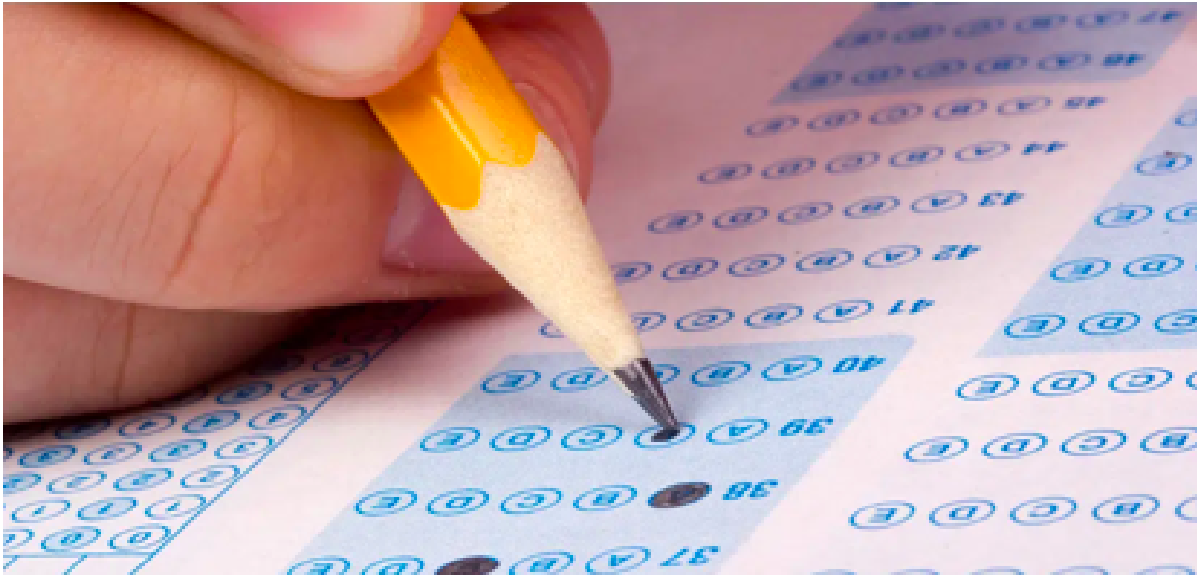


## Does Student Hardiness Go Above and Beyond?



Hannah D'Angelo

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## Executive Summary

The primary goal of this project is to determine what academic outcomes grit, growth mindset, and fixed mindset can predict. There is evidence that grit, growth mindset, and fixed mindset can contribute to academic outcomes (e.g., GPA, standardized assessment scores). Grit, growth mindset, and fixed mindset are measures of non-cognitive factors suggesting that there are other factors related to changes in academic outcomes. This led us to ask Research Question 1. However, there is mixed evidence on whether non-cognitive factors and student characteristics predict standardized assessment scores when accounting for GPA. I investigated if grit, growth mindset, fixed mindset, gender, and first-generation predict math and English assessment scores beyond the predictive influence of GPA in Research Question 2. Not only do math or English assessment scores matter, but students' pass rate also matters. If a student passes, it is based on the math or English level which is determined by their raw assessment scores. I dove deeper from Research Question 2 where I looked at the ability to predict assessment scores to look at the ability to predict if students pass the assessment.

**Research Question 1:** a) How can the sample be described in terms of their grit, growth mindset, and fixed mindset? b) How predictive are grit, growth mindset, and fixed mindset of GPA?

- Results: People who score higher on grit and growth mindset tend to have a higher GPA while higher scores on fixed mindset are related to a lower GPA (Table 1.5).
- Implications: I recommend that students should be taught grit and growth mindset skills in an attempt to increase their GPA.

**Research Question 2:** When considered all together, do student characteristics, non-cognitive factors, and academic background variables predict math assessment scores? If so, which variables make meaningful contributions to the prediction?

- Results: Higher growth mindset and GPA predict higher math assessment scores. Higher fixed mindsets and those who aren't first-generation students predict lower math assessment scores.

- Implications: I recommend that students should be taught a growth mindset and encouraged to increase their GPA in an attempt to produce higher math assessment scores.

**Research Question 3:** When considered all together, do student characteristics, non-cognitive factors, and academic background variables predict passing the English assessment? If so, which variables make meaningful contributions to the prediction?

