

# Academic Performance: The Role of Grit Compared to Short and Comprehensive Inventories of Conscientiousness

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## Abstract

Grit has been suggested as a predictor of academic success over and above established constructs like conscientiousness (C) but has only been compared to brief inventories of trait-level C. This study examined the difference between using a brief inventory of C (Big Five Inventory [BFI]) and a facet-level inventory (NEO Personality Inventory–Revised [NEO PI-R]) as controls for grit in an undergraduate sample ( $N = 1,394$ ). Grit exhibited strong correlations with C, particularly the facets of self-discipline and achievement striving. When BFI was used, both grit and C added small increments in explained variance while controlling for each other. When NEO PI-R was used, grit could not explain any additional variance in university grade and minuscule amounts (4%) in high school grade. Facets of C added moderate amounts (16%–54%) of incremental variance to both university and high school grades when controlling for grit. The results demonstrated that different outcomes are to be expected depending upon the choice of C measure.

## Keywords

grit, conscientiousness, GPA, academic performance

Conscientiousness (C) is by far the most widely measured and validated personality predictor of academic performance to date (Nofhle & Robins, 2007; Poropat, 2009). C describes a person's tendency to be hardworking, achievement-oriented, dependable, orderly, and self-controlled. Meta-analyses have found correlations ranging from .19 to .22 between C and high school or university grade point average (GPA; O'Connor & Paunonen, 2007; Poropat, 2009; Richardson et al., 2012). A conceptually related construct is grit, defined as “perseverance and passion for long-term goals” (Duckworth et al., 2007, p. 1087). Grit can be subdivided into two subscales known as Perseverance of Effort and Consistency of Interest.

Grit is associated with higher educational attainment (Duckworth & Quinn, 2009) and college GPA (Bowman et al., 2015; Strayhorn, 2014). A recent meta-analysis reported a mean correlation of  $r = .15$  between overall grit and academic performance (Credé et al., 2017), and research has begun examining how to foster grit in middle school students (Park et al., 2018).

Correlations between grit and C have ranged from .70 to .77 (Duckworth et al., 2007; Duckworth & Quinn, 2009). One study even classified grit as a lower level C trait (Ivcevic & Brackett, 2014). In order to examine the differences and similarities between these two constructs, it is useful to look at their subcomponents. Unfortunately, most research on grit has ignored the two subscales of the construct (Credé et al.,

2017), and very few studies have examined both grit and facets of C (Schmidt et al., 2018).

The “consistency of long-term goals” aspect of grit, which separates it most clearly from C, is best captured by the Consistency of Interest subscale. Most studies have found that consistency is in fact the part of grit with the weakest correlation to C (Credé et al., 2017). However, a meta-analysis (Credé et al., 2017) of grit also concluded that consistency of interest displayed a correlation of .08 with undergraduate GPA and .11 with high school GPA.

Grit's Perseverance subscale, on the other hand, seems most akin to the two C facets of achievement striving and self-discipline. Strong correlations support this notion for both perseverance and achievement striving ( $r = .70$  and  $r = .79$ ) and perseverance and self-discipline ( $r = .66$  and  $r = .87$ ; Abuhassan & Bates, 2015; Schmidt et al., 2018). Achievement striving and self-discipline are also the two facets of C showing the strongest and most consistent correlations with academic

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performance (Chamorro-Premuzic & Furnham, 2003; Gray & Watson, 2002; Lievens et al., 2002). Likewise, perseverance of effort is the part of grit showing the strongest correlations with both high school GPA ( $r = .22$ ) and undergraduate GPA ( $r = .20$ ; Credé et al., 2017). Thus, it seems that the parts of grit and C that are most related to each other are also the best predictors of academic performance. When two constructs like grit and C appear similar, there is a danger that we have fallen victim to the “jangle fallacy.” If grit and C are in fact two different constructs, we would expect grit to explain a unique portion of the variance in important outcome variables while controlling for C.

