Journal of Research in Personality 81 (2019) 168–175

Contents lists available at ScienceDirect

Journal of Research in Personality

journal homepage: www.elsevier.com/locate/jrp

Full Length Article

Examining the unique and combined effects of grit, trait self-control, and conscientiousness in predicting motivation for academic goals: A commonality analysis

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ARTICLE INFO

Article history:
Received 27 September 2018
Revised 8 May 2019
Accepted 10 June 2019
Available online 11 June 2019

Keywords:
Grit
Trait self-control
Conscientiousness
Academic motivation
Goal pursuit
Self-regulation
Commonality analysis

ABSTRACT

The purpose of the present research was to examine the predicative ability of both the unique and combined components of grit, trait self-control, and conscientiousness in the context of academic goal pursuit. Participants ($n_1 = 163$, $n_2 = 551$) were asked to complete assessments of each self-regulatory trait and reported their motivation for an academic goal. Together, grit, trait self-control, and conscientiousness explained 9.9% of the variance in academic goal motivation across both samples. Using commonality analysis, we found that the overlapping components of grit, trait self-control, and conscientiousness accounted for 49.6% of the explained variance (4.9% of the total variance), with the individual components each accounting for less than 20% (2% of the total variance). Implications for research on self-regulatory traits are discussed.

From Aristotle to Barack Obama, there is no shortage of public figures or academics throughout history touting the idea that tenacity is the key to success. At the core of these messages is the central theme, *if you persist, you will succeed*. This idea, more commonly known as grit, has recently taken the education world by storm. Grit is defined as "perseverance and passion for long-term goals. . ..[and] entails working strenuously toward challenges, maintaining effort and persistence over years despite failure, adversity, and plateaus in progress" (Duckworth, Peterson, Matthews, & Kelly, 2007, pp. 1087–1088). Instead of focusing on mere talent or intelligence, educators are instead encouraged to focus on promoting students' effort and persistence, and most importantly, to not give up when the going gets tough. While grit-tier individuals (in both academics and beyond; e.g., Duckworth et al., 2007) experience greater achievement as a function of their determination (and arguably their motivation), research has yet to consider the *type* of motivation that grit engenders. And although once thought to be "the best measure of success" (Davis, 2015), grit has recently come under fire for its conceptual and statistical overlap with other self-regulatory traits, including trait self-control and conscientiousness. Therefore, the purpose of the current research is twofold: (1) to examine the extent to which grit relates to different types of motivation during the pursuit of academic goals; and (2) to better understand the relation between grit, trait self-control, and conscientiousness.

1. Why motivation matters

Much like grit, motivation plays an important role in the successful pursuit of academic goals and achievement; however, the *quantity* of motivation alone is not sufficient, and instead it is *quality* of motivation that leads to long-term success. For example, past research finds that intrinsic motivation is a robust predictor of academic success (e.g., Burton, Lydon, D'Alessandro, & Koestner, 2006; Fortier, Vallerand, & Guay, 1995, Grolnick & Ryan, 1989; Hardre & Reeve, 2003; Michou, Vansteenkiste, Mouratidis, & Lens, 2014; Taylor et al., 2014), both in the short-term and in the long-term (Gottfried, Fleming, & Gottfried, 1994), whereas the use of extrinsic rewards may lead to short-term success, but ultimately undermines

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https://doi.org/10.1016/j.jrp.2019.06.003
0092-6566/

academic achievement (e.g., Deci, Vallerand, Pelletier, & Ryan, 1991; Fortier et al., 1995). Grounded in Self-Determination Theory (Ryan & Deci, 2017), we ascribe to the view that motivation falls along a continuum based on the extent to which a goal or activity is pursued for more or less autonomous reasons (Deci & Ryan, 2000; Ryan & Connell, 1989; Ryan & Deci, 2000). Autonomous motivation occurs as a function of pursuing a goal or behaviour out of interest and enjoyment (intrinsic), because it connects with an individual's own values (integrated), and/or because of personal importance (identified). Conversely, a goal or behaviour can be pursued based on controlled motivation (i.e., for less autonomous reasons), which includes wanting to avoid feelings of shame or guilt (introjected) or during the pursuit of tangible rewards or praise (extrinsic).