- Results: Higher grit and fixed mindset scores were linked to a lower chance of passing the English assessment (Table 3.4). Meanwhile, higher growth mindset scores and GPA were linked to a higher chance of passing the English assessment.
- Implications: I recommend that students should be taught growth mindset skills and encouraged to increase their GPA in an attempt to pass the English assessment.

# Background

The primary goal of this project is to determine what academic outcomes grit, growth mindset, and fixed mindset can predict. There is evidence that grit, growth mindset, and fixed mindset can contribute to academic outcomes (e.g., GPA, standardized assessment scores). Grit, growth mindset, and fixed mindset are measures of non-cognitive factors suggesting that there are other factors related to changes in academic outcomes. I expect to find that students who show higher levels of grit and a growth mindset are associated with a higher GPA. Additionally, students who show higher levels of fixed mindset are expected to be associated with a lower GPA. To understand what's going on in the sample, I asked the following:

- **Research Question 1:** a) How can the sample be described in terms of their grit, growth mindset, and fixed mindset? b) How predictive are grit, growth mindset, and fixed mindset of GPA?

The literature shows ample evidence for GPA being a strong predictor of a student's performance on standardized assessments. However, there is mixed evidence over whether non-cognitive factors and student characteristics predict standardized assessment scores when accounting for GPA. I investigated if grit, growth mindset, fixed mindset, gender, and first-generation predict math and English assessment scores beyond the predictive influence of GPA.

- **Research Question 2:** When considered all together, do student characteristics, non-cognitive factors, and academic background variables predict math assessment scores? If so, which variables make meaningful contributions to the prediction?

Not only do math or English assessment scores matter, but the pass rate of students matters as well. If a student passes is based on the math or English level which is determined by their raw assessment scores. I dove deeper from Research Question 2 where I looked at the ability to predict assessment scores to look at the ability to predict if students pass the assessment.

- **Research Question 3:** When considered all together, do student characteristics, non-cognitive factors, and academic background variables predict passing the English assessment? If so, which variables make meaningful contributions to the prediction?

## Methods

The sample was composed of 1,551 college students who were sampled for their background characteristics (high school GPA and if they're a first-generation college student), academic factors (GPA, math assessment score, English assessment score, math performance level, English performance level, math assessment pass rate, English assessment pass rate), and non-cognitive factors (grit, growth mindset, and fixed mindset scores). See the Appendix below for a description of the variables of interest ([Variable Breakdown](#)). More specifically, I looked at how grit, growth mindset, and fixed mindset predicted GPA as well as math and English assessment standardized scores. Additionally, I observed how background characteristics, GPA, and non-cognitive factors predicted math and English assessment scores as well as if they passed the assessments.

Table 0.1 below represents the gender makeup of the sample, which was dichotomous. There is a fairly even distribution between 755 females (48.7%) and 796 males (51.3%) in the sample. I can also view the makeup of how many first-generation college students there are (732 students or 47.2%) compared to those who aren't (819 or 52.8%; Table 0.2). Table 0.2 shows there is a fairly even amount of first-generation college students to those who aren't, with a slightly higher rate of not first-generation students. Additionally, Table 0.3 shows the majority of grades were split between A and B students (with a combined rate of 73.2%). The grade distribution in Table 0.3 revealed that most students achieved passing grades (A = 30.6%, B = 42.6%, C = 21.3%, D = 4.5%, F = 1%). The typical GPA based on the sample was 3.13; however, there was GPA information missing for 34 students which could alter the typical GPA (Table 0.4).

Table 0.1: Composition of Gender

Frequencies of Gender			
Gender	Counts	% of Total	Cumulative %
Female	755	48.7%	48.7%
Male	796	51.3%	100.0%

Table 0.2: Composition of First-Generation College Students

Frequencies of First_Gen			
First_Gen	Counts	% of Total	Cumulative %
No	819	52.8%	52.8%
Yes	732	47.2%	100.0%

Table 0.3: Composition of GPA

Frequencies of GPA_cat			
GPA_cat	Counts	% of Total	Cumulative %
A	464	30.6%	30.6%
B	646	42.6%	73.2%
C	323	21.3%	94.5%
D	69	4.5%	99.0%
F	15	1.0%	100.0%

Table 0.4: Descriptives for GPA

Descriptives	
	GPA
N	1517
Missing	34
Mean	3.127
Median	3.290
Standard deviation	0.769
Minimum	0.300
Maximum	4.000