Global grit has explained incremental variance in educational attainment controlling for trait C (Duckworth et al., 2007), but some studies found that global grit did not predict school success over and above C (Dumfart & Neubauer, 2016; Ivcevic & Brackett, 2014), while the Perseverance subscale of grit added some explained variance (Steinmayr et al., 2018). A meta-analysis concluded that the Perseverance subscale explained “a substantial amount of incremental variance” (Credé et al., 2017, p. 501) in academic performance even after controlling for trait C ( $\Delta R = .085$  for high school GPA;  $\Delta R = .023$  for college GPA). Global grit and the Consistency subscale added very little or no incremental variance, however, and the study proposed that grit should be differentiated into its two subscales to maximize its ability to predict performance (Credé et al., 2017). It is quite surprising that perseverance added a relatively large amount of incremental variance over C, when perseverance is also the part of grit that is most similar to C. However, a disadvantage of these studies is that none of them compared grit to facets of C, only the superordinate trait.

Several previous studies have found that the facets of C show stronger associations to academic performance than the broad trait (e.g., O’Connor & Paunonen, 2007; Paunonen & Ashton, 2001). Still, the vast majority of studies comparing grit and C have used different brief scales for measuring the construct. The Big Five Inventory (BFI), with 9 C items (John & Srivastava, 1999), is one of the most commonly used scales for measuring C in this context (e.g., Ivcevic & Brackett, 2014; Meriac et al., 2015; Ralph et al., 2017), although some studies use scales with even fewer items, like the Ten-Item Personality Measure with only 2 items for C (Muenks et al., 2017). Some research suggests that the use of short scales for measuring the five-factor model (FFM) traits can lead to an underestimation of the role of these traits and an overestimation of new constructs (Credé et al., 2012).

We found only four previous studies about grit, which used a broad measure of C (Abuhassan & Bates, 2015; Dumfart & Neubauer, 2016; MacCann & Roberts, 2010; Schmidt et al., 2018). One of these studies did not measure academic performance (Schmidt et al., 2018). Another did not measure the subscales of grit or C (Dumfart & Neubauer, 2016). This study concluded that global grit did not show any incremental explained variance in academic performance (GPA at the end of seventh grade) after controlling for trait C and intelligence. The remaining two studies did measure facets of C, academic

performance, and grit. The study by Abuhassan and Bates (2015) found that neither subscale of grit predicted high school GPA when controlling for trait C and neuroticism. Grit’s Perseverance subscale was the only significant predictor of “Achievements” in this study. However, “Achievements” was measured using a modified version of the Creative Achievement Questionnaire (Carson et al., 2003) and did not seem related to academic performance. The last study, by MacCann and Roberts (2010), looked at correlations between the subscales of grit and GPA and found that grit did not exhibit significant correlations with high school GPA, even before controlling for facets of C. The strength of these insignificant correlations decreased further when the facets of C were controlled for. In sum, these studies suggest that grit does not exhibit incremental predictive validity in academic performance when controlling for a broader measure of C. However, the combined number of participants in these four studies was less than 750 ( $n < 750$ ; Abuhassan & Bates, 2015; Dumfart & Neubauer, 2016; MacCann & Roberts, 2010; Schmidt et al., 2018), and none of them used regression analyses with both facets of C and grit.

The present study will be the first to compare grit to both a trait-level inventory of C (e.g., BFI) and a facet-level inventory of C (e.g., NEO Personality Inventory–Revised [NEO PI-R]). Additionally, a larger sample size will be used in order to more robustly determine the overlap in predictive power between grit and C. We expected trait-level C and subscales of grit to add approximately equal amounts of incremental explained variance in academic performance while controlling for each other. On the other hand, we expected facets of C to add a larger amount of incremental explained variance in academic performance than the two previously mentioned measures while controlling for subscales of grit. Moreover, we expected that the subscales of grit would not add any explained variance in academic performance controlling for the facets of C.

## Method

### Participants and Procedure

The study used a cross-sectional design administering paper-and-pencil questionnaires to undergraduate university students. The groups of prospective participants were selected based on a comprehensive search of the official list of the Norwegian Universities and Colleges Admission Service. Study programs were selected from this list based on four criteria: (1) being a study program at the Norwegian University of Science and Technology (the largest university in Norway); (2) a high enough number of males and females to ensure anonymity; (3) variety in required grade for entrance; and (4) the selected study programs varied in terms of content, with some STEM field study programs (science, technology, engineering, and mathematics) and some from the social sciences.

