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Demographics That Benefit the Most From a Growth Mindset of Intelligence Intervention

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ABSTRACT. Implicit theories pertain to one's beliefs about personal traits. According to the implicit theories of intelligence, a fixed mindset perceives intelligence as stagnant, whereas a growth mindset perceives intelligence as malleable and subject to growth. Interventions aimed at promoting a growth mindset have been successful in multiple realms among students of all ages, backgrounds, and demographics of interest. We investigated the effect of a growth mindset of intelligence intervention on implicit theories of intelligence, verbal language skills, perceived academic stress, grit, and term grade point average. We also measured various demographics to assess which ones benefit the most from such a treatment. The growth mindset intervention spanned over seven 30-minute sessions that took place in person over the span of four weeks. The control group received equivalent training on the various theories of intelligence. The data showed that the intervention was successful and was associated with an increase in implicit theories of intelligence specifically in the experimental group with a large effect size, $d = 1.80$, 95% CI [1.16, 2.42], $F(1,53) = 42.8$, $p < .001$. Certain demographic groups, such as athletes, first-generation students, traditional nontransfer intent students, non-Hispanics, students who play a musical instrument, and students with mental illness benefited the most from the intervention. Furthermore, the intervention increased perceived academic stress in students with mental illness, decreased academic stress in first-generation students, and increased grit in athletes. Understanding which student population is more receptive to such interventions is crucial to future efforts in tailoring growth mindset interventions on college campuses.

Keywords: growth mindset, implicit theories of intelligence, academic stress, first-generation students, grit

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For decades, research has been investigating what intrinsically motivates people in the face of setbacks and what affects their reactions to success or failure. The concept of implicit theories of intelligence proposed by Carol Dweck and colleagues in the late 80s and 90s (Dweck & Leggett, 1988; Dweck et al., 1995) has helped supplement what the attribution theory had lacked in this research area (Hong et al., 1999). Implicit theories pertain to one's beliefs about personal traits or attributes. According to the implicit theories of intelligence, a person with a fixed mindset perceives intelligence as stagnant whereas a person with a growth mindset perceives

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intelligence as malleable and subject to growth (Dweck & Leggett, 1988; Dweck, 2006). Individuals with a fixed mindset tend to avoid challenges and develop maladaptive tendencies that subliminally lead them to give up in the face of difficulties (Dweck, 2006; Haydel & Roeser, 2002). In contrast, individuals with a growth mindset perceive challenges and setbacks as opportunities for growth and tend to be process (effort, strategy, and progress) oriented (Dweck, 2006; Hong et al., 1999). In other words, one's mindset about intelligence can influence and guides one's initial reaction to challenges and obstacles, affecting overall outcomes in terms of motivation, effort, and persistence (for review, see Dweck & Yeager, 2019).

Benefits of Growth Mindset of Intelligence

Studies over the years have reiterated that a growth mindset of intelligence is associated with better academic performance in students of all ages ranging from elementary and junior high youth (Blackwell et al., 2007; Leondari & Gialamas, 2002), to high school students (Haydel & Roeser, 2002), and even college students (Fox et al., 2019; Fox & Barrera, 2020). Meta-analyses pertaining to various ages (Costa & Faria, 2018; Gál & Szamosközi, 2016) have also highlighted the academic and emotional benefits associated with a growth mindset of intelligence. The benefits of having a growth mindset of intelligence apply to a variety of academic measures, such as final exam course grades in mathematics and social sciences, mathematical ability, perceived academic performance and constructive coping mechanisms in a wide variety of student ages (Ahmavaara & Houston, 2007; Leondari & Gialamas, 2002; Shih, 2011; Shively & Ryan, 2013; Tempelaar et al, 2015). Most interesting is that cortisol levels were lower in high school students who displayed a growth mindset of intelligence when their grades were declining suggesting that a growth mindset leads to a relatively more positive perception of academic stressors (Lee et al, 2018). However, these apparent growth mindset-related academic benefits need to be considered carefully in light of recent evidence that the effect sizes associated with these findings are weak (Macnamara & Burgoyne, 2023; Sisk et al., 2018). A meta-analysis examining the effect of implicit theories and its related interventions on academic achievement in students of all ages argues that such a relationship is weak, and the benefits of growth mindset interventions are mainly limited to students with low socioeconomic status or students who are academically at risk (Sisk et al., 2018). A more recent meta-analysis by the same authors evaluated 63 studies, and reported a small nonsignificant effect size of growth mindset interventions on academic achievement after correcting for potential publication bias. These authors boldly conclude that the acclaimed fame of growth mindset interventions when it comes to academic improvement could likely be attributable to inadequate study design, reporting flaws and even researcher and publication biases (Macnamara & Burgoyne, 2023).

Nonetheless, the benefits of a growth mindset of intelligence (or the detrimental effects of a fixed mindset of intelligence) extend beyond academics into the realm of emotional regulation and well-being. For example, a meta-analysis of 46 studies of students ranging from junior high to college age found that a growth mindset of intelligence was correlated with positive affective states whereas a fixed mindset of intelligence was correlated with negative affective states (Gál & Szamosközi, 2016). A growth mindset of intelligence was also correlated with effective coping strategies for anxiety in young adult students (Ruiselová & Prokopčáková, 2005).

Other Types of Mindsets and Their Benefits

The concept of implicit theories has been applied to personal traits and attributes other than intelligence. Researchers have investigated the benefits of a growth mindset or the detriments of a fixed mindset of thoughts, emotions, behavior (Schleider & Weisz, 2016a), and personality (Erdly & Dweck, 1993). For example, a fixed mindset of thoughts, emotions, and behavior was associated with mental health problems in teenage girls (Schleider & Weisz, 2016b). In fact, psychopathology predicted a fixed mindset in these domains (Schleider & Weisz, 2016a). A fixed mindset of emotions predicted higher distress and lower well-being (Howell, 2017). Those with a fixed mindset of emotions also had lower life satisfaction and less positive emotions (King & dela Rosa, 2019). A fixed mindset of emotions also led to less adaptive functioning (Howell, 2017). Those with a fixed mindset of emotions experienced difficulty developing coping strategies, but cognitive reappraisal eradicated some of these negative effects (King & dela Rosa, 2019). A multitude of studies led by pioneers such as Schleider and Yeager have shown that interventions promoting growth mindset of personality and related brain malleability result in improved mental health by increasing hope and agency and decreasing depression symptoms and self-hate (Miu & Yaeger, 2014; Schleider et al., 2022; Yeager et al., 2013). Pertaining to mindset domains other than thoughts, emotions, behavior, and personality, a growth mindset of well-being was correlated with prioritizing positivity, which translates into incorporating pleasurable activities into a daily routine (Passmore et al., 2018). Furthermore, those with a growth mindset about personal beliefs were less likely to experience negative emotions than those who possessed fixed beliefs (Howell, 2017).