To illustrate the conceptual differences between autonomous and controlled motivation, let us use the example of a psychology student pursuing the goal to get an A in their statistics course. From the more autonomous perspective, the student may pursue this goal because acquiring these skills is considered to be important for their future as a graduate student researcher (identified), being successful in statistics will help the student enter a career that is congruent with their values and interests (e.g., to help others) (integrated), or they simply find math and statistics to be a fun and interesting topic (intrinsic). Conversely, a psychology student may strive to do well in statistics because they would feel guilty or ashamed if they did not succeed in every aspect of their degree (introjected) or their parents will pay them for every A they get in their classes (extrinsic). It is likely the case that the student in this scenario will pursue their goal for a multitude of reasons, which is why it is important to consider the relative autonomous nature of one's goal – that is, the extent to which a goal is pursued for more autonomous relative to controlled reasons (e.g., (Sheldon & Houser-Marko, 2001; Werner, Milyavskaya, Foxen-Craft, & Koestner, 2016). In essence, pursuing a goal with more autonomous motivation refers to goals that people actually *want to* pursue, whereas more controlled (less autonomous) motivation emerges in situations where people feel that they *have to* pursue a certain goal (e.g., Milyavskaya, Inzlicht, Hope, & Koestner, 2015).

In the context of education, past research indicates that having greater autonomous motivation facilitates positive learning outcomes, including enhanced conceptual understanding (Benware & Deci, 1984; Grolnick & Ryan, 1987), interest and enjoyment (Grolnick & Ryan, 1987; Reeve & Jang, 2006), and higher grades (Black & Deci, 2000), findings that have been demonstrated cross-culturally (e.g., Jang, Reeve, Ryan, & Kim, 2009; Kage & Namiki, 1990; Tsai, Kunter, Lüdtke, Trautwein, & Ryan, 2008). With respect to goal pursuit more generally, there is consistent and robust evidence to suggest that people make more progress on more autonomous goals (e.g., Koestner et al., 2002; Koestner, Otis, Powers, Pelletier, & Gagnon, 2008; Milyavskaya et al., 2015; Sheldon & Elliot, 1998, 1999; Werner et al., 2016, Werner & Milyavskaya, 2018; Werner, Milyavskaya, & Koestner, 2018). In relation to grit, however, the most notable finding is the relation between motivation and self-regulatory behaviours, such as effort and persistence. Since past research finds that autonomous motivation facilitates greater effort and persistence (e.g., Standage, Duda, & Ntoumanis, 2006), we believe that the type of motivation that drives an individual's behaviour may serve as a possible underlying mechanism explaining the relation between grit and the attainment of academic goals (Eskreis-Winkler, Shulman, Beal, & Duckworth, 2014; Strayhorn, 2014). In this regard, understanding the type of motivation that grit engenders may be important for understanding both academic goal pursuit and other positive learning outcomes (such as enjoyment, Reeve & Jang, 2006), and appears to be uncharted territory. The first aim of this research is to examine whether grit is indeed related to more autonomous motivation for academic goals.

2. Beyond grit: associations with additional self-regulatory traits

Within the realm of personality and self-regulation, there has been a boisterous debate regarding the overlap between grit, trait self-control, and conscientiousness (cf. Credé, Tynan, & Harms, 2017; Duckworth & Gross, 2014). From a theoretical standpoint, grit has been proposed as a higher order personality trait that is distinct from other self-regulatory constructs, namely through its focus on long-term achievement rather than mitigating daily temptations (Duckworth & Gross, 2014). However, one prominent counterargument is that the concept of grit is not new, and researchers may simply be tapping into the same construct under a different name (otherwise known as the jangle fallacy; Kelley, 1927). Beyond self-control and conscientiousness, other similar constructs include the need for achievement (e.g., McClelland, 1985) and self-discipline (Costa & McCrae, 1992; cf. Credé et al., 2017). From an empirical standpoint, a large scale meta-analysis provides evidence in favour of this proposition, as "the size of the correlation ($\rho = 0.84$) with overall conscientiousness is so strong. . .that grit may be redundant" (Credé et al., 2017, p. 502).