The questionnaires were handed to the students during lectures at the university. Out of 1,602 questionnaires handed out, only two students chose not to receive it, 94 questionnaires

were handed back unanswered after the lectures, 100 questionnaires went missing (were never handed in), and 6 questionnaires were excluded from the study as a result of too many missing variables. Thus, in total, 202 students were given the opportunity to participate in the study and chose not to. This gave a participation rate of 87%. The respondents did not receive credit or any other reward for partaking in the study, but they received anonymous feedback about their personality based on a simple self-scoring solution at the end of the questionnaire.

The total sample consisted of 1,394 adults, 763 females and 618 males, from more than 20 different study programs. The most frequently reported study program represented only 11.2% of the total sample. Age measurement was limited to four categories in order to preserve anonymity: 18–19 years ( $n = 310$ ), 20–21 years ( $n = 695$ ), 22–23 years ( $n = 241$ ), and 24 years and older ( $n = 144$ ). Only undergraduate students were selected in order to increase the odds that the participants would remember their mean high school grades. The highest possible mean high school grade in Norway is 6.0 and the lowest 1.0. The mean high school grade of the sample was 4.95 ( $SD = .56$ ,  $Min = 2.3$ ,  $Max = 6.0$ ). Mode university grade was reported with seven options: A, B, C, D, E, F, and Not received grade. More than two thirds of the participants reported either B or C as their mode grade (see Table 1 for sample characteristics).

## Measures

All questionnaires were identical and contained information about the study, one measure of grit, two measures of C, demographic variables (age and sex), 3 items mapping academic performance, and a “personality feedback” item.

**Grit.** Grit was assessed with the original 12-item scale (Original Grit Scale [Grit-O]; Duckworth et al., 2007). This scale has the advantage of also containing all the 8 items of the Short Grit Scale (Grit-S; Duckworth & Quinn, 2009). Both grit scales contain the same two subscales. The Perseverance of Effort subscale reflects an individual’s sustained effort toward long-term goals despite the presence of setbacks and distress (e.g., “I finish whatever I begin”). The Consistency of Interest subscale reflects an individual’s passion, commitment, and dedicated time toward long-term goals (e.g., “I have been obsessed with a certain idea or project for a short time but later lost interest,” a reversed item). All statements were answered on a 5-point scale ranging from 1 (*not like me at all*) to 5 (*very much like me*).

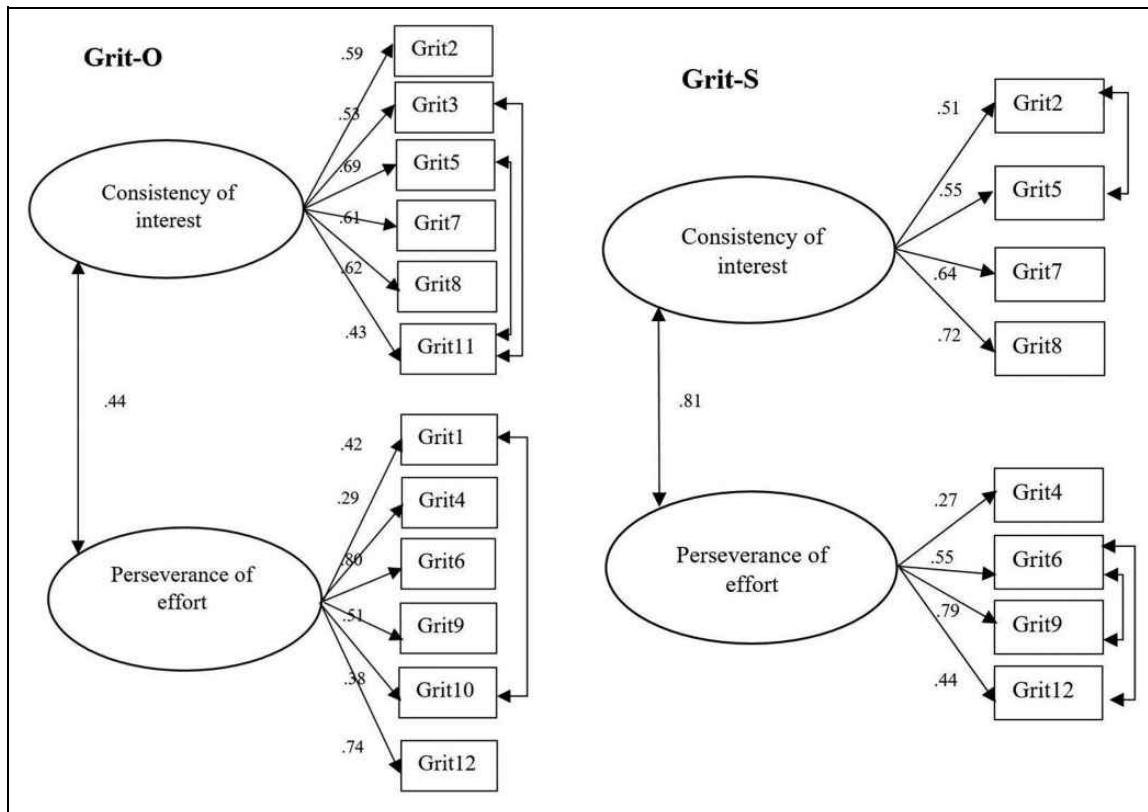
**C.** The six facets of C were measured using all C items of the NEO PI-R (Costa & McCrae, 2010). Competence reflects an individual’s confidence in their ability to accomplish tasks. Order reflects an individual’s preference for being tidy, neat, and well organized. Dutifulness reflects an individual’s sense of obligation, duty, and willingness to follow rules. Achievement striving reflects an individual’s drive to be recognized

