How Do Gritty Students Perform in an Introductory Finance Course

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I Introduction

The positive impact of proficiency in arithmetic and mathematics on the performance of undergraduate students in introductory finance courses is well documented in the academic literature. This proficiency in quantitative methods is crucial not only for finance courses but in related building block oriented business subjects such as economics and accounting (Akimov et al., 2018; Takezawa, 2020 among others). Academic success in these settings is not predicated on pre-existing knowledge in quantitative methods or intelligence alone. Of equal importance is the role that non-cognitive skills such as passion and perseverance have in the learning process. It is this set of non-cognitive skills which could help us better understand the cross sectional variation of academic performance of students with equal intelligence. Duckworth (2016) argues that such non-cognitive skills play a central role in the study of mathematics, however, their impact on student performance in quantitative business subjects has yet to be extensively explored (Thompson et al., 2021). Our focus on non-cognitive skills is motivated by recent studies that show non-cognitive skills have predictive outcomes in education. These skills are broadly defined to include feelings, personal traits, attitudes, motivation and other characteristics which are determined socially and develop over one's lifetime (Gutman & Schoon, 2013; Zhou, 2016). Gutman & Schoon (2013) argue that non-cognitive characteristics such as self-perception, including self-efficacy and perseverance, can be cultivated through training and education. While this paper examines the impact of non-cognitive skills on academic performance, it is important to note that "every facet of psychological functioning, from perception to personality, is inherently 'cognitive' insofar as processing of information is involved" (Duckworth & Yeager, 2015, p.238).

Grit (Duckworth, 2016), a non-cognitive skill, has received much attention in the academic literature (Zhou, 2016). The current study examines the impact of grit, defined "as trait-level perseverance and passion for long-term goals" (Duckworth & Quinn, 2009, p.166), within the context of a semester long finance course. Grit as proposed by Duckworth et al. (2007) "entails working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress" (p.1088). Grit is a malleable trait which can be cultivated through education and not an innate, fixed personality trait. A recent study by economists corroborates the notion that grit is indeed malleable (Alan et al., 2019) and finds that intervention yields a positive impact on grit,

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contributing to improved performance in mathematics over time. While grit can be perceived as domain neutral (Luthans et al., 2019), it does involve persevering to "something in particular – the achievement of one's goals long term goals" (Mueller et al., 2017, p.4). This is to be distinguished from the notion of "effort" which entails the amount of time dedicated to the pursuit of a task at hand. We acknowledge the potential limits to developing grit like skills across different socio-economic environments (Denby, 2016). However, in the context of this study, we expect students with higher levels of grit to exhibit perseverance when faced with adversity and the ability to bounce back from setbacks whereas low grit students could be discouraged or simply give-up when faced with unexpected challenges in a semester long course.

Although grit focusses on long term goals, we investigate the impact of grit within the context of a semester long course. While grit could reasonably be expected to be a key determinant in performance for a demanding science program, Bazelais et al. (2016) focused on a challenging undergraduate physics course on electricity and magnetism only to find that student performance is unrelated to grit. In contrast, Bennett et al. (2020) finds grit helps to predict performance in undergraduate economics courses and further reveals the grit-performance relationship is stronger for minority students. This positive relationship also holds for a college level corporate finance class in the United States (O' Malley & Payne, 2020). The current study, contributes to the growing literature on grit as a predictor variable (Fernandez-Martin et al., 2020) by providing preliminary international evidence that grit impacts performance in an introductory finance course.

Ⅱ Data

Data is collected for an introductory finance course titled Financial Management delivered online in the Fall semester 2020 and taught by the author of the paper. As an elective course offered within an all English international liberal arts program at a recognized private university located in central Tokyo (refer to as WU), prerequisites in economics and accounting are not mandatory. Financial Management course enrollment for the Fall semester 2020 was 95 students, and after removing incomplete observations due to missing information, 79 observations remain in our data set. All students involved in the study consented to the use of their data in aggregate form for this study by signing and dating the basic information sheet.

