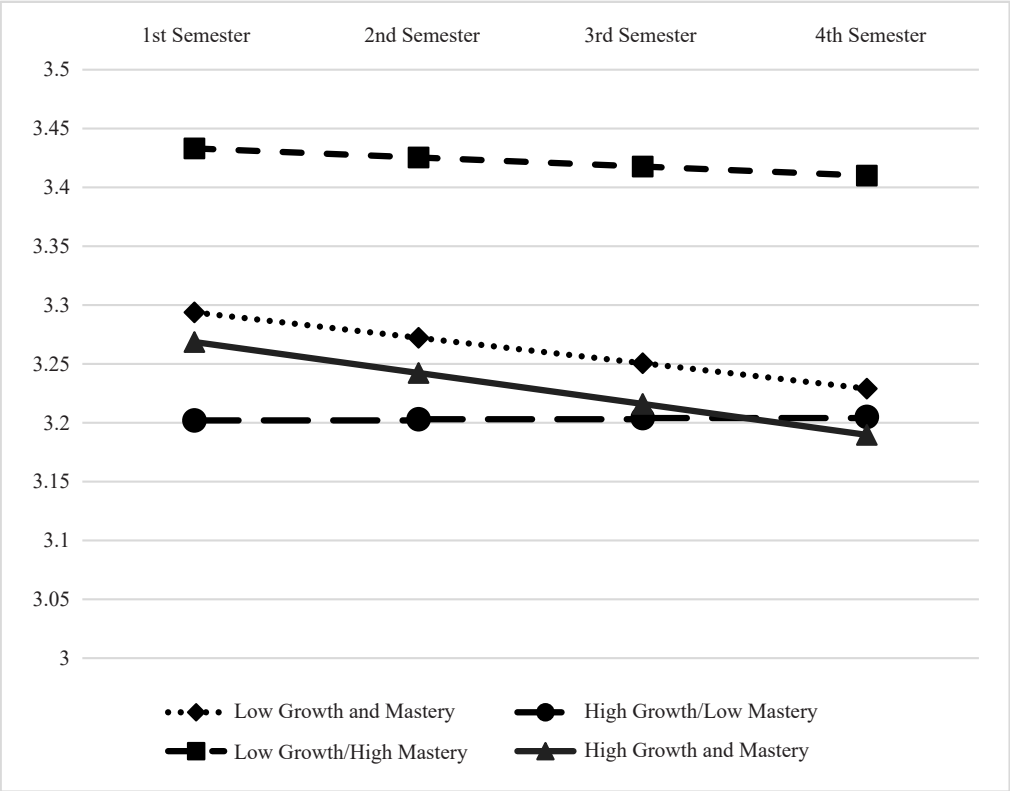

Figure 3. Growth by mastery by time interaction on GPA

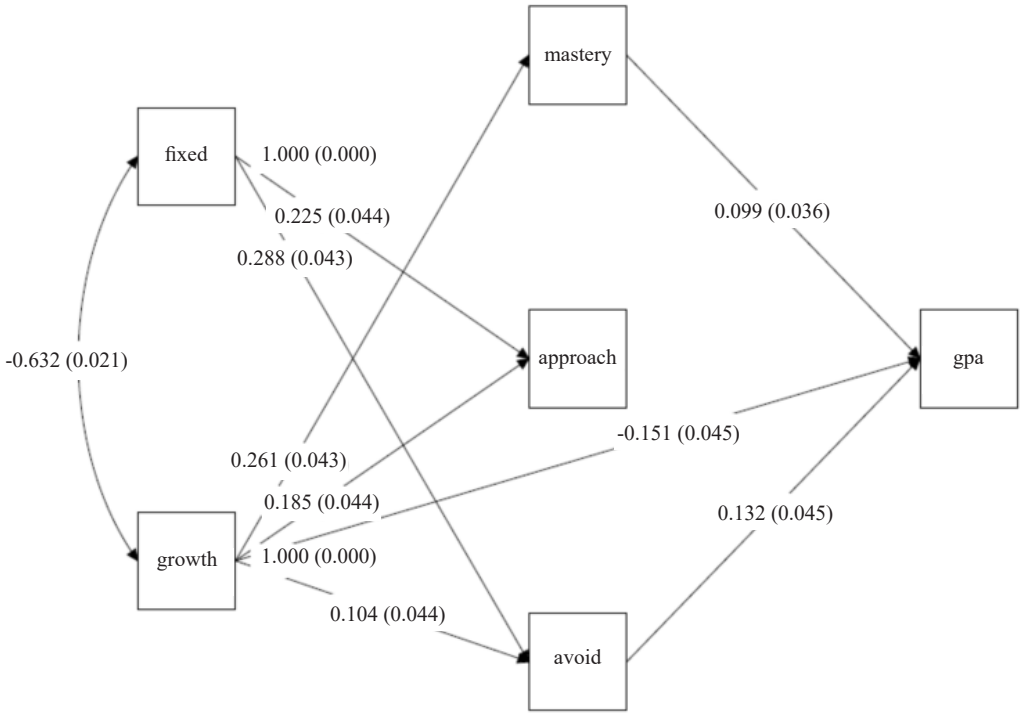

Figure 4. Path model with standardized coefficients (standard errors in parentheses) and nonsignificant ($p > 0.05$) paths removed

5. Discussion

We examined entity and growth mindsets in relationship with achievement goals after accounting for demographic characteristics. In accordance with social cognitive theory, the growth mindset positively predicted mastery of learning goals and an entity mindset positively predicted both performance orientations. Contrary to theory, a growth mindset was positively predictive of both performance and goal orientations. Both performance orientations are associated with social concerns and are considered maladaptive to meaningful learning. In addition, the positive relationships between growth and entity mindsets with performance-avoidance were larger for entity relative to a growth mindset. This finding suggests that although a growth mindset is associated with performance-avoidance goals, an entity mindset potentially plays a larger role in setting performance avoidant academic behaviors.

Second, we investigated if mindsets, goal orientations and their interactions were predictive of end of second-year GPA. The results indicate growth mindset and mastery goal orientation have negative and positive relationships with second-year cumulative GPA, respectively. Surprisingly, we did not find a longitudinal relationship between entity mindset and academic achievement as reported elsewhere (McCutchen et al., 2016). The finding that a growth mindset at baseline negatively predicts college student GPA was theoretically and empirically unanticipated and partially replicates prior research (McCutchen et al., 2016). The positive relationship between mastery learning goals and achievement was unsurprising given the consistency of prior evidence (e.g., Belenky & Nokes-Malach, 2012; Dupeyrat & Mariné, 2005).

Growth mindset and mastery learning goal orientation interacted to predict change over time and GPA. However, probing the interactions did not indicate a synergistic effect with college students who are high in both having greater achievement. Rather, when simultaneously high or low in growth mindset and mastery learning, the simple slopes of GPA on time were negative, while mixed mindset and goal orientations had nonsignificant slopes. The finding that holding a low growth mindset along with low mastery goal orientation is associated with a negative relationship between time and GPA is expected. The finding that holding both a high growth mindset and mastery learning orientation is associated with a negative slope for time is surprising, because we anticipated the two positive qualities would synergistically combine to support academic achievement. A comparable finding was observed when probing the growth mindset by mastery learning goal interaction in predicting the end of year two GPA. Participants holding high and mean levels of mastery learning goals exhibited negative growth mindset slopes while low mastery goal orientation students had a flat slope for growth mindset on final GPA. Third, an exploratory mediational analysis considering the theoretical predictions of achievement goal orientations mediating the relationships between mindsets and second-year GPA found positive indirect effects for growth via mastery and entity via performance-avoidance goals.