Implicit Theories and Gender

Studies have also explored gender differences in implicit theories. Girls seem to have adopted relatively more fixed

beliefs about their thoughts, emotions, (Jiang et al., 2022) and behavior (Schleider & Weisz, 2016b). Longitudinal assessment reveals that these fixed mindsets in girls were associated with worse mental health symptoms and increased over the span of a school year (Schleider & Weisz, 2016b). Furthermore, young men with a growth mindset of behavior show reduced peak in cortisol under social stress but young women did not show that same stress buffering benefit from having a growth mindset (Fischer et al., 2023). This tendency for girls to have relatively more of a fixed mindset is not limited to thoughts, emotions, and behavior. Girls were reported to have more of a fixed mindset of intelligence than boys and that fixed perception of their intelligence was associated with lower perception of efficacy in math (Todor, 2014). However, other studies reported that gender differences in implicit theories of intelligence were not significant (Macnamara & Rupani, 2017; Sigmundsson et al., 2021; Storek & Furnham, 2013). Further, implicit theories of intelligence were not a mediating factor in gender differences in intelligence in college age students or adults (Macnamara & Rupani, 2017; Storek & Furnham, 2013). This inconsistency in the relationship between mindset and gender is even more pronounced in unique types of mindsets. For example, engineering students that were men were more likely than women to have a fixed mindset about their making abilities (Galaledin et al., 2016). Taken all together, the data up to date showed that the relationship between gender and implicit theories is still unclear and merits further investigation (Fischer et al., 2023).

Growth Mindset Interventions

As mentioned above, studies have shown that participants can be taught to have a growth mindset about various personal attributes such as intelligence and personality, a phenomenon referred to as growth mindset interventions. For example, these interventions led to an increase in growth mindset of intelligence in students of various ages, which then led to positive outcomes in the academic setting (Blackwell et al., 2007; Skipper, 2015; Spitzer & Aronson, 2015). Striking in the literature is the finding that these interventions are most beneficial to certain demographics. For example, these interventions and their related academic benefits have been particularly successful among minority students, such as African American college students and students at risk (Aronson et al., 2001; Sisk et al., 2018). Low-income students, women especially, have benefited from mindset interventions, which led to higher scores on standardized tests and mitigated disparities previously observed between men's and women's' test scores (Good et al., 2003; Sisk et al., 2018). Specifically in adolescents who have generalized anxiety disorder, a growth mindset of intelligence intervention was a useful tool to combat school-related stress and in some cases, improve scores on IQ tests (Da Fonseca et al., 2008a; Da Fonseca et al., 2008b). A growth mindset of intelligence intervention combined with a sense-of-purpose intervention was associated with improved grades for underperforming high school students (Paunesku et al., 2015). As mentioned earlier, the growth mindset of intelligence is focused on effort and progress rather than the outcome. Accordingly, a study conducted with Division I collegiate athletes concluded that those with competing-to-excel orientation mentalities had higher confidence in their own athletic ability and had increased goal-orientation, which is in stark contrast to athletes who developed competing-to-win orientation mindsets, scoring lower on levels of confidence (Ryska, 2001). Because college-athletes are typically considered competitive, leading them to a strong drive for personal and team success, the potential for changes in mindset, and how such findings can be applied to performance, are of interest. Similarly, grade school students who play a musical instrument were more likely to engage in incremental (growth) theory of learning, or overall success from the amplification of many smaller successes, than those who did not play an instrument; furthermore, playing an instrument proves that capabilities in music can be advanced through effort (O'Neil, 2011). These studies suggest that athletes and music instrument players might be primed to benefit greatly from a growth mindset intervention.

Mindset interventions have been applied to areas other than intelligence and their benefits extend beyond academics particularly among youth. A study conducted on undergraduate students by Schroder et al. (2017) showed that the association between the number of stressful life events a student had experienced, and mental illness symptoms (e.g., posttraumatic stress, depression), was weaker in students who had adapted a growth mindset of anxiety as a result of their intervention, compared to those with a fixed mindset. Additionally, maladaptive coping strategies, such as nonsuicidal self-injury, alcohol abuse, and drug use, were found to be lower in those students who acquired a growth mindset of anxiety due to the intervention (Schroder et al., 2017). Other researchers have also concluded that growth mindsets of both anxiety and emotions are related to improved emotional regulation practices (De Castella et al., 2013). Increasing mindset of personality in adolescents reduced aggression in response to victimization and exclusion (Yeager et al., 2013). Using the Growth Mindset Single Session Intervention (GM-SSI) in youth, Schleider and colleagues demonstrated that learning to adopt a growth mindset about traits, brain malleability, emotional and social setbacks, and personality led to

better mental health in this population that is vulnerable to depression and anxiety (Schleider et al., 2018, Schleider et al., 2019a; Schleider et al., 2019b; Schleider et al., 2020a; Schleider et al., 2020b). GM-SSIs have been found to reduce the internalized distress in adolescents with mental illnesses, particularly anxiety (Schleider & Weisz, 2018; Schleider et al., 2020). Teaching growth mindset to adolescents and their parents resulted in lower youth-reported depression and lower parental reporting of children's depression (Schleider & Weisz, 2017). In fact, the study showed that parents' beliefs about psychotherapy are also malleable and can be adjusted using growth mindset educational services (Schleider & Weisz, 2018). A 9-months postintervention assessment reported that these intervention outcomes are effective long-term (Schleider et al, 2019a) and are predictive of better mental health treatment response over time (Schleider et al., 2019a).

In light of this comprehensive review of research highlighting that growth mindset interventions are particularly helpful to students within certain demographics, those developing certain skills or those who suffer from mental illness, the present research aims at investigating the beneficial effects of a growth mindset of intelligence intervention with a focus to assess which demographics of college students would benefit the most. Specifically, the goal of the current study was to investigate the effectiveness of a growth mindset intervention promoting the malleability of intelligence and the brain in college students. We investigated the effect of a growth mindset of intelligence intervention on implicit theories of intelligence, verbal language skills assessment, perceived academic stress, grit and term grade point average (GPA). A second goal of the study was to assess which demographics benefitted the most from such a treatment. Gender, ethnicity, socioeconomic status, first-generation status, athleticism, musical experience, mental health and traditional vs. nontraditional college programs were the demographics considered in this study. We hypothesized that the intervention would result in an increase in growth mindset of intelligence, verbal language skills, grit, and term GPA and that the intervention will result in a decrease in perceived academic stress. We also hypothesized that the growth mindset intervention would relatively benefit women and disadvantaged students such as students from ethnic minorities, low socioeconomic status, and first-generation students (Aronson et al., 2001; Good et al., 2003). The growth mindset intervention spanned over seven 30-minute sessions that took place in person over four weeks teaching subjects about the concept of implicit theories, the malleability of the brain and providing practical advice on how to grow one's mindset of intelligence. The control group received equivalent training on the various theories of intelligence.

Methods

Sample

The sample consisted of 65 first-year and sophomore students, with ages ranging from 18 to 24 years old. As shown in Table 1, the sample consisted of 60% women (n = 39) and 40% men (n = 26). Of the 65 students, 53.8% were traditional four-year students (n = 35), while 46.2% were nontraditional transfer intent students (n =30). Additionally, 85% of students were nonathletes (n = 52), while 15% were involved in collegiate-level athletics (n = 13). As for ethnicity, 73.8% of students identified as non-Hispanic (n = 50), and 26.2% identified as Hispanic/Latino (n = 15). The socioeconomic status based on household income was diversified with 27.7% of households earning less than $75,000 per year

TABLE 1

Sociodemographic Characteristics of Subjects

	n	%
Gender		
Male	26	40.0
Female	36	60.0
Program		
Traditional	35	53.8
Nontraditional	30	46.2
Student-Athletes		
Nonathletes	52	85.0
College Athletes	13	15.0
Ethnicity		
Non-Hispanics	50	73.8
Hispanics	15	26.2
Household Socioeconomic Status		
<$75,000	18	27.7
>$75,000	47	72.3
First-Generation		
Non-First-Generation	49	75.4
First-Generation	16	24.6
Musical Capabilities		
Noninstrument Players	47	72.3
Instrument Players	18	27.7
Mental Illness		
No Mental Illness	53	81.5
Mental Illness	12	18.5

Note. Nontraditional programs at Holy Cross College are made up of one-year or two-year transfer intent programs.