Student performance is measured as the score on a comprehensive open note and open book final test administered on the last day of class in January 2021. The final comprised of an online in-class component and take-home section to be returned to the instructor within 3 hours. The online in-class component consists of a mix of multiple choice and short answer problems while the take-home component involves a short essay and word problems. Bennett et al. (2020) use a percentage based course grade as the outcome variable for their study on introductory economics, and O' Malley and Payne (2020) employ the course grade point as their measure for performance in a corporate finance class. We contribute to the literature by investigating the impact of grit on two differing test components separately and in aggregate, for a total of three different measures of academic performance: the combined in-class and take-home score (*TOTAL*), in-class component score only (*INCLASS*), and take-home component score only (*TAKEHOME*).

The information for the explanatory variables including the GRIT-S index (Duckworth & Quinn, 2009) was obtained from a survey conducted early in the term. In order to facilitate assessment and discussion on policy intervention, we employed explanatory variables which

are factors that can be controlled directly by the student or the program director. The 8 item GRIT-S was employed as opposed to the full 12 item GRIT-O (Duckworth et al., 2007) as Duckworth & Quinn (2009) claims "the 8-item GRIT-S is both shorter and psychometrically stronger than the 12 item GRIT-O" (p.174). Four of the items in the survey gauge consistency of interest which is often referred to as passion. The remaining four questions examine the extent to which there is a perseverance of effort.

The second explanatory variable is the grade earned (grade point) in a statistics course, *STAT*, which serves as a proxy for proficiency in quantitative skills. This statistics course is part of the mandatory core curriculum of the WU liberal arts program and is within the control of the academic program. Moreover, *STAT* is found to be a good predictor of success for previous cohorts in the same finance course (Takezawa, 2020). As a third explanatory variable we include the self-reported number of hours studied each week on average in the previous term (*HRS*). Outside of the classroom, students are assumed to have control over the time allocated towards their studies. In the current study, *HRS* is a dummy variable ranging from one to four based on self-reported information (1= zero to 5 hours, 2= 6 to 10 hours, 3= 11 to 15 hours, and 4= 16 hours or more). This classification of study hours is designed to be consistent with survey data collected and reported in 2008 by the Center for Research on University Management and Policy (CRUMP), Tokyo University <http://ump.p.u-tokyo.ac.jp/crump/cat77/cat82/post-6.html>. The descriptive statistics for the collected data is summarized in Table 1 and correlations are found in Table 2.

Table 1 *Summary of Descriptive Statistics*

	Mean	SD	Maximum	Minimum
GRITS	3.29	0.62	4.5	2.12
GRITPAS	3.17	0.85	4.75	1
GRITPER	3.5	0.68	5.00	2.00
STAT	3.24	0.82	4.00	1.00
TOTAL	63.79	13.53	87.34	27.03
INCLASS	52.59	16.13	87.5	7.81
TAKEHOME	68.93	15.20	95.00	22.50
Observations	79	79	79	79

Table 2 *Correlation*

	GRITS	*GRITPAS*	*GRITPER*	*STAT*	*TOTAL*	*INCLASS*
GRITPAS	0.854					
GRITPER	0.760	0.313				
STAT	-0.024	-0.031	-0.007			
TOTAL	0.205	0.127	0.215	0.327		
INCLASS	0.092	0.045	0.106	0.321	0.873	
TAKEHOME	0.263	0.172	0.267	0.229	0.850	0.487

Ⅲ Model

We run three separate regressions for each of the three different test scores $TEST_j$. $TEST_j$ is regressed on 1) the 8 item grit score, *GRITS*, 2) the self-reported grade point for the statistics course, *STAT*, and 3) the self-reported number of hours studied on average each week in the previous semester, *HRS*.

$$TEST_{ij} = \beta_{0j} + \beta_{Gj}GRITS_i + \beta_{Sj}STAT_i + \beta_{Hj}HRS_i + u_{ij} \quad (1)$$

where j = *TOTAL, INCLASS, TAKEHOME* and u_i is the error term for the i th student. *TOTAL* is the average of the in-class and take-home components of the final test, *INCLASS* denotes the score on the online component of the final test conducted in-class, and *TAKEHOME* is the take-home section score of the final test.