**Table 1.** Description of the Sample’s Academic Performance, Sex, Age, and Personality.

Variable	N	%	M	SD	$\alpha$	Missing Data (%)
Sex						0.93
Female	763	54.7				
Male	618	44.3				
Age						0.29
18–19	310	22.3				
20–21	695	50.0				
22–23	241	17.3				
24+	144	10.4				
Grades						
High school (1–6)			4.95	0.56		4.58
University						3.65
A	148	11.0				
B	408	30.3				
C	548	40.7				
D	135	10.0				
E	39	2.9				
F	19	1.4				
Not received	51	3.8				
Univ. $\times$ Entry (0–100)			53.79	19.23		6.96
Personality						
Grit-S (1–5)						0.20
Total			3.31	0.60	.76	
Col			3.09	0.74	.72	
PoE			3.54	0.66	.64	
Grit-O (1–5)						0.20
Total			3.30	0.52	.77	
Col			3.09	0.66	.75	
PoE			3.52	0.61	.69	
BFI C total (1–5)			3.57	0.57	.79	0.11
NEO PI-R (T scores)						0.18
C total			53.37	10.32	.90	
Competence			52.42	10.22	.67	
Order			52.45	10.94	.71	
Dutifulness			54.02	9.03	.54	
Achievement striving			51.37	11.09	.78	
Self-discipline			49.10	10.66	.81	
Deliberation			56.03	11.09	.76	

Note.  $N = 1,394$ . Univ.  $\times$  Entry = university grade times entry requirement of study program (the “university grade” variable used in subsequent analyses); Grit-S = Short Grit Scale; Grit-O = Original Grit Scale; Col = consistency of interest; PoE = perseverance of effort; NEO PI-R C total = NEO PI-R conscientiousness; BFI C total = BFI conscientiousness; SD = standard deviation; BFI = Big Five Inventory; NEO PI-R = NEO Personality Inventory–Revised.

as successful and tendency to work hard to achieve excellence. Self-discipline reflects an individual’s self-perceived tendency to persist at difficult or unpleasant tasks until they are done. Deliberation reflects an individual’s preference for thinking through possibilities carefully before acting and avoiding mistakes. A 5-point Likert-type scale was used ranging from 0 (*strongly disagree*) to 4 (*strongly agree*). The BFI (John & Srivastava, 1999) was used as a representative for a brief, trait-only measure of C. The full BFI contains 44 items. Out of these, the 9 items measuring C were utilized in the questionnaire. A 5-point Likert-type scale ranging from 1 (*does not fit*) to 5 (*fits completely*) was used.



**Figure 1.** Confirmatory factor analysis of Grit-O and Grit-S.

**Academic performance.** Academic performance was assessed with 3 items: one measuring high school GPA, one measuring mode university grade, and one asking for the participant's current study program. High school grade was measured with a single self-report question: "What was your average grade at high school, not counting any extra points?" followed by some examples of "extra points." This results in a score ranging from 1.0 to 6.0.

