

Title: The Effects of a Purpose for Learning Mindset Intervention on Low-Income High School Students' Academic Success

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Background:

Many mindset interventions have strong evidence of improving high school students' grades, particularly for academically at-risk and low-income populations (Sisk et al., 2018). Recent studies have argued that in order to better understand the mechanism through which these interventions operate, researchers should focus on proximate outcomes collected before academic achievement measures – particularly for children from diverse circumstances and populations (Hanselman et al., 2017). Mindset interventions that orient students to a broader sense of purpose for learning, including identifying their own authentic goals for learning (such as contributing to their community), may lower their feelings of frustration and anxiety when faced with academic challenges, thus improving their academic performance in the long-term. In the present study, we explore the influence of a one-time Purpose for Learning (PFL; Yeager et al., 2014) intervention on low-income, ethnic minority adolescents' academic outcomes, task persistence, task-relevant anxiety, and positive health behaviors.

Research Design:

Participants were 463 adolescents (232 randomly assigned to treatment, 231 to control), the majority of whom were in high school (77%). The majority of the students were Black (68%) and 25% were Hispanic. Students in the PFL writing intervention reflected on problems in the world and/or their community, and then considered how working hard in school could enable them to help alleviate these problems. Students in the control group wrote about an unrelated topic. Outcomes of the intervention included the College Knowledge task (which targeted applied academic diligence), state anxiety, self-reported overall grades and math grades, level of fixed intelligence, feelings of belongingness in school, and social “strengths.”

Analysis:

For the analysis, we regressed each dependent variable on a dummy variable for the mindset treatment status and fixed effects for the students' school site to account for the unit of randomization.

$$\text{Equation 1: } Outcome_{ij} = a_1 + \beta_1 Tx_{ij} + \sum_{j=1}^{18} \beta_2 Site_j + e_{ij}$$

$$\text{Equation 2: } Outcome_{ij} = a_1 + \beta_1 Tx_{ij} + \sum_{j=1}^{18} \beta_2 Site_j + \chi Demographics_{ij} + e_{ij}$$

$$\text{Equation 3: } Outcome_{ij} = a_1 + \beta_1 Tx_{ij} + \sum_{j=1}^{18} \beta_2 Site_j + \chi Demographics_{ij} + \Omega Cognitive_{ij} + e_{ij}$$

Due to some small signs of imbalance at baseline, in addition to the main effects model (Equation 1), we ran models that included covariates for demographics and cognitive skills. For all models, we considered cases that had non-missing data on outcome measures. For control variables with missing data, we imputed the mean value of each variable for any observations with missing cases, and added a dummy variable indicating whether a variable had been missing for that observation to the regression model.

Additionally, we ran models examining the heterogeneity of treatment effects by student gender, race, high/low trait anxiety, and by the prior year's GPA. These interaction models included the full set of covariates (i.e., *Equation 3*).

Results:

At post-intervention, participants completed manipulation checks to assess the level of meaning they associated with images of school tasks and to test the immediate efficacy of the implementation. Students in the PFL intervention group had more correct responses than control students ($\beta = 0.268$, $p = 0.002$), suggesting that the intervention was effectively administered.

See Table 1 for our measures of student self-reported grades. We found negative treatment impacts for the first main effects model ($\beta = -0.17$, $p = 0.04$), the magnitude of which increased with the inclusion of the first set of covariates ($\beta = -0.21$, $p = 0.04$). Our fully controlled model indicated a marginally statistically significant effect ($\beta = -0.14$, $p = 0.097$). For our measures of students' math grades, we found marginally significant negative effects for our first two models ($\beta = -0.15$, $p = 0.08$) and ($\beta = -0.17$, $p = 0.09$), but for the model with the full set of controls, we failed to detect any significant treatment effects. For the outcome measures related to the College Knowledge task, state anxiety, mindset (i.e., belongingness and fixed intelligence), and health strengths behaviors, our models failed to detect any significant effects of treatment.

Heterogeneity results are presented in Table 2. Highly anxious students in the treatment group had significantly higher math grades relative to their control-group assigned counterparts, while low-anxiety students in the treatment group reported lower grades than their control-group counterparts ($\beta = .62$, $p < .001$). Additionally, we found that treated Black students tended to not play games during College Knowledge task more frequently than Black students in the control group. Interestingly, prior grades had no moderating effect on outcome grades. Treated students with high grades played more games ($\beta = .21$, $p = .045$) and had higher state anxiety ($\beta = .38$, $p = .04$) than their control counterparts. Furthermore, treated students with low grades spent more time on the College Knowledge task ($\beta = .71$, $p = .02$) and reported lower levels of social strengths ($\beta = -.54$, $p = .002$) than the control group students with low grades.

Sensitivity Check:

Given that 19% of participants did not report their grades or responded "I'm not sure," we considered the possibility that non-response might bias our estimated treatment effects. To adjust for this, we ran alternative models that weighted for the probability of having missing data on grades, and we found little indication that non-response substantially affected our reported estimates.