To obtain a better grasp of the impact of grit on test scores, we decompose the GRIT-S index into its two sub-indices as in O'Malley and Payne (2020). The scores on the four questions associated with passion, consistency of interest, are averaged to produce *GRITPAS* and the four questions related to perseverance, perseverance of interest, are used to create *GRITPER*. We then undertake separate regressions for each of the final test scores, *TOTAL, INCLASS, TAKEHOME* on the two grit sub-indices, the statistics grade, and hours studied (equation 2).

$$TEST_{ij} = \alpha_{0j} + \alpha_{PASj}GRITPAS_i + \alpha_{PERj}GRITPER_i + \alpha_{Sj}STAT_i + \alpha_{Hj}HRS_{+i}e_{ij} \quad (2)$$

where *GRITPAS* is the sub-index for the four questions related to *consistency of interest*, *GRITPER* is the sub-index for the questions associated with *perseverance*, and e_i is the error term for the $_i$th student. This specification allows us to discern the effect of perseverance (*perseverance of effort*) from passion (*consistency of interest*).

Ⅳ Empirical Results and Discussion

When we employ *TOTAL* as our outcome variable in model (1), both the GRIT-S score and statistics grade are found to be positive and statistically significant (Table 3). The regression estimates reinforce findings in previous studies on both quantitative skills (Takezawa, 2020) and grit (Bennett et al., 2020; O'Malley & Payne, 2020) as important determinants positively impacting test scores in introductory finance and economics. Overall, we find grittier students scored higher on the total final test on average. However, when we decompose the total final test score, *TOTAL*, into its component parts, *INCLASS*, the in-class component and *TAKEHOME*, the take-home component, and regress them on the same set of explanatory variables we find evidence that the GRIT-S score results are driven by the relationship with the take-home component (equation 1). In other words, the GRIT-S score is not statistically significant for the in-class test outcome regression but statistically significant in the take-home section regression (Table 3). This implies that the learning process associated with grit is better reflected when students engage in slightly more complex problem solving activities or allocated sufficient time to produce a creative solution. In contrast, we find grit is not associated with the in-class component which is designed to test basic knowledge of the subject matter (numerical and facts).

Table 3 *Regression Model (1) : Explanatory Variables GRIT-S score, Statistics grade, Study hours*

	TOTAL	*INCLASS*	*TAKEHOME*
Constant	30.20 (0.002)***	22.75 (0.067)*	32.56 (0.003)***
GRITS	4.55 (0.047)**	2.51 (0.377)	6.46 (0.014)**
STAT	5.46 (0.002)***	6.334 (0.004)***	4.34 (0.031)**
HRS	0.39 (0.818)	0.465 (0.822)	0.449 (0.816)
Adjusted R^2	0.12	0.08	0.09
White	0.825 (0.595)	0.784 (0.632)	1.062 (0.402)

p-value in parenthesis. *** p<0.01; ** p<0.05; *p<0.1. White test for heteroskedasticity is F(9, 69).

We take the analysis one step further by decomposing the GRIT-S index into its two subcomponents (equation 2), and find the perseverance sub-index to be statistically significant but not the passion sub-index (Table 4). Our main results are confirmed against a smaller, separate data set of College of Business Rikkyo University students (Appendix). This suggests that the impact of GRIT-S on test scores is driven primarily by the perseverance sub-index. These results are in line with studies documenting that grit-perseverance plays a role in predicting student satisfaction in the health sciences in Korea (Kim & Hong, 2019) and grades for a corporate finance course in the US (O' Malley & Payne, 2020). Moreover, Wolters and Hussain (2015) provide empirical evidence that grit`s perseverance of effort is a strong predictor for all indicators of self-regulated learning (SRL) which is measured in terms of self-efficacy, cognitive, metacognitive, motivational, and time and study environment management strategies.