University grade was measured through the self-report question: "What grade have you received the *most times* after you started university?" with seven options: "A," "B," "C," "D," "E," "F," or "Not received grade." Lastly, the participants were asked to report what study program they were currently studying at university. For each study program, the entry criteria for the current school year were found in the official list of the Norwegian Universities and Colleges Admission Service. The entry criteria ranged from 33.6 to 60.8. In Norway, each applicant's score is constructed by multiplying their high school GPA by 10 and then adding extra points for specific classes, age, and so on. The final "university grade" variable used in correlation and regression analyses later on in this article was constructed by multiplying the reported mode grade at university with the entrance criterion for the "first-time quota" of the reported study program. The mode grades were transformed into numbers in the following fashion: F = 1, E = 2, D = 3, and so on. The participants who reported "Not received grade" on the mode university grade question did not receive a final

"university grade" score and were reported as missing. Whenever "university grade" is mentioned later on in this article, it is referring to this combination of mode grade and study program entrance criterion.

### Statistical Analyses

Six of the original 1,400 questionnaires handed in were excluded from the study, 4 as a result of too many missing variables and 2 because of invalid response styles (e.g., answering alternative five on every question). The remaining 1,394 participants in the final sample received a score on each variable as long as the participant did not have more than 25% missing responses on the items comprising the variable in question. Missing values were not replaced for any demographic or academic performance variables.

For all variables, the mean, standard deviation (*SD*), and internal consistency (Cronbach's  $\alpha$ ) were calculated (see Table 1). All variables used in the regression analyses were checked for skewness and kurtosis. Due to significant skewness and kurtosis, the "high school grade" variable was transformed using a  $\log_{10}^*(-1)$ -transformation. The remaining variables conformed well to a normal distribution and were not changed in any way.

Psychometric properties of the Norwegian translation of Grit-O and Grit-S have not been reported before. Thus, a confirmatory factor analysis (CFA) was conducted for both the Grit-O and the Grit-S (see Figure 1). To evaluate the models,

**Table 2.** Correlations Between Grit, C, and Academic Performance.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Grit-S, total													
2. Grit-S, Col	.87**												
3. Grit-S, PoE	.84**	.46**											
4. BFI, C	.71**	.55**	.67**										
5. NEO PI-R, C	.69**	.53**	.66**	.84**									
6. NEO PI-R, competence	.48**	.33**	.50**	.62**	.72**								
7. NEO PI-R, order	.40**	.32**	.36**	.55**	.70**	.32**							
8. NEO PI-R, dutifulness	.39**	.27**	.41**	.49**	.66**	.44**	.33**						
9. NEO PI-R, achievement striving	.62**	.42**	.65**	.68**	.78**	.52**	.42**	.43**					
10. NEO PI-R, self-discipline	.75**	.60**	.69**	.77**	.80**	.55**	.46**	.42**	.68**				
11. NEO PI-R, deliberation	.33**	.32**	.24**	.48**	.65**	.40**	.43**	.38**	.30**	.29**			
12. University grade	.15**	.10**	.17**	.17**	.17**	.19**	.03ns	.00ns	.18**	.20**	.10**		
13. High school grade	.23**	.17**	.24**	.24**	.25**	.25**	.10**	.11**	.23**	.22**	.19**	.59**	
14. Mode grade (A–F) at university	.10**	.05ns	.12**	.15**	.13**	.17**	.01ns	.00ns	.15**	.16**	.07*	.86**	.31**

Note. Grit-S = Short Grit Scale; BFI = Big Five Inventory (9 items for C); NEO PI-R = NEO Personality Inventory–Revised (48 items for C); university grade = mode grade at university multiplied by the admission requirement of the education program of each participant; high school grade = mean grade from high school; ns = not significant; Col = consistency of interest; PoE = perseverance of effort; C = conscientiousness.

\* $p < .05$ . \*\* $p < .01$ .

five of the most recommended (Hu & Bentler, 1999) fit indices were used: the standard  $\chi^2$  test, the root-mean-square error of approximation (RMSEA), the standardized root-mean-square residual (SRMR), and the comparative fit index (CFI). According to Hu and Bentler (1999), values close to .06 or lower on the RMSEA, less than .08 on the SRMR, and close to or above .95 on CFI are considered representative of a good fit.