Conclusions:

We found primarily null effects of the PFL intervention on our measures of task persistence and anxiety. However, we were surprised that our models suggested that student's reported lower grades as a function of having participated in the intervention. Low-income students of color often experience despair and hopelessness as a result of existing within a "limited opportunity structure," (Fordham & Ogbu, 1986; Ogbu, 1978) and it is possible that activating a higher purpose for learning in students in the treatment condition without a long-term plan to offer steps for attaining these goals may have left this group of students frustrated. We also found moderation by students' prior grades. High-achieving treatment-group students seemed to be less interested in the College Knowledge task, as evidenced by this group playing more games and

spending less time on task. Furthermore, our heterogeneity analyses suggest that the role of anxiety should be examined in further replication models of mindset interventions.

Table 1. PFL Intervention Outcomes

	Unconditional	Demographics	Cognitive Skills
	1	2	3
College Knowledge: Played Any Games <i>n</i> =445	-0.007 (0.052)	0.001 (0.049)	0.007 (0.050)
College Knowledge Block 2 Duration <i>n</i> =445	-0.110 (0.106)	-0.155 (0.123)	-0.152 (0.109)
College Knowledge: Time on Task <i>n</i> =445	0.040 (0.110)	0.017 (0.109)	0.009 (0.108)
State Anxiety Mean <i>n</i> =448	0.143 (0.105)	0.148 (0.103)	0.139 (0.105)
Grades <i>n</i> =375	-0.166* (0.075)	-0.205* (0.089)	-0.135+ (0.077)
Math Grades <i>n</i> =393	-0.152+ (0.082)	-0.167+ (0.094)	-0.121 (0.090)
Fixed Intelligence <i>n</i> =402	-0.011 (0.084)	0.015 (0.093)	0.024 (0.098)
Belongingness <i>n</i> =402	0.045 (0.130)	0.040 (0.135)	0.034 (0.133)
Strengths Mean <i>n</i> =408	0.033 (0.085)	0.065 (0.101)	0.093 (0.107)
<i>Baseline Covariates Included</i>			
Site	Inc.	Inc.	Inc.
Demographics		Inc.	Inc.
EF & Cognitive Skills			Inc.

Note. Standard errors were adjusted for site-level clustering and are displayed in parentheses. All continuous variables in the models were standardized, so coefficients can be interpreted as effect sizes. The College Knowledge task (Pressler & Masucci, 2015) was used to test students' diligence on a boring (but useful) task that offered information and reading comprehension questions about college selection and application, while simultaneously giving students the option to quit and play video games, with no negative consequences for doing so. The "Played Any Games" outcome is a binary measure (1 = played at least one game). "Block 2 Duration" refers to the length of time the student spent on the section of the task that incorporated the option to play games. "Time on Task" refers to the proportion of time the students spent reading the college material (the on-task behavior) during Block 2.

+*p* < .10, **p* < .05, ***p* < .01, ****p* < .001

Table 2. PFL Moderators

	Treatment X Female	Treatment X Black	Treatment X High Trait Anxiety	Treatment X 'A' GPA	Treatment X 'B' GPA	Treatment X 'C' GPA	Treatment X 'D' GPA
College Knowledge: Played Any Games	-0.204+ -0.101	-0.205* (0.074)	0.097 (0.104)	0.213* (0.098)	-0.058 (0.050)	0.000 (0.082)	-0.324* (0.146)
College Knowledge Block 2 Duration	-0.151 -0.196	0.063 (0.225)	0.052 (0.288)	-0.232 (0.206)	0.251+ (0.121)	-0.255 (0.192)	0.199 (0.390)
College Knowledge: Time on Task	0.260 (0.183)	0.112 (0.173)	-0.279 (0.258)	-0.078 (0.166)	-0.090 (0.124)	0.047 (0.242)	0.712* (0.280)
State Anxiety Mean	0.064 (0.178)	0.136 (0.251)	-0.048 (0.162)	0.375* (0.167)	-0.245+ (0.138)	0.009 (0.214)	0.346 (0.508)
Grades	0.110 (0.159)	0.141 (0.170)	0.206 (0.223)	-0.005 (0.252)	-0.044 (0.149)	0.154 (0.171)	-0.356 (0.383)
Math Grades	-0.060 (0.261)	0.076 (0.233)	0.623*** (0.154)	-0.074 (0.241)	0.092 (0.186)	-0.050 (0.220)	-0.137 (0.481)
Fixed Intelligence	0.038 (0.167)	-0.158 (0.100)	-0.213 (0.197)	-0.127 (0.220)	0.203 (0.173)	-0.151 (0.205)	-0.254 (0.277)
Belongingness	0.192 (0.202)	-0.161 (0.187)	0.027 (0.231)	-0.029 (0.223)	0.087 (0.186)	-0.125 (0.162)	0.055 (0.148)
Strengths Mean	-0.194 (0.198)	-0.048 (0.186)	-0.002 (0.238)	-0.166 (0.132)	0.027 (0.119)	0.219 (0.163)	-0.541** (0.151)
<i>Baseline Covariates Included</i>							
Site	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
Demographics	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.
EF & Cognitive Skills	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.	Inc.

Note. +p < .10, *p < .05, **p < .01, ***p < .001. Standard errors were adjusted for site-level clustering and are displayed in parentheses. High trait anxiety was determined by the sample mean.