I also viewed the math and English assessment scores based on their senior-level of high school standardized test scores. The lowest score was 650 and the highest score was 850 for both assessments (Table 0.5). Table 0.5 also shows there was a typical score of 729 for the math assessment score and 741 for the English assessment score, with both typical scores being

represented by the mean due to minimal skewness (math = 0.04, English = 0.001). There's missing data for both the math assessment score (43 students) and English assessment score (39 students), which could potentially change the typical assessment scores if they were accounted for. Additionally, I accounted for the math and English levels of the sample which is derived based on their respective assessment scores. Due to minimal skewness, I looked at the mean as the typical math (2.64) and English level (3.07; Table 0.6). Further, I evaluated how many students passed (0 = didn't pass, 1 = passed) the math and English assessment based on their respective levels. For the math assessment, 347 (23%) students passed while 1,161 (77%) didn't pass meaning that the majority of students didn't pass the math assessment. For the English assessment, 629 (41.6%) students passed while 883 (58.4%) didn't pass meaning that slightly more students didn't pass the English assessment (Table 0.7). Overall, students tended to score better and pass at a higher rate on the English assessment than on the math assessment.

Table 0.5: Descriptives for Math and English Assessment Scores

Descriptives		
	Math_Score	English_Score
N	1508	1512
Missing	43	39
Mean	729.042	741.452
Median	729.000	741.000
Standard deviation	30.530	37.027
Minimum	650	650
Maximum	850	850
Skewness	0.039	0.001
Std. error skewness	0.063	0.063



Table 0.6: Descriptives for Math and English Levels

Descriptives		
	Math_Level	English_Level
N	1508	1512
Missing	43	39
Mean	2.636	3.065
Median	3.000	3.000
Standard deviation	1.049	1.208
Minimum	1	1
Maximum	5	5
Skewness	−0.023	−0.209
Std. error skewness	0.063	0.063

Table 0.7: Descriptives for Assessment Pass Rate

Frequencies of Math_Pass			
Math_Pass	Counts	% of Total	Cumulative %
0	1161	77.0 %	77.0 %
1	347	23.0 %	100.0 %

Frequencies of English_Pass			
English_Pass	Counts	% of Total	Cumulative %
0	883	58.4 %	58.4 %
1	629	41.6 %	100.0 %

## Results

**Research Question 1:** a) How can the sample be described in terms of their Grit, growth mindset, and fixed mindset?

I ran a descriptives table (Table 1.1) of typical scores and spread associated with grit, growth mindset, and fixed mindset scores for the college student sample. As seen in Table 1.1, there were no missing values or nonresponses to the questionnaires. The mean scores represent the typical scores of the entire college student sample. The typical or mean score was utilized due to very minimal skewness noted (grit = -0.033, growth mindset = -0.46, fixed mindset = .009; Table 1.1). No noticeable skewness means that the sample is fairly evenly distributed around the typical score, without an abundance of students clustered around low or high scores. The typical score of the sample was around 3-4 points for each student (grit = 3.3, growth mindset = 4.08, fixed mindset = 3.62; Table 1.1). The measure of grit is on a 1-5 point scale with higher scores suggesting higher levels of grit, so this suggests that people in the sample showed a moderate amount of grit. The measure of growth mindset and fixed mindset is on a 1-6 point scale with higher scores suggesting higher levels of each, so this suggests that the sample had a slightly higher than moderate amount of growth mindset and fixed mindset. However, the typical score of the growth mindset was higher than the fixed mindset.

Table 1.1: Descriptives for Grit, growth mindset, and fixed mindset Scores

Descriptives			
	Grit_Score	GMS_Score	FMS_Score
N	1551	1551	1551
Missing	0	0	0
Mean	3.308	4.084	3.619
Standard deviation	0.587	0.908	0.944
Minimum	1.400	1.000	1.000
Maximum	5.000	6.000	6.000
Skewness	-0.033	-0.460	0.009
Std. error skewness	0.062	0.062	0.062

Afterward, I wanted to see if grit, growth mindset, and fixed mindset scores were related to an academic outcome (GPA). I ran a correlation matrix in order to determine if there was a relationship between grit, growth mindset, and fixed mindset. The sign associated with Pearson's  $r$  (+ or -) shows the direction of the relationship and values closer to 1 indicate a strong relationship. From Table 1.2, I can see that GPA is related to grit ( $r = 0.27, p < .001$ ), growth mindset ( $r = 0.21, p < .001$ ), and fixed mindset ( $r = -0.14, p < .001$ ). There is a positive relationship between GPA with grit and growth mindset, implying that a higher GPA is associated with higher grit and growth mindset scores. There is a negative relationship between GPA and fixed mindset scores, implying that a higher GPA is related to lower fixed mindset scores. Since there is proof of a relationship, I investigated further to see if grit, growth mindset, and fixed mindset are predictors of GPA.