5.1 *Theoretical implications*

According to social cognitive theoretical explanations, implicit views of intelligence set achievement goal orientations (Burnette et al, 2013; Dweck & Leggett, 1988). Students with growth mindsets view their academic performances as malleable through effort and persistence while those with entity theorists hold the view that their performances are unmalleable. As a result of these beliefs about the nature of intelligence, growth and entity theorists set achievement goals that promote either adaptive or maladaptive academic behavior. Social cognitive theory predicts learners with growth mindsets will set mastery learning goals because they hold the view that aptitude changes with persistence and effort. The setting of mastery learning goals increases the likelihood of deep cognitive processing. Achievement goal theory (Pintrich, 2000) anticipates greater academic achievement because learners engage in this deep cognitive processing.

Our results suggest baseline growth mindset is positively associated with baseline learning and performance goals and negatively associated with the end of year two college GPA. Why growth orientations are positively predictive of performance goal orientations and a negative relationship exists with GPA is difficult to determine with the present data. The observed cross-sectional associations of growth mindset with mastery learning goals and entity mindset with performance goals cohere with theory. Our finding of entity mindset positively predicting performance goals and not learning goals was theoretically expected and replicates prior research (Dinger & Dickhäuser, 2013; Vermetten et al., 2001; Yeager et al., 2014). Our results support theoretical propositions suggesting entity theorist students want to appear competent and avoid looking foolish. In other words, when one must acquire new conceptions and skills, entity mindset theorists are likely to activate performance goals (Dweck, 1986).

The longitudinal results are somewhat contrary to theoretically anticipated relationships. Social-cognitive theory predicts that growth and entity mindsets are positively and negatively associated with achievement, respectively. Potential explanations for the unanticipated results are that domain-general growth mindset may be a protective factor held by lower performing college students to reassure themselves they are academically capable and performance goal orientations are positive in certain contexts. In terms of the first explanation, individuals often hold high levels of confidence in their abilities while performing poorly on performance measures (Kruger & Dunning, 1999). Concerning the latter explanation, when a task is not particularly relevant to students, goals associated with appearing proficient to others or avoiding failure may result in beneficial learning. College environments often reward performance over authentic learning and it may be detrimental to focus on learning opportunities not directly related to class objectives. Mastery learning goals may not always provide paths to academic success and social comparisons play a role for growth theorists as well.

We explored two theoretically relevant possibilities with our data. First, we tested whether mastery learning goals moderate the relationships between mindsets and GPA. Mastery goals moderated the relationship between growth mindset and GPA with the negative slope of growth statistically significant for average- and high-mastery goal learners, but not significant for low-mastery learners. Related to this finding is the interaction of a growth mindset with mastery goals in the prediction of the time slope for GPA. For both these interactions, simultaneously possessing high growth and mastery is associated with lower academic achievement. Why these findings indicate high levels of each combined to inhibit achievement is uncertain. Although speculative, lower academic performing students may simultaneously adopt growth mindsets and mastery goals. The adoption of both may serve as protective responses to poor academic performance. Another possibility is that students high in both are less interested in a high GPA, thereby focusing on learning processes associated with authentic learning.

The exploratory analysis finding of goal orientations mediating mindsets partially supports theoretical predictions. Our data is not ideal for this analysis, because we measured mindsets and achievement goals concurrently at baseline rather than longitudinally, so we consider the mediational analysis exploratory. Nonetheless, the observed indirect relationships between growth and entity mindsets with college student GPA are of high theoretical interest. The first result supports the proposition (Dweck & Leggett, 1988) that mastery goals mediate the association between growth and academic achievement. This indirect relationship was positive as predicted by social cognitive theory. We also observed an indirect positive relationship between entity mindset and GPA with performance-avoidance mediating the relationship. Although theoretically unanticipated, this finding demonstrates a pathway where entity theorists may be academically successful. These learners are motivated to avoid appearing foolish in classes, which in turn improves academic performance. In college environments, this approach may be effective because grading practices often reward compliance with course requirements (Brookhart et al., 2016).