Table 4 *Regression Model (2) : Explanatory Variables GRIT-S Passion, GRIT-S Perseverance, Statistics grade, Study Hours*

	TOTAL	*INCLASS*	*TAKEHOME*
Constant	28.61 (0.007)***	21.75 (0.088)*	30.30 (0.011)**
GRITPAS (Passion)	1.19 (0.505)	0.42 (0.847)	1.85 (0.364)
GRITPER (Perseverance)	3.78 (0.093)*	2.33 (0.393)	5.20 (0.043)**
STAT	5.44 (0.003)***	6.31 (0.004)***	4.31 (0.035)**
HRS	0.37 (0.825)	0.46 (0.826)	0.42 (0.826)
Adjusted R^2	0.11	0.07	0.09
White	0.91 (0.554)	0.455 (0.894)	1.22 (0.283)

p-value in parenthesis. *** p<0.01; **p<0.05; *p<0.1. White test for heteroskedasticity is F(16, 64).

V Concluding Remarks

This study finds grit plays an important role in determining academic performance in an online introductory finance course where the results are largely driven by the perseverance component of the GRIT-S scale index. Moreover, our findings contribute to the literature by providing preliminary evidence that grit best predicts the outcome requiring relatively more complex problem-solving and creativity rather than straightforward numerical calculations or testing basic knowledge in the subject matter. Academic programs in Japan which encourage project oriented tasks and small class sizes could stand to benefit from incorporating grit-building exercises into their curriculum design, or by adjusting college admission requirements to assess an applicant`s non-cognitive skills in addition to conventional measures of

academic performance based on one-shot entrance examinations. We also note as Japanese universities begin to experiment with e-learning, grit is also "a promising area of exploration for increasing student achievement in online education" (Buzzetto-Hollywood et al., 2019, p.9).

The current study is exploratory in nature. While we document the impact of grit on test scores in a single course, the cognitive process which connects grit to academic achievement remains relatively unexplored. Luthans et al. (2019) posit that academic psychological capital (PsyCap) which embodies self-efficacy, hope, optimism and resilience could serve to mediate the impact of grit on academic performance for college students. Nolzen (2018) among others provides a comprehensive overview of PsyCap research in the field of management. Also, a possible implication of our results is that it lends support to the argument put forward by Jachimowicz et al. (2018) that GRIT-S is really a measure of perseverance alone and the consistency of interest sub-index does not reflect passion. Jachimowicz et al. (2018) posits that passion is a requisite for perseverance to be a success factor and thus seek to better measure the notion of passion. Future research could incorporate measures of psychological capital as well as examine the passion that instructors bring to the classroom and how this unfolds in the learning process (Lehtonen & Gatto, 2020) as it relates to grit.

Appendix

To gauge the robustness of our empirical findings data was collected, in collaboration with Gene Thompson and Heath Rose, from a similar undergraduate finance course offered online in the College of Business at Rikkyo University in the Spring semester of 2021. We regressed the test scores (percent) on the two sub GRIT-S scores and the score on a customized 7 question arithmetic test, *MATH* (Takezawa, 2020). Our data set was limited to 39 observations due to incomplete and missing information. The students consented to the use of the data in aggregate form for this study. The regression estimates are displayed in Table 5 and confirms our main results that the *GRITPER* perseverance sub-index is an important predictor of academic performance.

Table 5 *COB Rikkyo University Sample: Test Score is regressed on GRIT-S Passion, GRIT-S Perseverance, MATH*

	FINAL TEST	*INCLASS*	*TAKEHOME*
Constant	-2.45 (0.92)	-4.99 (0.85)	0.09 (0.99)
GRITPAS (Passion)	-5.89 (0.20)	-6.52 (0.21)	-5.25 (0.24)
GRITPER (Perseverance)	18.73 (0.001)***	21.54 (0.001)***	15.93 (0.004)***
MATH	3.27 (0.14)	3.15 (0.21)	3.34 (0.11)
Adjusted R2	0.24	0.22	0.19
Observations	39	39	39

p-value in parenthesis: *** p<0.01.

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