Table 1.2: Correlations Between GPA, Grit, growth mindset, and fixed mindset

Correlation Matrix		GPA	Grit_Score	GMS_Score	FMS_Score
GPA	Pearson's r	—			
	p-value	—			
Grit_Score	Pearson's r	0.274 ***	—		
	p-value	<.001	—		
GMS_Score	Pearson's r	0.214 ***	0.495 ***	—	
	p-value	<.001	<.001	—	
FMS_Score	Pearson's r	-0.141 ***	-0.323 ***	-0.124 ***	—
	p-value	<.001	<.001	<.001	—

Note. \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

**Research Question 1:** b) How predictive are grit, growth mindset, and fixed mindset of GPA?

Next, I explored grit, growth mindset, and fixed mindset as predictors of academic achievement. Starting with the first model, I ran a linear regression that will show how much the predictors (grit, growth mindset, and fixed mindset) contribute to GPA. This will allow me to see if I can better predict a student's GPA based on their grit, growth mindset, or fixed mindset scores compared to using the typical estimate. Including all the predictors in the same model, allows us to control for the other predictors to see if a predictor contributes to the model above the influence of the other predictors. The statistics in Table 1.3 inform us how well grit, growth mindset, and fixed mindset predict GPA.  $R^2$  informs us how much of the variation in GPA is predicted by grit, growth mindset, and fixed mindset. I found that the predictors explain 8.6% of the variance in GPA (Table 1.3). A higher  $F$  value and a significant  $p$ -value ( $p < .05$ ) suggest that a model can predict the outcome. Based on Table 1.3, I can see that grit, growth mindset, and fixed mindset seem to be predictive of GPA ( $F = 47.72$ ,  $p < .001$ ). Additionally, a higher AIC value informs us how well the model predicts the outcome. In this case,  $AIC = 3,379.97$  providing more evidence that grit, growth mindset, and fixed mindset predict GPA.

Table 1.3: Grit, growth mindset, and fixed mindset as Predictors of GPA  
- Model Fit

Model Fit Measures							
Model	R	R <sup>2</sup>	AIC	Overall Model Test			
				F	df1	df2	p
1	0.294	0.086	3379.956	47.727	3	1513	<.001

With the same model, I determined how well each variable contributes to the overall model's predictive ability through the overall model test. Higher  $F$  values and significant  $p$ -values resemble a high impact on GPA. Table 1.4 shows that grit is the largest predictor of GPA ( $F = 45.6, p < .001$ ), followed by growth mindset ( $F = 14.39, p < .001$ ), and fixed mindset ( $F = 5.56, p = .019$ ). The statistics suggest that grit, growth mindset, and fixed mindset are all meaningfully predictive of GPA while controlling for each other (Table 1.4).

Table 1.4: Grit, growth mindset, and fixed mindset as Predictors of GPA  
- Predictor Contributions to the Overall Model

Omnibus ANOVA Test					
	Sum of Squares	df	Mean Square	F	p
Grit_Score	24.684	1	24.684	45.601	<.001
GMS_Score	7.791	1	7.791	14.394	<.001
FMS_Score	3.007	1	3.007	5.556	0.019
Residuals	818.992	1513	0.541		

Note. Type 3 sum of squares

The model coefficients inform us if the predictors meaningfully increase or decrease GPA. The estimate shows how much change in GPA I would expect if the scores from grit, growth mindset, or fixed mindset increased by 1 point with significant  $p$ -values suggesting it is a meaningful predictor of GPA. Table 1.5 shows that as the grit score increases by 1 point, I would expect the GPA to increase by 0.26 and this is a meaningful change ( $p < .001$ ). As the growth mindset score increases by 1 point, I would expect GPA to increase by .09 and this is a meaningful change ( $p < .001$ ). When the fixed mindset score increases by 1 point, I would expect

GPA to decrease by .05 and this is a meaningful change ( $p = .019$ ). This informs us that a person with higher scores on grit and growth mindset is predicted to have a higher GPA (Table 1.5). Inversely, individuals with a higher fixed mindset score are predicted to have a lower GPA. This supports the initial hypothesis that students who show higher levels of grit and growth mindset are associated with a higher GPA and higher levels of fixed mindset are associated with a lower GPA.