(n = 18) and 72.3% (n = 47) earning $75,000 or more per year. First-generation students are a population of interest in this study, as 24.6% (n = 16) indicated they were the first to attend college in their family, and 75.4% (n = 49) indicated that they were not. 27.7% of students played an instrument (n = 18), and 72.3% did not (n = 47). Concerning mental illness, 18.5% of the students reported suffering from at least one mental illness during the semester when the study was conducted (n = 12) and 81.5% of students reported having no mental illness (n = 53). Table 2 shows how these demographic groups were distributed across the control and treatment groups.

With prior consent of participants, the end of the term GPA was collected for everyone.

TABLE 2

Descriptive Statistics Across Demographics and Group

	Control Group		Experimental Group	
	n	%	*n*	%
Age (Years)				
18	21	63.6	14	43.8
19	11	33.3	14	43.8
22	0	0	1	3.1
24	1	3.0	1	3.1
N/A	0	0	2	6.3
Gender				
Men	13	39.3	13	40.6
Women	20	60.6	19	59.4
Enrollment				
Traditional	18	54.5	17	53.1
Nontraditional	15	45.5	15	46.9
Student Athletics				
Nonathletes	28	84.8	24	75.0
College Athlete	5	15.2	8	25.0
Ethnicity				
Non-Hispanic	29	87.8	21	65.6
Hispanic	4	12.2	11	34.4
Household Socioeconomic Status				
<$75,000	8	24.2	10	31.3
>$75,000	25	75.8	22	68.8
First-Generation				
Non-First-Generation	25	75.8	24	75.0
First-Generation	8	24.2	8	25.0
Musical Capabilities				
Noninstrument Player	24	72.7	23	72.0
Instrument Player	9	27.3	9	28.0
Mental Illness				
No Mental Illness	24	72.7	29	90.6
Mental Illness	9	27.3	3	9.4

Note. Traditional students are the ones committed to staying on campus for four years vs. nontraditional students who are part of programs that are designed for transfer to an R1 university.

With prior consent of participants, the end of the term GPA was collected for everyone.

Demographics

This form asked participants various demographic questions pertaining to age, gender, ethnicity, socioeconomic status, first generation status, athleticism, musical experience, mental health and traditional vs. nontraditional college programs.

Basic Achievement Skills Inventory

The Basic Achievement Skills Inventory (BASI) is a standardized achievement skills test for verbal language that measures vocabulary, spelling, language, and reading comprehension (Griffith, 2006). The test was timed for 25 minutes and contained 50 multiple choice questions. Subjects read the instructions and the questions from a booklet and recorded their answers on a scantron.

Theories of Intelligence Scale

The Theories of Intelligence Scale (TIS) is an 8-item questionnaire, with a 6-point scale, assessing implicit theories of intelligence or general beliefs about the fixedness or malleability of intelligence (Dweck, 2000). The growth mindset items were reversed scored and the average of all items was calculated. Higher scores are indicative of a higher growth mindset of intelligence. Internal consistency of TIS items was α = .92 preintervention and α = .97 postintervention.

Perception of Academic Stress Scale

The Perception of Academic Stress (PAS) is an 18-item, 5-point scale, measured three different aspects of perceived academic stress using three subscales (Bedewy & Gabriel, 2015). Subscale 1, items 6, 9, 13, and 14, measured stress related to students' academic expectations. Subscale 2, items 4, 5, 10, 11, 12, 15, 16, and 17, measured stress related to faculty expectations and examination. Lastly, Subscale 3, items 1, 2, 3, 7, 8 and 18, measured stress pertaining to students' academic perceptions. Total academic stress was calculated by adding up all three scales. Internal consistency of Subscale 1 items was α = .64, that of Subscale 2 items was α = .62, and of Subscale 3 items was α = .54.

12-Item Grit Scale

This grit questionnaire uses a 5-point scale and was developed by Angela Duckworth (Duckworth et al.,

2007). Items 2, 3, 4, 7, 8, and 11 are reversed when scoring, and a higher average score indicates higher grit. The internal consistency of grit items was $\alpha = .70$.

Design

The research project was approved by the Institutional Review Board (IRB) of Holy Cross College. We used a mixed within and between research design with some outcomes measured pre-and postintervention and compared between control and experimental groups (implicit theories of intelligence and verbal language skills) and other outcomes only measured postintervention and compared between control and experimental groups (perception of academic stress, grit, and term GPA). Participants were randomly assigned to an experimental group learning about the growth mindset of intelligence and its benefits or a control group learning about various theories of intelligence. Each group met with the researchers in the mornings on average twice a week for a total of seven 30-minute sessions. At the beginning of session 1, all participants willing to participate signed an informed consent and completed a demographic questionnaire. We then collected baseline measures of verbal language skills and implicit theories of intelligence. The following five sessions consisted of presentations specific to each group. Participants in the experimental group were presented with slides that were modified versions of the materials available on the Project for Education Research that Scales (PERTS) website (PERTS, n.d.) Participants were taught the basic concepts of growth vs. fixed mindset of intelligence and their effects on people's thinking and behaviors. Then participants were introduced to the concept of neuroplasticity with basic neuroscience knowledge. The treatment concluded with practical applications of how participants can shape their mindsets exploring the power growth mindset has through language and feedback to the individual and from others. The control group presentation slides covered four intelligence theories (Spearman's general intelligence, Cattell's theory of intelligence, Sternberg triarchic theory and Gardner's theory of multiple intelligences). Presentations started with a quick survey regarding students' prior knowledge of the various theories, detailed slides explaining each theory and possible careers stemming from each type of intelligence when applicable. In both groups, participants took part in a writing activity at the end of each session that prompted them to reflect on what they learned and provided them with some opportunities for personal applications such as applying the knowledge to varying social scenarios or connecting it to their past experiences. Both groups watched short video clips pertaining to the content and were asked to discuss with a partner what they learned and what was most interesting to them. Grit and perceived academic stress were measured on the last day of testing. Verbal language skills and implicit theories of intelligence tests were also readministered on the final day. The study concluded with the participants receiving a small gift to thank them for their time.

Statistical Analysis

All statistical analyses were conducted in the R programming language (R Core Team 2023). Prior to analysis, data were checked for normality and homogeneity of variances. All data and R code used for the present analysis are available at for review.[1]

The first goal of the study pertaining to the effectiveness of the intervention (control vs. experimental groups) on the post-intervention dependent variables was evaluated by computing between-groups effect sizes using Cohen's *d* and 95% confidence intervals within the R package "psych." Cohen's *d* and 95% confidence intervals were used to estimate the effect of the intervention on multiple measures: postintervention implicit theories of intelligence scores, postintervention verbal language skills scores, term GPA, total academic stress, academic stress Subscales 1, 2 and 3, and grit. A MANOVA ($\alpha = .05$) was also conducted to identify statistically significant differences between the control and experimental groups on the various outcome measures post-intervention.