Bivariate correlations were conducted for all personality and academic performance variables (see Table 2). This matrix included global grit, the two subscales of grit, trait C from both inventories, the six facets of C, and university and high school grade. Correlations of .10, .20, and above .30 were interpreted as being “small, typical, or relatively large” (Gignac & Szodorai, 2016).

Eight hierarchical linear regressions were performed to examine the incremental predictive power of both grit and C on academic performance (see Table 3). Academic performance was measured by high school grade and university grade. These two outcome variables resulted in two regressions with subscales of grit and a short, trait-level inventory of C (BFI) and two regressions with subscales of grit and a more comprehensive, facet-level inventory of C (NEO PI-R). All four of these regressions examined the incremental predictive validity of grit over C. Afterward, the same four hierarchical regressions were conducted reversing the order of the predictor variables to investigate the incremental predictive validity of C over grit.

## Results

### CFAs Comparing Grit-O and Grit-S

A CFA was conducted for both the Norwegian translation of the Grit-O and the Grit-S. For Grit-O, the goodness-of-fit indices were poor,  $\chi^2(53) = 979.1$ ,  $p < .001$ , RMSEA = .114, SRMR = .103, CFI = .763. After allowing three

modifications to the model, the fit improved but was still not good,  $\chi^2(50) = 652.0$ ,  $p < .001$ , RMSEA = .094, SRMR = .083, CFI = .846. A summary of the CFA for Grit-O is displayed in Figure 1. The fit for Grit-S without any modifications was poor,  $\chi^2(19) = 386.200$ ,  $p < .001$ , CFI = .858, RMSEA = .119, SRMR = .086. After allowing three modifications, the fit became acceptable,  $\chi^2(16) = 69.359$ ,  $p < .001$ , CFI = .979, RMSEA = .050, SRMR = .032.

### Relationship Between Grit, C, and Academic Performance

Most personality variables showed significant positive correlations with academic performance (see Table 2). The only exceptions were the insignificant correlations between university grade and the C facets of order and dutifulness. The correlation coefficients of the significant correlations between academic performance and personality ranged from small ( $r = .10$ ) to typical ( $r = .25$ ), and stronger correlations were found across the board with high school grade than university grade. University grade and high school grade exhibited a large correlation ( $r = .59$ ).

The global scores for both grit and C showed correlations with academic performance of approximately equal magnitude. For grit, academic performance correlated more strongly with the Perseverance subscale than with Consistency. For C, the facets of competence, self-discipline, and achievement striving presented the strongest correlations with academic performance.

Lastly, the correlations between global grit and trait C were large for both the short and long inventories of C ( $r = .71$  and  $r = .69$ , respectively), indicating a substantial overlap between grit and C. Both measures of trait C also showed a large correlation ( $r = .84$ ) with each other. The facets of C that showed the strongest correlations with grit, and its subscales, were self-

**Table 3.** Eight Hierarchical Linear Regressions Explaining Variance in Academic Performance.

Variable	Brief Trait-Level Inventory of C (BFI)				Facet-Level Inventory of C (NEO PI-R)			
	High School Grade		University Grade		High School Grade		University Grade	
	Adj. $R^2$	$\Delta R^2$	Adj. $R^2$	$\Delta R^2$	Adj. $R^2$	$\Delta R^2$	Adj. $R^2$	$\Delta R^2$
<b>Model 1</b>								
Step 1 (age and sex)	.120	.122***	.047	.048***	.120	.122***	.047	.048***
Step 2 (BFI or NEO PI-R)	.171	.051***	.079	.032***	.196	.079***	.116	.073***
Step 3 (Grit)	.182	.013***	.084	.007**	.202	.007**	.118	.003 <sub>ns</sub>
<b>Model 2 (reversed order)</b>								
Step 2 (Grit)	.177	.057***	.079	.033***	.177	.057***	.079	.033***
Step 3 (BFI or NEO PI-R)	.182	.006**	.084	.006**	.202	.029***	.118	.043***
<b>Final step of the regressions</b>								
	$\beta$	Sign.	$\beta$	Sign.	$\beta$	Sign.	$\beta$	Sign.
Age	-.34	<.001	-.15	<.001	-.33	<.001	-.14	<.001
Sex	.08	.003	.19	<.001	.06	.013	.17	<.001
BFI C	.12	.001	.11	.004				
NEO PI-R, competence					.12	<.001	.09	.007
NEO PI-R, order					-.07	.026	-.10	.002
NEO PI-R, dutifulness					-.06	.036	-.15	<.001
NEO PI-R, achievement striving					.09	.012	.10	.011
NEO PI-R, self-discipline					.01	.889	.14	.003
NEO PI-R, deliberation					.11	.001	.10	.002
Grit-S, PoE	.14	<.001	.11	.002	.12	.001	.07	.087
Grit-S, Col	.04	.236	-.01	.659	.03	.323	-.05	.171