**Table 1.5: Grit, growth mindset, and fixed mindset as Predictors of GPA**  
- Model Coefficients

Model Coefficients - GPA						
Predictor	Estimate	SE	95% Confidence Interval		t	p
			Lower	Upper		
Intercept	2.067	0.160	1.752	2.382	12.888	<.001
Grit_Score	0.263	0.039	0.186	0.339	6.753	<.001
GMS_Score	0.091	0.024	0.044	0.138	3.794	<.001
FMS_Score	-0.050	0.021	-0.092	-0.008	-2.357	0.019

**Research Question 2:** When considered all together, do student characteristics, non-cognitive factors, and academic background variables predict math assessment scores? If so, which variables make meaningful contributions to the prediction?

To answer this question, I ran a linear regression model to see if gender, first-generation students, grit, growth mindset, and fixed mindset predicted math assessment scores beyond the effects of GPA. Linear regression will test how well a predicted line of best fit can match the actual math assessment scores observed. The predictor variables were grit, growth mindset, fixed mindset, gender, first-generation student, and GPA with the outcome being math assessment scores. The model fit statistics inform us how well the model predicts GPA. Starting with the  $R^2$ , this informs us how much of the variation in math assessment scores is predicted by grit, growth mindset, fixed mindset, gender, first-generation student, and GPA. Table 2.1 shows that 28.8% of the variance in math assessment scores is predicted by the model. Higher  $F$  values and significant  $p$ -values suggest that this model is a better predictor of math assessment scores than

the typical scores. Table 2.1 also shows that the model is a meaningful predictor of math assessment scores ( $F = 99.86, p < .001$ ). Additionally, a higher AIC value resembles a better predictive model which I see by  $AIC = 13,937$  (Table 2.1). The statistics show that grit, growth mindset, fixed mindset, gender, first generation, and GPA are meaningful predictors of math assessment scores.

Table 2.1: Grit, growth mindset, fixed mindset, Gender, First Generation, and GPA as Predictors of Math Assessment Scores - Model Fit

Model Fit Measures							
Model	R	R <sup>2</sup>	AIC	Overall Model Test			
				F	df1	df2	p
1	0.536	0.288	13937.004	99.858	6	1484	<.001

The overall model contributions show how much each variable has an impact on the model's predictability of the outcome. Higher  $F$  values and significant  $p$ -values resemble a high impact on math assessment scores. Table 2.2 shows that GPA is the highest contributor to the overall model ( $F = 441.61, p < .001$ ), followed by fixed mindset ( $F = 27.45, p < .001$ ), growth mindset ( $F = 10.59, p = .001$ ), and first-generation student ( $F = 4.91, p = .027$ ). This means that GPA, fixed mindset, growth mindset, and first-generation student are meaningful predictors of math assessment scores beyond the influence of other variables. Gender and grit are not meaningful predictors of math assessment scores beyond the influence of other variables (Table 2.2).

Table 2.2: Grit, growth mindset, fixed mindset, Gender, First Generation, and GPA as Predictors of Math Assessment Scores - Predictor Contributions to Overall Model

Omnibus ANOVA Test

	Sum of Squares	df	Mean Square	F	p
Grit_Score	1058.547	1	1058.547	1.586	0.208
GMS_Score	7070.571	1	7070.571	10.593	0.001
FMS_Score	18323.623	1	18323.623	27.452	<.001
Gender	2306.857	1	2306.857	3.456	0.063
First_Gen	3278.117	1	3278.117	4.911	0.027
GPA	294768.089	1	294768.089	441.609	<.001
Residuals	990549.349	1484	667.486		

Note. Type 3 sum of squares

The model coefficients inform us if the predictors meaningfully increase or decrease math assessment scores. The estimate shows how much change in math assessment scores I would expect if the scores from grit, growth mindset, fixed mindset, gender, first-generation student, or GPA increased by 1 point with significant p-values suggesting it is a meaningful predictor of the outcome. Table 2.3 shows that as growth mindset scores increase by 1 point, then there's a meaningful increase in math assessment scores by 2.81. As fixed mindset scores increase by 1 point, then there's a meaningful change in math assessment scores by -3.96. If someone is not a first-generation college student, then there's a meaningful change in math assessment scores by -3.01. As GPA increases by 1, then there's a meaningful increase in math assessment scores by 19.6. This informs us that growth mindset, fixed mindset, first-generation student, and GPA are meaningful predictors of math assessment scores. A higher growth mindset and GPA predict higher math assessment scores. Higher fixed mindsets and those who aren't first-generation students predict lower math assessment scores. Once again, grit and gender are not meaningful predictors of math assessment scores (Table 2.3).