Principal components analysis (PCA) following the "princomp" method in the vegan R library was used to complement Cohen's *d* and MANOVA analyses and provide a visual illustration of how all the dependent variables interact across the demographic categorical variables. Although boxplots of the outcomes across control and experimental groups provide a visual of the differences in growth mindset according to the demographic characteristics, PCA is frequently used to explore trends in multidimensional data that may be overlooked in traditional graphical analyses. Thus, the purpose of PCA in this context was to discern relationships among term GPA, verbal language skills, all academic stress scales, grit, and implicit theories of intelligence according to control and experimental groups. Prior to conducting the PCA, we computed two derived variables: language skill score difference, the absolute difference between pre- and postintervention language skills scores, and implicit theories score difference, the absolute difference between pre- and postimplicit theories of intelligence scores. This was done to reduce redundancy and multicollinearity, and to show the magnitude of change in these variables between control and experimental groups.

[1] https://osf.io/286m4

To address the study's second goal, which was to evaluate which demographic groups benefited the most from the intervention, we again computed between-groups effect sizes using Cohen's *d* statistic and 95% confidence intervals within the R package "psych." We calculated the difference between the control and experimental groups using Cohen's *d* to assess the effect size of the change in specific postintervention outcomes (e.g., postimplicit theories of intelligence, grit) in each binary demographic category (e.g., gender, ethnicity, music experience).

Finally, we employed multiple linear regression ($\alpha = .05$) using the "lm" function in the R program to build a model that represents the most important and influential variables that contribute to an enhancement in growth mindset in our study population. We included in this model the postintervention implicit theories of intelligence as the response variable, and the preintervention implicit theories and all the dichotomous demographic variables such as gender and race predictor variables. All predictors were included in the initial model, and then we used backward stepping multiple regression and Akaike's Information Criterion (AIC) with the "step.AIC" function in the R program "MASS" library to arrive at the best fit model. Finally, we ran an ANOVA on the final model using the "anova()" function in R to calculate the percentage of the variance explained by each predictor on postintervention growth mindset. This was accomplished by dividing the *F*-statistic of each predictor variable over the sum of the *F* statistics for all predictor variables and multiplying by 100.

Results

Effect of the Intervention on Outcomes

Table 3 shows the difference between the control and experimental group in the postintervention implicit theories of intelligence, which was significantly higher in the experimental group ($M = 5.25$, $SD = 0.73$) compared to the control group ($M = 3.60$, $SD = 1.12$) with a very large effect size ($d = 1.80$, 95% CI [1.16, 2.42]) that was corroborated with the MANOVA test, $F(1, 53) = 42.8$, $p < .001$, showing that the intervention was successful and is associated with a substantial increase in growth mindset specifically in the experimental group. This effect of the intervention on increasing implicit theories of intelligence did not translate to other outcomes that pertain to academics such as verbal language assessment, GPA or grit. The effect of the intervention on these outcomes is small with a Cohen's *d* around 0.2 or smaller (verbal assessment $d = -0.27$, 95% CI [–0.80, 0.27]; GPA $d = -0.04$, 95% CI [–0.57, 0.48]; grit $d = -0.22$, 95% CI -0.75, 0.31). In contrast, the effect of the intervention on the perceived academic stress pertaining to students' academic expectations (Subscale 1) shows that Cohen's *d* is small to medium in size ($d = 0.39$, 95% CI [-0.14, 0.92]). The experimental group ($M = 2.38$, $SD = 0.72$) appears to be slightly higher on that outcome than the control group ($M = 2.18$, $SD = 0.67$). However, MANOVA indicated that the observed difference in academic stress pertaining to students' academic expectations between control and experimental groups was not statistically significant, $F(1,53) = 2.03$, $p = .16$; For the remainder of the outcomes, the MANOVA results agreed with the small effect sizes revealed by Cohen's *d* analysis, as none of the measures differed significantly between the control and experimental groups.

To disentangle possible underlying relationships among response variables and demographic characteristics, we used PCA to provide a visual assessment of the effect of the intervention (control v. experimental groups) on the relationships among the dependent variables (see Figure 1). Subjects in the control and experimental groups formed two distinct clusters in multivariate space, which supports the findings reported above that the intervention is associated with an increase in growth mindset of intelligence in the experimental group. Within the experimental group, implicit theories score difference is greater, as indicated by the vector that is associated with this metric, which shows that individuals who learned about implicit theories of intelligence did exhibit greater growth mindset of intelligence. A few other interesting findings that emerged from the PCA are that Grit and BASI score differences are strongly correlated in the control group. All measures of perceived academic stress were strongly correlated with each other as expected. Importantly, the PCA results support these bivariate correlations that are presented in Table 4.

TABLE 3

Effect of the Intervention on Outcomes

Outcomes	Control Group: *M* (*SD*)	Experimental Group: *M* (*SD*)	Cohen's *d* (CI)
Postintervention TIS	3.54 (1.16)	5.25 (0.70)	1.80 [1.16, 2.42]
Postintervention BASI	37.00 (5.83)	36.00 (6.37)	−0.27 [-0.80, 0.27]
Grit	3.09 (0.75)	2.96 (0.66)	−0.22 [-0.75, 0.31]
Term GPA	3.48 (0.67)	3.43 (0.74)	−0.04 [-0.57, 0.49]
PAS Total	2.40 (0.55)	2.50 (0.51)	0.16 [-0.37, 0.69]
Stress Subscale 1	2.18 (0.67)	2.38 (0.72)	0.39 [-0.14, 0.92]
Stress Subscale 2	2.43 (0.66)	2.60 (0.61)	0.21 [-0.32, 0.74]
Stress Subscale 3	2.51 (0.51)	2.46 (0.50)	-0.21 [-0.74, 0.32]

Note. TIS represents implicit theories of intelligence, BASI measures verbal language skills and PAS stands for perceived academic stress. PAS subscale 1 measures students academic expectations, subscale 2 measures faculty expectations and examination and subscale 3 measures students academic perception. Notice the increase in implicit theories of intelligence in the experimental group relative to the control group post intervention as marked by a large Cohen's *d*.

Demographics That Benefited the Most From the Intervention

Table 5 presents the effect sizes and 95% confidence intervals of the difference between control and experimental groups on postintervention implicit theories of intelligence for each demographic grouping. For example, the effect of the treatment (control vs experimental group) was assessed across first-generation vs. non-first-generation participants, first-generation students seem to exhibit a greater increase in growth mindset of intelligence following the intervention (d = 2.03, 95% CI [0.55, 3.44]) relative to non-first-generation students (d = 1.75, 95% CI [1.03, 2.44]; see Figure 2). Traditional students appeared to benefit more from the intervention (d = 2.09, 95% CI [1.18, 2.97]) compared to nontraditional students (d = 1.50, 95% CI [0.59, 2.38]) as illustrated in Figure 3. Athletes also showed a greater growth mindset of intelligence following the intervention (d = 3.07, 95% CI 0.79, 5.24) relative to nonathletes (d = 1.65, 95% CI [0.96, 2.32]). This differential effect of the intervention on athletes compared to nonathletes is captured in Figure 4. Comparably, students who play an instrument appear to express a greater increase in growth mindset of intelligence postintervention (d = 2.66, 95% CI [1.07, 4.20]) compared to those who do not play an instrument (d = 1.66, 95% CI [0.94, 2.35]) as well illustrated in the box plot in Figure