5.2 *Educational implications*

There are two educational implications of the study. First, if the results are robust, it is unlikely long-term benefits will accrue from solely encouraging college students to adopt a growth mindset. Although positive psychology, encouraging the belief that ability is changeable in absence of effective instructional approaches may be an empty intervention and unlikely to benefit academic goal setting and subsequent achievement. In other words, informing college students of their capabilities to solve complex mathematical equations without teaching directly or providing opportunities to discover associated mathematics skills is unlikely to support meaningful learning. Second, the results of the study are clear in terms of educational challenges facing college students from low-income and minority populations. In particular, it is concerning African American and Hispanic college students have lower GPAs at the end of their second year. After statistically accounting for prior academic performance and socioeconomic status, differences in GPA remain with minority students at considerable risk for academic failure. These observed disparities in academic achievement require that postsecondary institutions seek efficacious instructional interventions to achieve comparable graduation rates across groups. Based on the results of this study, focusing student attention on mastery learning is more likely to be worthwhile.

5.3 *Strengths and limitations*

The primary strengths of the study are associated with the longitudinal nature of the study and the selection of the sample. The matching of baseline data with meaningful longitudinal educational outcomes is relatively rare in the literature. Many studies examining motivational constructs in relation to academic outcomes collect data at one-time point; making it challenging to determine whether achievement preceded mindset or vice versa. In the present study, baseline demographics, theory of intelligence and achievement goal orientation constructs are associated with subsequent academic outcomes. This design characteristic assures the predictors preceded academic achievement. The second strength of the study is that the sample is relatively large and randomly selected. The size of the sample allows the identification of relationships of practical significance and allows a modicum of the belief that unobserved anticipated relationships are not due to a lack of statistical power. Random selection from institutional records combined with an adequate response rate increases the generalizability of the results to the larger population of college students served by the institution. Furthermore, the demographics of the participating university are comparable to many large United States universities to which the results of the present study may generalize.

There are three significant limitations in our ability to make strong causal claims. First, the absence of longitudinal measurement of goal orientation and theory of intelligence constructs does not allow the determination of whether these factors changed over time or a strong test of mediation. It is entirely possible that mindsets and achievement goals change in a developmental fashion as students experience academic challenges. However, literature on older children and college students indicates mindsets are relatively stable over time (Robins & Pals, 2002). Second, GPA includes many sources of assessment and may not be sensitive to baseline mindset levels. In some cases, the assessments college instructors use may not be sensitive to the student growth mindset, because the instructors themselves hold entity mindsets regarding the nature of intelligence. As a result, classroom assessments fail to emphasize student academic growth. If so, possessing a growth mindset potentially hinders, rather than facilitates, college student achievement, which in turn can lead to the conclusion that growth mindsets are not beneficial characteristics of students. A third limitation is the measure of mindset is domain-general rather than domain-specific, studies finding relationships between growth mindset and academic achievement often focus on domain-specific mindset and outcomes. For example, Hwang and colleagues (2016) examined mathematics mindset in relation to mathematics achievement. A possibility exists that the general academic mindset may share a muted relationship relative to domain-specific mindset.

5.4 *Future directions*

The key findings of this study provide ample directions for future research. The direct and indirect relationships among mindsets, achievement goal orientations and achievement require further examination in terms of developmental trajectories. How late adolescent students develop in terms of the implicit theory of intelligence factors requires further study. In terms of mindsets, high school years are likely more teacher-directed and may reward an entity orientation that students carry into their college careers. During the college years, the responsibility for learning shifts to the student, which in turn may cultivate an increase in growth mindset and/or disfavor students with entity views. Longitudinal examinations of college students' implicit theories of intelligence may prove fruitful in understanding late-adolescent development into adulthood.

6. Conclusion

The present study examined relationships between implicit theories of intelligence and achievement goal orientations with longitudinal academic outcomes. With a diverse sample of college students, the results provide partial support for theoretically predicted relationships between mindsets, achievement goals and second-year academic achievement. Growth and entity mindsets were positively predictive of learning and performance goals, respectively. Contrary to theoretical predictions, a growth mindset was positively associated with performance goals and negatively associated with academic achievement. These results have theoretical and educational implications for social-cognitive learning theory researchers and college-level instruction.

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Conflict of interest

The authors have no conflicts of interest to declare.

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