Table 2.3: Grit, growth mindset, fixed mindset, Gender, First Generation, and GPA as Predictors of Math Assessment Scores - Model Coefficients

Model Coefficients - Math_Score						
Predictor	Estimate	SE	95% Confidence Interval		t	p
			Lower	Upper		
Intercept <sup>a</sup>	676.539	6.251	664.277	688.802	108.224	<.001
Grit_Score	-1.771	1.406	-4.530	0.988	-1.259	0.208
GMS_Score	2.808	0.863	1.116	4.500	3.255	0.001
FMS_Score	-3.961	0.756	-5.444	-2.478	-5.239	<.001
Gender:						
Male – Female	2.537	1.365	-0.140	5.213	1.859	0.063
First_Gen:						
Yes – No	-3.009	1.358	-5.672	-0.346	-2.216	0.027
GPA	19.601	0.933	17.772	21.431	21.015	<.001

<sup>a</sup> Represents reference level

**Research Question 3:** When considered all together, do student characteristics, non-cognitive factors, and academic background variables predict passing the English assessment? If so, which variables make meaningful contributions to the prediction?

To answer this question, I ran a binomial logistic regression to test if grit, growth mindset, fixed mindset, gender, first generation, and GPA predict a pass on the English assessment. A binomial logistic regression model tells us how well the predictors can estimate either passing or failing the English assessment. The model fit statistics show us how well the model is predictive of passing the English assessment. Higher  $\chi^2$  and significant p-values determine if the model is a better predictor of passing the English assessment scores. Table 3.1 shows that grit, growth mindset, fixed mindset, gender, first generation, and GPA are predictive of passing the English assessment ( $\chi^2 = 389.34, p < .001$ ).

Table 3.1: Grit, growth mindset, fixed mindset, Gender, First Generation, and GPA as Predictors of Passing English Assessment - Model Fit

Model Fit Measures						
Model	Deviance	AIC	$R^2_{McF}$	Overall Model Test		
				$\chi^2$	df	p
1	1641.506	1655.506	0.192	389.338	6	<.001

Table 3.2 shows how much each variable contributed to the overall model. GPA was the highest contributor to the model ( $\chi^2 = 310.37$ ,  $p < .001$ ), followed by fixed mindset ( $\chi^2 = 110.02$ ,  $p < .001$ ), grit ( $\chi^2 = 8.15$ ,  $p = .004$ ), and growth mindset ( $\chi^2 = 6.34$ ,  $p = .012$ ). This shows that GPA, fixed mindset, grit, and growth mindset are meaningful predictors of passing the English assessment beyond the other variables. Gender and first-generation students are not meaningful predictors of passing the English assessment.

Table 3.2: Grit, growth mindset, fixed mindset, Gender, First Generation, and GPA as Predictors of Passing English Assessment - Predictor Contributions to Overall Model

Omnibus Likelihood Ratio Tests			
Predictor	$\chi^2$	df	p
Grit_Score	8.154	1	0.004
GMS_Score	6.341	1	0.012
FMS_Score	11.024	1	<.001
Gender	2.238	1	0.135
First_Gen	1.763	1	0.184
GPA	310.369	1	<.001

Table 3.3 shows that the model is able to accurately predict the chances of first-year post-secondary enrollment 72.3% of the time with a higher amount of predictability for true negatives (76.3% of the time) compared to true positives (66.8% of the time). This means that I can better predict when a student doesn't pass the English assessment (true negative) compared to when a student does pass the English assessment (true positive). The AUC score of 0.792

indicates that I have a model that is more predictive than chance (which would be a score of 0.5; Table 3.3). The ROC curve in Figure 3.1 shows that the model better predicts true negative cases. Overall, I can assume that grit, growth mindset, fixed mindset, gender, first-generation student, and GPA are meaningful predictors of passing the English assessment.