FIGURE 1

Relationships Between Outcomes Comparing Experimental to Control Group

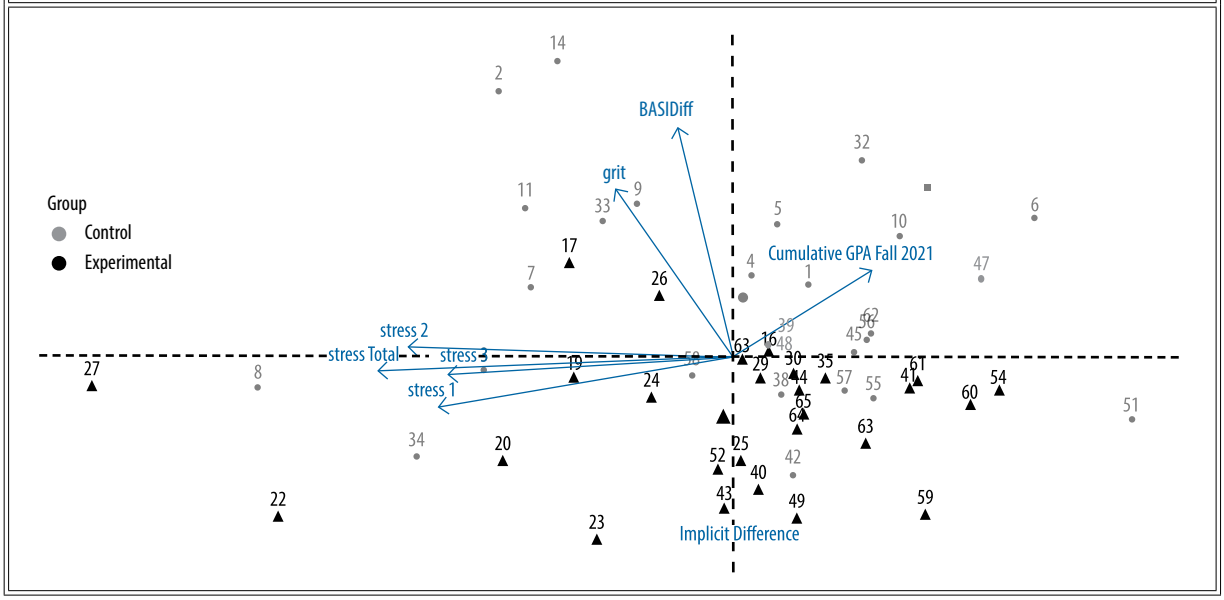


TABLE 4

Descriptive Statistics and Bivariate Correlations

Variable	*n*	*M*	*SD*	1. BASI Pre	2. BASI Post	3. Grit	4. Post Implicit	5. Pre Implicit	6. Total Stress	7. Stress 1	8. Stress 2	9. Stress 3
1. BASI Pre	66	34.60	5.57	-								
2. BASI Post	63	36.50	6.02	0.74*	-							
3. Grit	63	4.11	0.89	−0.29*	−0.04	-						
4. Post Implicit	66	4.40	1.29	−0.06	−0.18	−0.01	-					
5. Pre Implicit	66	3.04	0.71	−0.16	−0.20	0.03	0.71*	-				
6. Total Stress	66	2.45	0.52	−0.36*	−0.28*	0.32*	0.15	0.14	-			
7. Stress 1	66	2.27	0.69	−0.17	−0.23	0.24	0.14	0.16	0.73*	-		
8. Stress 2	66	2.52	0.64	−0.36*	−0.23	0.36*	0.18	0.14	0.90*	0.57*	-	
9. Stress 3	66	2.47	0.50	−0.33*	−0.22	0.22	0.01	0.05	0.83*	0.47*	0.63*	-

Note. BASI = Basic Achievement Skills Inventory. *$p < .05$.

TABLE 5

Effect of the Intervention on Implicit Theories of Intelligence (TIS) Across Demographic Groups

Outcomes	Preintervention TIS *M*	*SD*	Postintervention TIS *M*	*SD*	Cohen's *d*	95% CI
Gender						
Male	4.18	0.91	4.50	1.35	1.87	[0.79, 2.92]
Female	4.06	0.88	4.31	1.26	1.79	[0.99, 2.57]
Program						
Traditional	4.14	0.97	4.36	1.41	2.09	[1.18, 2.97]
Nontraditional	4.06	0.79	4.40	1.15	1.50	[0.59, 2.38]
Student-Athletes						
Nonathletes	4.06	0.92	4.23	1.29	1.65	[0.96, 2.32]
College Athletes	4.42	0.59	5.34	0.75	3.07	[0.79, 5.24]
Ethnicity						
Non-Hispanics	4.70	0.59	5.25	0.58	1.91	[1.06, 2.75]
Hispanics	3.89	0.88	4.07	1.33	1.58	[0.56, 2.55]
Household Socioeconomic Status						
<$75,000	4.40	0.79	4.70	1.30	1.75	[0.46, 2.99]
>$75,000	3.99	0.90	4.26	1.27	1.77	[1.02, 2.51]
First-Generation						
Non-First-Generation	3.99	0.88	4.27	1.23	1.75	[1.03, 2.44]
First-Generation	4.48	0.84	4.75	1.44	2.03	[0.55, 3.44]
Musical Capabilities						
No-Instrument	4.17	0.88	4.42	1.28	1.66	[0.94, 2.35]
Instrument Player	3.91	0.91	4.28	1.33	2.66	[1.07, 4.20]
Mental Illness						
No Mental Illness	4.08	0.90	4.46	1.25	1.67	[0.98, 2.35]
Mental Illness	4.23	0.83	4.03	1.46	2.46	[0.62, 4.21]

Note. Cohen's *d* values comparing control to experimental groups on implicit theories of intelligence at postintervention show that first gen, non-Hispanics, athletes, traditional students, instrument players and subjects with mental illness benefited more from the intervention. These specific demographic groups were associated with relatively large Cohen's *d* values.

TABLE 6

Effect of the Intervention on Grit and Perceived Academic Stress (PAS) Across Demographic Groups

	Grit				PAS Subscale 1:			
	M	*SD*	Cohen's *d*	95% CI	*M*	*SD*	Cohen's *d*	95% CI
Student-Athletics								
Non-Athletes	2.98	(0.70)	−0.53	[−1.12, 0.07]	2.26	(0.70)	0.35	[−0.24, 0.93]
College Athletes	3.32	(0.72)	1.15	[−0.57, 2.79]	2.39	(0.65)	−0.09	[−1.66, 1.48]
Mental Illness								
No Mental Illness	3.10	(0.65)	−0.33	[−0.92, 0.26]	2.28	(0.70)	0.26	[−0.33, 0.85]
Mental Illness	2.71	(0.88)	−0.07	[−1.42, 1.29]	2.29	(0.71)	1.21	[−0.29, 2.66]

Note. Grit and perceived academic stress were only measured after the intervention. Perceived Academic Stress (PAS) subscale 1 pertains to students academic expectations. When looking at Cohen's *d* values comparing the control to the experimental group within athletes and within non-athletes, note that the intervention is associated with an increase in grit only in athletes. The intervention also is associated with an increase in perceived stress in students stemming from their academic expectations only in subjects with mental illness.