Note. Grit-S = Short Grit Scale; BFI = Big Five Inventory (9 items for C), NEO PI-R = NEO Personality Inventory-Revised (48 items for C); Sex: 1 = woman, 2 = man; ns = not significant; Col = consistency of interest; PoE = perseverance of effort; C = conscientiousness; BFI C = BFI conscientiousness.

\*\* $p < .01$ . \*\*\* $p < .001$ .

discipline and achievement striving. These showed particularly strong correlations with perseverance of effort. See eTable 1 for a summary of the correlations when using the Grit-O. There were no notable differences, and the largest discrepancy observed was the correlation between consistency of interest and high school grade, which was .17 when using the Grit-S and .15 when using the Grit-O.

### C and Grit as Predictor Variables of Academic Performance

Eight hierarchical linear regressions were conducted in order to examine the incremental predictive power of grit and C on academic performance (see Table 3). For all eight of these regressions, the collinearity diagnostics were within acceptable bounds (the highest variance inflation factor was 3.1 and the lowest Tolerance was .322). In the regressions with grit and the trait-level inventory of C (BFI), subscales of grit added a small amount of explained variance for high school grade ( $\Delta R^2 = .013$ ) and a minuscule amount of explained variance for university grade ( $\Delta R^2 = .007$ ). Trait C added minuscule amounts of explained variance for both high school grade ( $\Delta R^2 = .006$ ) and university grade ( $\Delta R^2 = .006$ ). In the final step of these regressions, all variables except for consistency of interest were significant. Younger participants reported higher grades than older participants, and males reported higher grades than females.

In the regressions with grit and the facet-level inventory of C (NEO PI-R), grit added a minuscule amount of explained variance for high school grade ( $\Delta R^2 = .007$ ) and did not add any explained variance for university grade. Facets of C added moderate amounts of explained variance for both high school grade ( $\Delta R^2 = .029$ ) and university grade ( $\Delta R^2 = .043$ ). In the final step of the regressions for high school grade, all variables except consistency and self-discipline were significant. In the final step of the regressions for university grade, all variables except for the two subscales of grit were statistically significant contributors to the variance explained. The facets of order and dutifulness exhibited negative  $\beta$  coefficients.

The variables explained less of the total variance in university grade (adjusted  $R^2$  total = .08 and .12) than high school grade (.18 and .20). Additionally, the incremental explained variance for subscales of grit and trait C (BFI) was small ( $\Delta R^2$  ranging from nonsignificant to .01), while facets of C (NEO PI-R) added moderate amounts of incremental explained variance ( $\Delta R^2$  ranging from .03 to .04). Facets of C increased the amount of variance that could be explained by 54% for university grade and 16% for high school grade, even after accounting for the variance explained by subscales of grit. By contrast, subscales of grit increased the amount of variance explained by 0% for university grade and 4% for high school grade after accounting for the variance explained by facets of C. See eTable 2 for a summary of regression using total scores only. Total scores did not differentiate much between grit and

C with respect to explaining variance in academic performance. Grit was a stronger predictor of high school grade than university grade, while C showed similar results across both types of grades.

## Discussion

This study set out to explore the relationship between grit, C, and academic performance. We found slightly stronger correlations between grit and academic performance than those found in the meta-analysis of grit (Credé et al., 2017). Trait C exhibited correlations to academic performance of approximately equal magnitude to those in two meta-analyses of C (Poropat, 2009; Richardson et al., 2012). As expected, grit's Perseverance subscale displayed stronger correlations to academic performance than its Consistency subscale. For C, we expected self-discipline and achievement striving to show the strongest correlations to academic performance based on previous research (O'Connor & Paunonen, 2007). However, it was surprising that the facet of competence also displayed correlations of equal magnitude. We also found that all personality constructs exhibited stronger correlations to high school grades than university grades.