Table 3.3: Predictability of the Model

Predictive Measures			
Accuracy	Specificity	Sensitivity	AUC
0.723	0.763	0.668	0.792

Note. The cut-off value is set to 0.5

Figure 3.1: ROC Curve of Model Predictability

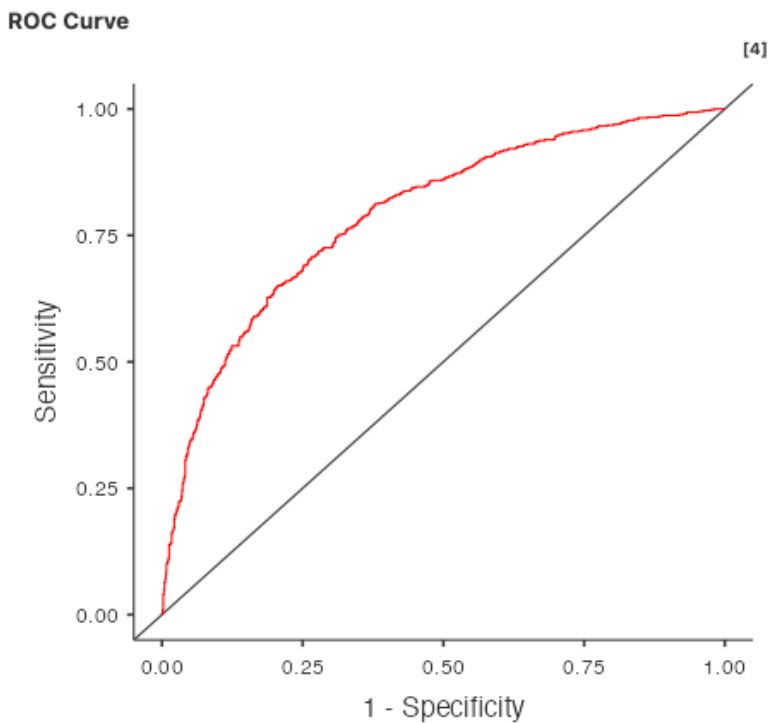


Table 3.4 shows us the odds ratios, p-values, and corresponding confidence intervals for each variable to determine if predictors meaningfully increase or decrease the odds of passing the English assessment. The odds ratio for grit suggests that having a higher grit score changes the likelihood of passing the English assessment by -0.36. The odds ratio for growth mindset

suggests that having a higher growth mindset score changes the likelihood of passing the English assessment by 0.2. The odds ratio for fixed mindset suggests that having a higher fixed mindset score changes the likelihood of passing the English assessment by -0.23. The odds ratio for GPA suggests that having a higher GPA changes the likelihood of passing the English assessment by 1.64. Overall, a higher grit and fixed mindset score are linked to a lower chance of passing the English assessment. Meanwhile, a higher growth mindset score and GPA are linked to a higher chance of passing the English assessment (Table 3.4).

Table 3.4: Grit, growth mindset, fixed mindset, Gender, First Generation, and GPA as Predictors of Passing English Assessment - Model Coefficients

Model Coefficients - English_Pass									
Predictor	Estimate	95% Confidence Interval		SE	Z	p	Odds ratio	95% Confidence Interval	
		Lower	Upper					Lower	Upper
Intercept	-4.299	-5.494	-3.103	0.610	-7.046	<.001	0.014	0.004	0.045
Grit_Score	-0.360	-0.609	-0.112	0.127	-2.838	0.005	0.697	0.544	0.894
GMS_Score	0.198	0.043	0.354	0.079	2.508	0.012	1.220	1.044	1.424
FMS_Score	-0.228	-0.362	-0.093	0.069	-3.307	<.001	0.797	0.696	0.912
Gender:									
Male - Female	-0.182	-0.420	0.056	0.121	-1.498	0.134	0.834	0.657	1.058
First_Gen:									
Yes - No	-0.161	-0.400	0.077	0.122	-1.328	0.184	0.851	0.670	1.080
GPA	1.642	1.426	1.858	0.110	14.897	<.001	5.167	4.163	6.414

Note. Estimates represent the log odds of "English\_Pass = 1" vs. "English\_Pass = 0"

## Conclusion & Recommendations

Based on the results from Research Questions 1, 2, and 3, I can draw some conclusions about grit, growth mindset, and fixed mindset and their contributions to predicting academic performance. For Research Question 1, I saw that grit ( $F = 45.6, p < .001$ ), growth mindset ( $F = 14.39, p < .001$ ), and fixed mindset ( $F = 5.56, p = .019$ ) meaningfully predicted GPA. This suggests that people who score higher on grit and growth mindset tend to have a higher GPA while higher scores on fixed mindset are related to a lower GPA (Table 1.5). I recommend that students should be taught grit and growth mindset skills in an attempt to increase their GPA.