5. Participants who reported a mental illness also appear to glean greater benefit from the intervention (d = 2.46, 95% CI [0.62, 4.21]) over those who reported no mental illness (d = 1.70, 95% CI [0.98, 2.35]; see Figure 6). Non-Hispanic students also showed greater but statistically insignificant gain in growth mindset of intelligence following the intervention (d = 1.83, 95% CI [1.06, 2.75]) compared to their Hispanic peers (d = 1.50, 95% CI [0.56, 2.55]) as illustrated in Figure 7. The intervention did not have a differential effect among gender groups (see Figure 8) nor among socioeconomic groups (d = 1.83, 95% CI [1.06, 2.75]; see Figure 9). Women showed a slightly lower gain in growth mindset (d = 1.79, 95% CI [0.99, 2.57] compared to men (d = 1.87, 95% CI [0.79, 2.92]), as displayed in Figure 8. Similarly, students who identified as low socioeconomic status (reported annual income < $75,000) had nearly identical responses to the growth mindset intervention (d = 1.75, 95% CI [0.46, 2.99]) to those of higher socioeconomic status (reported annual income > $75,000; d = 1.77, 95% CI [1.02, 2.51]).

Table 6 presents effect sizes and 95% confidence intervals of the difference between control and experimental groups in some of the demographic subgroups on grit and perceived academic stress following the intervention. Interestingly, first-generation students in the control group had a higher level of stress (Subscale 1, stress due to students' academic expectations, and Subscale 3, stress pertaining to students' academic perceptions) compared to first-generation students in the experimental group whereas non-first-generation students in the control and experimental groups had similar levels of stress. The effect size results imply that the intervention decreased the two measures of academic stress specifically in first-generation students. Furthermore, grit and perceived academic stress Subscale 1 pertaining to students' academic expectations were two outcomes that showed a change that is associated with the intervention, specifically in athletes and subjects with mental illness. The intervention was associated with an increase in grit in athletes Cohen's d was large in athletes when comparing control to experimental groups, showing an increase in grit in athletes that is associated with the intervention (d = 1.15, 95% CI [-0.57, 2.79]) but that was not observed in nonathletes (d = -0.53, 95% CI [-1.12, 0.07]). Similarly, the intervention is associated with higher perceived academic stress due to students' academic expectations as reflected by a large effect size between the control and experimental groups in subjects with mental illness (d = 1.21, 95% CI [-0.29, 2.66]) but not in subjects with no mental illness (d = 0.26, 95% CI [-0.33, 0.85])

Finally, stepwise multiple linear regression analysis was conducted to determine which variables most strongly predict postintervention implicit theories of intelligence.

The results from this analysis showed that preintervention implicit theories of intelligence, $t(4, 50) = 9.17$, $p < .001$, treatment group, $t(4, 50) = 6.26$, $p < .001$, gender, $t(4,50) = 6.88$, $p < .001$, and Hispanic roots, $t(4,50) = -6.48$, $p < .001$, explained 93% of the variance in postintervention implicit theories of intelligence, $F(4, 50) = 164.5$, $p < .001$. According to the ANOVA conducted on the regression model, the treatment (control v. experimental), preintervention implicit theories of intelligence, race, and gender accounted for 63%, 29%, 6%, and 2% of the variance in growth mindset, respectively.

Discussion

The present study investigated the effect of a growth mindset of intelligence intervention on multiple outcomes in college students while taking into consideration various demographics. The study found that the intervention resulted in an increase in growth mindset of intelligence showing that the intervention was successful. Furthermore, based on effect sizes analysis, certain demographic groups such as athletes, first-generation students, traditional nontransfer intent students, non-Hispanic students, music instrument players and participants with mental illness benefited the most from the intervention. The intervention resulted in an increase in perceived stress pertaining to students' academic expectations in participants with mental illness and resulted in a decrease in two measures of academic stress in first-generation students. The intervention also resulted in an increase in grit, particularly in athletes. Our hypothesis that the intervention would increase a growth mindset of intelligence and would benefit certain demographics including underprivileged students was confirmed with the exception that the intervention did not particularly benefit women or participants from low socioeconomic status. Furthermore, our hypothesis that the intervention would result in an increase in academic related measures such as verbal language skills, grit, and term GPA and a decrease in perceived academic stress was only partly confirmed as the intervention did decrease perceived academic stress only in first-generation students and did increase grit only in athletes.

The intervention was successful in increasing growth mindset of intelligence in the experimental group as shown in previous studies (Skipper, 2015; Spitzer & Aronson, 2015). This increase in growth mindset of intelligence provides benefits such as prioritizing learning goals that encourage strategies in overcoming difficulties despite any inherent abilities. When acquiring a growth mindset, participants learn that their personal traits such as intelligence can be improved upon by employing mastery-centered response strategies through effort (Henderson & Dweck, 1990; Hong et al., 1999). These benefits gleaned from a growth mindset of intelligence were associated with improved academic performance (Blackwell et al., 2007; Fox et al., 2020), constructive coping mechanisms (Ahmavaara & Houston, 2007), and a more positive perception of academic stressors (Lee et al., 2018). However, in the current study, the intervention-induced increase in growth mindset of intelligence did not translate in a general improvement of academic related measures such as verbal skills, term GPA, grit, or perceived academic stress. This result agrees with recent meta-analysis studies (Macnamara & Burgoyne,2023; Sisk et al., 2018) showing that the effect of growth mindset interventions on academic outcomes is, at its best, weak, and is affected by faulty research design, research and publication bias,

FIGURE 2

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across First Generation Status

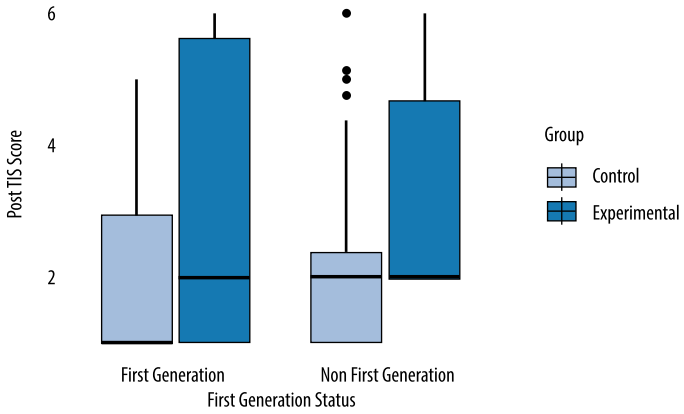
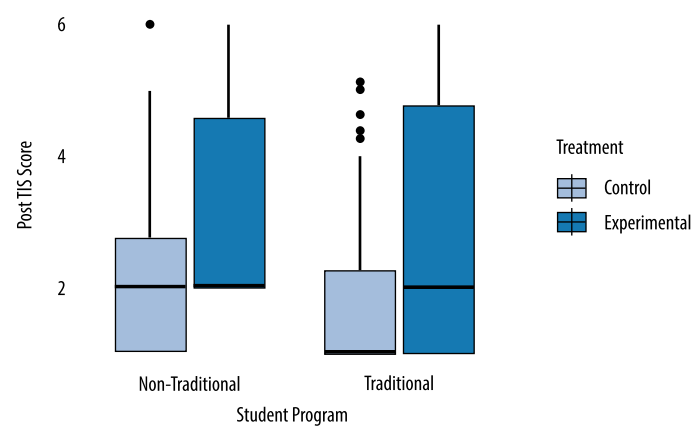


FIGURE 3

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Student Program



and even financial conflicts of interest. Keep in mind, however, that these meta-analyses assessed the effect of various types of growth mindset interventions on academic outcomes and did not focus solely on growth mindset of intelligence. Meta-analysis that focused on growth mindset of intelligence did report significant low to moderate association between having a growth mindset of intelligence and academic outcomes (Costa & Faria, 2018). Furthermore, when the investigation of the effect of growth mindset on academic outcomes was narrowed to certain demographics such students with low socio-economic status or students at risk, the meta-analysis did report that these specific populations did benefit academically from adopting a growth mindset of intelligence (Sisk et al., 2018).