When a short, trait-level inventory (BFI) was utilized, subscales of grit explained slightly more incremental variance in academic performance controlled for trait C than trait C could explain controlled for subscales of grit. However, all of these increments in explained variance in academic performance (for both trait C and subscales of grit) were small or minuscule. When a facet-level inventory of C (NEO PI-R) was used, facets of C explained a moderate amount of additional variance for both high school grade and university grade over and above subscales of grit. Furthermore, subscales of grit could not explain any additional variance in the participants' university grade and only minuscule amounts of incremental variance in the participants' high school grade. Facets of C increased the amount of variance that could be explained by 54% for university grade and 16% for high school grade, as opposed to grit with 0% for university grade and 4% for high school grade.

Our correlation analyses indicated that grit and C are quite similar constructs ( $r = .71$  and  $.69$ ), which is consistent with previous research (Schmidt et al., 2018). Even though grit did not add a meaningful amount of explained variance in academic performance when compared to the facets of C, the Grit-S could still be pragmatically useful as a time-efficient measure (Schmidt et al., 2018). Our study suggests that most of grit's utility lies in its Perseverance subscale. This finding is consistent with previous research (Abuhassan & Bates, 2015; Credé et al., 2017). Perseverance of effort was the portion of grit most closely related to C and in particular the facets of C with the highest correlations to academic performance, namely self-discipline and achievement striving. This may indicate that the Perseverance of Effort subscale is the most time-efficient way to measure the persistent and hardworking aspect of personality relevant for explaining individual differences in academic performance.

A surprise finding was that order and dutifulness showed negative significant  $\beta$  coefficients. These facets also displayed very weak or insignificant positive correlations with academic performance. This is likely a negative suppression effect. Further research is needed to examine if these surprising results represent a legitimate finding or a statistical artifact.

Although the present study had a relatively large sample size and measured facets and subscales of both C and grit, it did have its limitations. The cross-sectional design cannot address causality. All participants were university students, and the mean GPA of the sample was quite high. However, the sample seemed representative of populations from similar age cohorts (students), as the mean and *SD* for grit were similar to those found in previous studies ( $d = .11-.17$ ; Duckworth & Quinn, 2009; Ivcevic & Brackett, 2014). Also, other constructs such as intelligence and the other Big Five traits were not measured, and the Cronbach's  $\alpha$  values for some of the C facets were low. There was a possibility of selection bias in the sample; however, response rates were high and missing data were not a problem. Another issue was that the total amount of academic performance explained was quite modest (ranging from 8.4% to 20.2%). Having accounted for the personality constructs of C and grit still leaves a lot of variance in academic performance unexplained. Lastly, all grades were self-reported. Although grades obtained from school transcripts are always preferred, self-reported grades are very highly correlated with actual grades (Kuncel et al., 2005).

Further limitations concern the conceptualization and psychometric properties of grit. All items measuring consistency of interest are reversely scored, which could be psychometrically problematic. There could also be potential issues with how perseverance of effort is conceptualized as indicated by the continuing reduction in the number of items loading onto the factor. These observations suggest that further conceptual and psychometric work is needed for the grit construct. Questions are also raised concerning the conceptual and empirical status of grit as a unique predictor of academic performance since grit explained limited additional variance in academic performance and showed strong correlations with C. These observations dovetail previous research concluding that grit is strongly related to C and especially the self-discipline facet, suggesting that grit could be integrated into the hierarchical structure of C (e.g., Schmidt et al., 2018).

In conclusion, our study advocates for the use of facet-level inventories of C in future research exploring differences in academic performance. Grit-S and BFI explained approximately equal amounts of variance in academic performance. NEO PI-R, on the other hand, captured more variance than both of these measures did. However, the Perseverance of Effort subscale of grit may still turn out to be a time-efficient way to measure an aspect of personality relevant for explaining differences in academic performance.

## Declaration of Conflicting Interests


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## Supplemental Material

The supplemental material is available in the online version of the article.

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