For Research Question 2, I saw that growth mindset, fixed mindset, first-generation student, and GPA meaningfully predicted math assessment scores (Table 2.3). Grit and gender were not meaningful predictors of math assessment scores. A higher growth mindset and GPA predict higher math assessment scores. Higher fixed mindsets and those who aren't first-generation students predict lower math assessment scores. I recommend that students should be taught a growth mindset and encouraged to increase their GPA in an attempt to produce higher math assessment scores.

For Research Question 3, I saw that higher grit and fixed mindset scores were linked to a lower chance of passing the English assessment (Table 3.4). Meanwhile, higher growth mindset scores and GPA were linked to a higher chance of passing the English assessment (Table 3.4). I recommend that students should be taught growth mindset skills and encouraged to increase their GPA in an attempt to pass the English assessment.

Overall, it depends on what academic performance outcome (i.e., GPA, math assessment score, or passing English assessment) is measured or what control variables are included to determine whether grit, growth mindset, and fixed mindset predict academic performance. The next step is to determine which factors are most meaningful to us to answer that question.

# Appendix

## Variable Breakdown

- First generation: this identifies if a student was the first in their family to attend college (yes or no). This is labeled on a dichotomous level with 0 = no and 1 = yes they're a first-generation college student.
- GPA: This is the student's grade point average as a high school student. This is broken down into letter grades based on the following distribution.
  - A = 3.7 - 4.0
  - B = 3.6 - 2.7
  - C = 2.6 - 1.7
  - D = 1.6 - 1.0
  - F = Below 1.0
- Math level: this represents the performance level of a student based on their high school (12th grade) standardized math assessment score. This is broken down on a 1 to 5-point scale:
  - 1 = Did not yet meet expectations
  - 2 = Partially met expectations
  - 3 = Approached expectations
  - 4 = Met expectations
  - 5 = Exceeded expectations
- Math assessment score: represents the math assessment standardized score taken during 12th grade without any transformations. The math assessment standardized score is represented in two ways: 1) raw score or 2) if they passed the assessment (0 = did not pass, 1 = passed).
- English level: this represents the performance level of a student based on their high school (12th grade) standardized English assessment score. This is broken down on a 1 to 5-point scale:
  - 1 = Did not yet meet expectations
  - 2 = Partially met expectations

- 3 = Approached expectations
- 4 = Met expectations
- 5 = Exceeded expectations
- English assessment score: represents the English assessment standardized score taken during 12th grade without any transformations. The English assessment standardized score is represented in two ways: 1) raw score or 2) if they passed the assessment (0 = did not pass, 1 = passed).
- Grit score: an individual can be described as displaying grit if they have a tendency to show perseverance when attempting to achieve a goal. This is calculated as the average across 10 items (e.g., I am a hard worker, my interests change from year to year, I finish whatever I begin). The score for grit is on a 1 to 5-point scale:
  - 1 = Not like me at all
  - 2 = Not much like me
  - 3 = Somewhat like me
  - 4 = Mostly like me
  - 5 = Very much like me
- Growth mindset score: an individual can be described as having a growth mindset if they believe that skills or traits can be acquired through hard work. This is calculated as the average across 4 items (e.g., I like my work best when it makes me think hard, I like work that I'll learn from even if I make a lot of mistakes). The score for a growth mindset is on a 1 to 6-point scale:
  - 1 = Disagree a lot
  - 2 = Disagree
  - 3 = Disagree a little
  - 4 = Agree a little
  - 5 = Agree
  - 6 = Agree a lot
- Fixed mindset score: an individual can be described as having a fixed mindset if they believe that skills or traits are unable to change or grow. This is calculated as the average across 3 items (e.g., I like my work best when I can do it really well without too much trouble). The score for a fixed mindset is on a 1 to 6-point scale:

- 1 = Disagree a lot
- 2 = Disagree
- 3 = Disagree a little
- 4 = Agree a little
- 5 = Agree
- 6 = Agree a lot