FIGURE 4

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Athlete Status

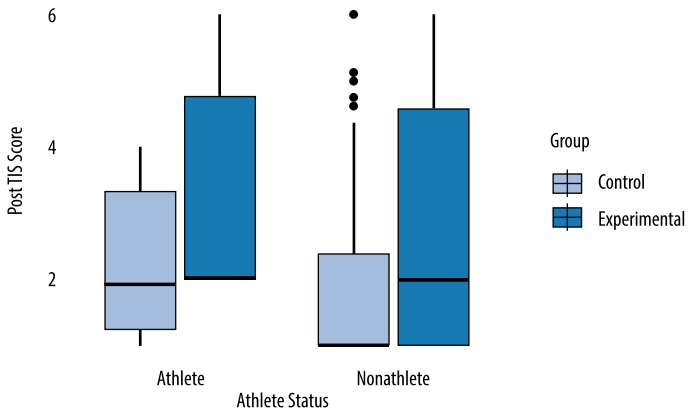
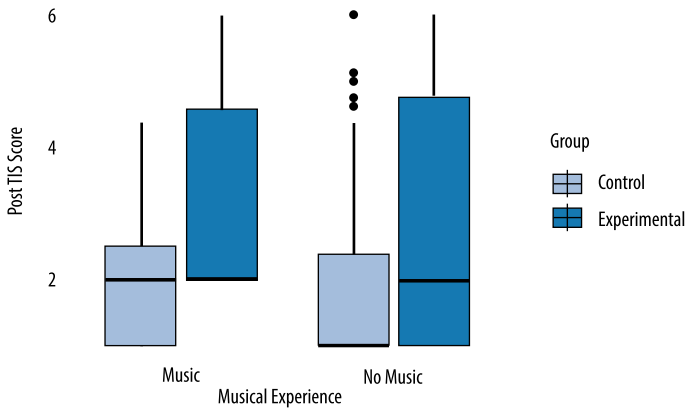


FIGURE 5

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Musical Experience



An important goal of this study was to evaluate which demographics among college students benefit the most from a growth mindset of intelligence intervention. The intervention did benefit non-Hispanic students, first-generation students, athletes, music instrument players, traditional nontransfer intent students, and students with mental illness. However, socioeconomic status and gender did not interact with the effect of the intervention. In contrast with our findings, studies have shown that students with low socioeconomic status, women, and underperforming or academically at-risk students benefitted the most from such interventions (Good et al., 2003; Paunesku et al., 2015; Sisk et al., 2018). This could be due to the small sample size in the current study especially in subjects with low socioeconomic status ($n = 18$) and to the fact that even at baseline our subjects portrayed implicit theories leaning towards a strong growth mindset with an average between the experimental and the control group of 4.11 on that measure. Therefore, this relatively high baseline of growth mindset combined with a relatively small sample size might have contributed to the lack of interaction between the intervention and gender and socioeconomic status. As to gender and growth mindset, some studies have reported that women tend to have relatively more of a fixed mindset of intelligence associated with lower perception of efficacy in math (Todor, 2014) and therefore may benefit more from a growth mindset intervention than men but that result has not been consistently found in the literature (Macnamara & Rupani, 2017; Sigmundusson et al., 2021; Storek & Furnham, 2013;). Therefore, both men and women, according to our results, may benefit equivalently from a growth mindset intervention. Also, in contrast with previous studies, our data shows that non-Hispanics benefited more from the intervention relative to Hispanic students. Hispanic students have been shown to display a greater growth mindset than non-Hispanic white students and non-Hispanic students with higher socioeconomic status were more likely to endorse a fixed mindset (Hwang et al., 2019). In accordance with our results, an intervention aiming at increasing growth mindset over a semester, even though it benefited both Hispanic and non-Hispanic students, the study did show that Hispanic students gained relatively a stronger growth mindset as the result of the intervention (Kwak et al., 2022).

Interestingly, our results show that an increase in growth mindset of intelligence is associated with a decrease in perceived academic stress in first-generation students and with an increase in academic related stress in students with mental illness. The former result is in

line with previous literature showing the stress mitigating effect of adopting a growth mindset of intelligence (Gal & Szamoskozi, 2016; Lee et al., 2018). On the other hand, the intervention-induced increase in perceived academic stress in students with mental illness might be intriguing. However, research has shown that stress is not always detrimental (Crum et al., 2017) and short-term academic stress, when accompanied by a sense of control and growth mindset can be beneficial. In fact, studies have shown that teaching subjects the 'stress-is-enhancing' mindset results in better cognitive performance and health and moderates the response in face of challenges (Crum et al., 2017; Jiang et al., 2019). It is noteworthy that the intervention-induced increase in academic expectations stress was pronounced in subjects with mental illness, a population vulnerable to the detrimental effect of stress. This leads to the idea that interventions promoting growth mindset of intelligence could be combined with interventions promoting a stress-is-enhancing mindset and tailored specifically to students suffering from mental illness to teach them how to manage the growth mindset-induced stress in a healthy way. Long-term assessment in college students of these benefits and drawbacks acquired through the adoption of a growth mindset of intelligence should be the focus of future investigations.

To our knowledge, no other studies have looked at the impact of growth mindset interventions on specifically first-generation students or on nontraditional transfer intent students. As mentioned above, we report that first-generation students benefited more from the intervention than non-first-generation students. Many studies showed that first-generation college students oftentimes have reduced campus engagement combined with difficulty in establishing firm social and professional networks and difficulty in directly seeking out support from faculty (Katrevich & Aruguete, 2017; Pratt et al., 2017; Stebleton et al., 2014). Growth mindset of intelligence interventions resulting in greater emphasis on effort and persistence may be crucial to increasing success and retention of first-generation students in college. Accordingly, a study by Prat-Sala and Redford (2012) combined many growth mindset principles in relation to self-efficacy, writing and literary skills, concluded that increased confidence in writing likely leads to an increase in motivation and perseverance. Furthermore, qualitative research geared specifically towards first-generation students by Conefrey (2021) aimed at high-impact practices to enhance literacy and study skills found an increase in academic outcomes, persistence in academics, and self-efficacy. More specifically, metacognitive, and self-regulation skills help first-generation students in valuing perseverance regardless of the challenge (Conefrey, 2021) which is closely related to the growth mindset concept. As for our result showing that traditional students benefited more from the intervention than nontraditional students, we speculate that this result is because traditional students who are invested in their current institution prioritize learning objectives and creative learning strategies. Contrastingly, the nontraditional students in this study are all part of a program designed for them to transfer to an elite university contingent on their maintaining of a high GPA. Such a contingency may have resulted in these transfer-intent students focusing on transfer requirements and acquiring the highest GPA possible rather than the learning process and the prospect of growing their intelligence.

Engagement in enriching activities such as athleticism

FIGURE 6

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Mental Illness

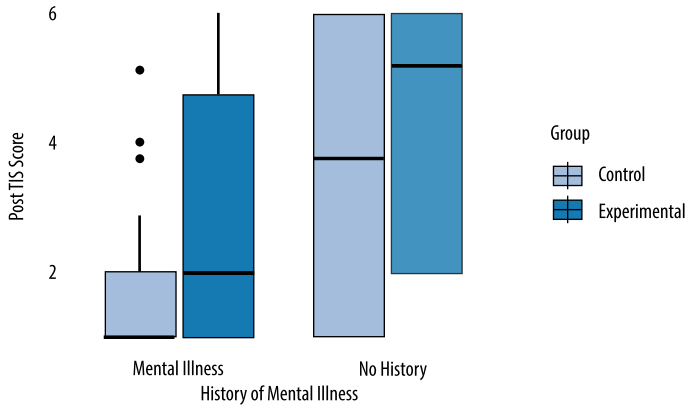
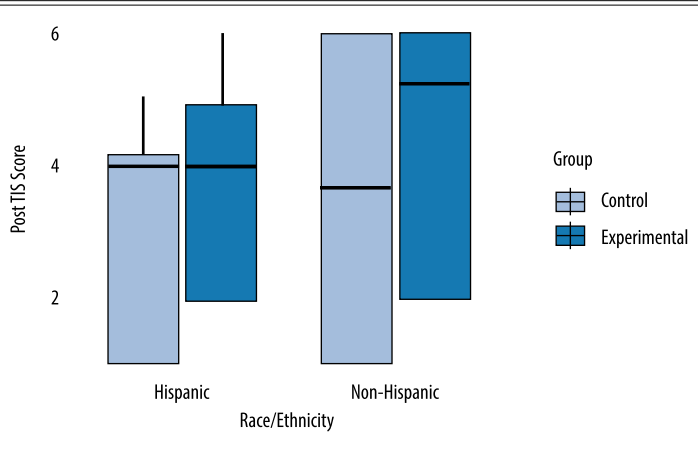


FIGURE 7

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Ethnicity



or music might provide a greater receptivity to growth mindset interventions. In accordance with our results showing that athletes benefited more from the intervention than nonathletes and that the intervention resulted in an increase in grit only in athletes, growth mindset interventions have been shown to be particularly beneficial to athletes by reducing negative emotional and physical states, increasing mental toughness, helping to create a better training environment, and thus resulting in better performance (Hardy et al., 1996; Sheard & Golby, 2006). An intervention aimed at increasing athletic performance by feedback modification to praising

FIGURE 8

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Gender Groups

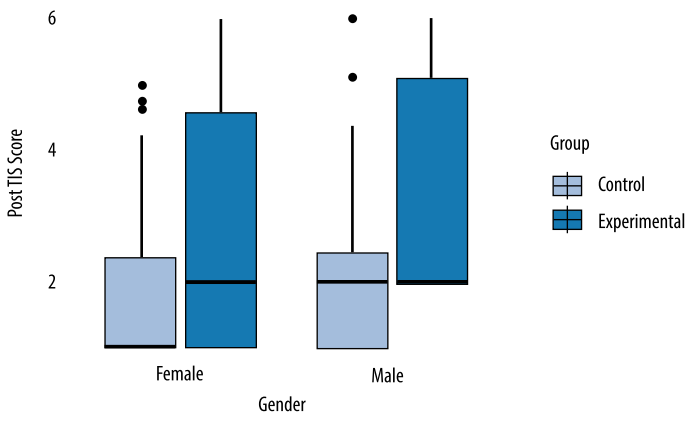
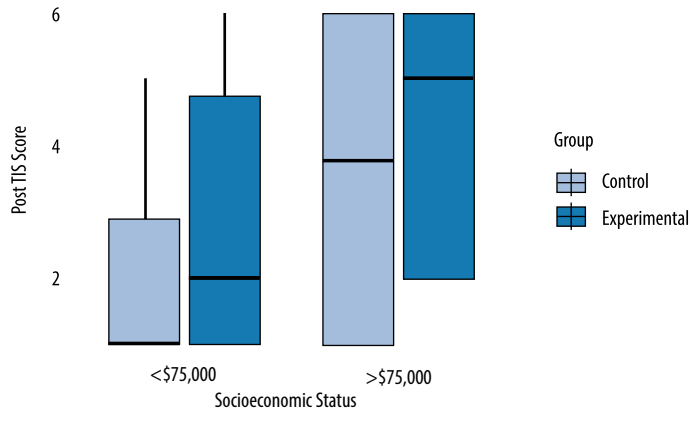


FIGURE 9

Differences Between Control and Experimental Groups in Postintervention Implicit Theories Outcome Across Socioeconomic Status



effort, motivation, and persistence promoted growth mindset and the athletes developed a healthier attitude towards failure (Dweck 2009; Rattan et al., 2015). As for the relationship between growth mindset and music experience, children learning how to play an instrument have an increased likelihood to appreciate principles of incremental theories of learning or growth mindset than students who do not play an instrument (O'Neill, 2011). Furthermore, in support of our results, the practice of music itself demonstrates the ability to improve with effort, meaning children who play an instrument may have an advantage by being more receptive to the concept of growth mindset through their continuous practice and appreciation of the payoff of effort (Davis, 2016; O'Neill, 2011). Learning to play an instrument is among the best first-hand experiences to help individuals learn the importance of hard work (Davis, 2016). Therefore, students who play music instruments, due to the persistence and effort, might be primed to adopting the concept of growth mindset and hence that would explain our result that the intervention benefited more music instrument players than nonplayers.

Students with mental illness reaped relatively greater benefits from the growth mindset of intelligence intervention used in this study. In accordance with our results, studies have shown that growth mindset interventions benefit adolescents with internalizing mental illness such as depression and anxiety (Schleider & Weisz, 2016a, b; Schleider et al., 2022). A meta-analysis exploring mental distress and growth mindset reported a negative correlation between these two variables but found a positive correlation between active coping strategies and growth mindset (Burnette et al., 2020). Individuals with growth mindset that employed active coping strategies and use of cognitive reappraisal were found to experience easier social adjustments and less depressive symptoms (De Castella et al., 2013). Therefore, as mentioned earlier, prioritizing growth mindset interventions combined with positive perception of stress and healthy coping strategies geared towards students with mental illness is essential.

The primary limitation of the current study lies within the small overall sample size, which consequently led to small sample sizes within each respective demographic group. This is the result of the potential subject pool size, as the study was conducted at a small liberal arts college with an enrolment of under 500 students. This may limit the generalizability of the results, and therefore replication of the study at a larger undergraduate institution would be very beneficial especially if the institution has a strong representation of all the demographic groups considered in this study.

In conclusion, our study reports a successful growth mindset of intelligence intervention that increased growth mindset of intelligence particularly in certain demographic groups among college students such as athletes,

students with music experience, first-generation students, non-Hispanics, traditional nontransfer intent students, and students with mental illness. The intervention was also associated with changes in grit and academic related perceived stress in specific demographic population of students. Understanding which student population is more receptive to such interventions is crucial in future efforts in tailoring such interventions on college campuses.

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