While grit has been in the spotlight more recently, there have also been similar arguments made for the relation between trait self-control and both conscientiousness and grit. Although trait self-control was conceptualized to assess "the ability to override or change one's inner responses, as well as to interrupt undesired behavioral tendencies and refrain from acting on them" (Tangney, Baumeister, & Boone, 2004), others have argued that self-control may simply represent a facet of conscientiousness (along with orderliness, industriousness, and responsibility; see Roberts, Lejuez, Krueger, Richards, & Hill, 2014). Indeed, Roberts and colleagues argued that as a multifaceted trait, conscientiousness encompasses both self-control and grit/industriousness as separable facets of the overarching conscientiousness construct.

Consistent with these arguments, researchers have found that grit, trait self-control, and conscientiousness all correlate at around 0.70 or higher (e.g., Credé et al., 2017; Duckworth et al., 2007; Duckworth & Quinn, 2009; Saunders, Milyavskaya, Etz, Randles, & Inzlicht, 2018). Such high correlations are problematic when comparing predictors in terms of their utility, as issues of multicollinearity or singularity may arise when a set of predictor variables correlates at 0.70 or higher are used within the same analysis (cf. Tabachnick & Fidell, 2013). In an effort to address this limitation of past research, our second aim in the current research was to examine the predictive ability of both the unique and combined (i.e., overlapping) components associated with grit, trait self-control, and conscientiousness.

3. Present research

To recap, the purpose of the present research is twofold. Within the context of academic goal pursuit, our first objective was to use the framework of Self-Determination Theory to examine the extent to which grit relates to the quality of motivation for academic goals. We focused specifically on academic goals (rather than personal goals more broadly) since research on grit falls largely within the academic domain. From a broader personality perspective, our second objective was to better understand the overlap between grit and other self-regulatory traits, namely trait self-control and conscientiousness. To test these ideas, we used regression commonality analysis (Nimon, 2010). While past research has used multiple regression and the interpretation of beta weights to evaluate which construct is most important in predicting academic success, this method is problematic because beta weights are heavily influenced by the level of multicollinearity among other predic-

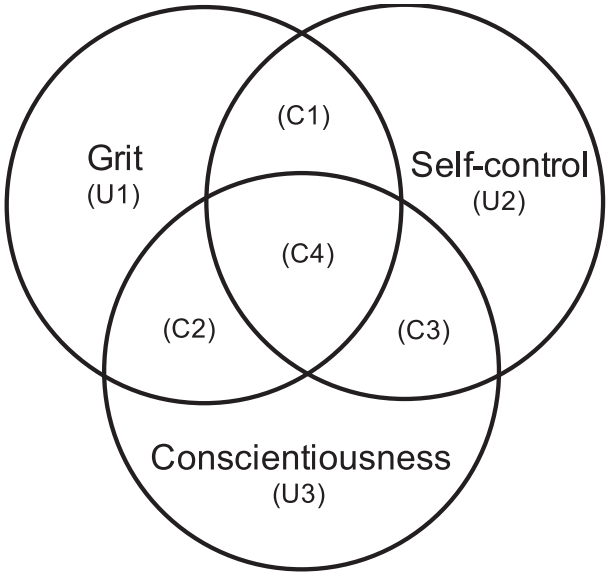

Fig. 1. Conceptual diagram representing the commonality analysis examining the unique (U) and combined (C) aspects of grit, trait self-control, and conscientiousness. U1-U3 represent the amount of variance in academic goal motivation that is uniquely explained by each construct, whereas C1-C4 represent the common or overlapping components of the various constructs (C1: grit and self-control, C2: grit and conscientiousness, C3: self-control and conscientiousness, C4: grit, self-control, and conscientiousness).

tors "and by themselves are not good indicators of predictor usefulness" (Nimon, 2010, p. 10). Instead, commonality analysis provides a more thorough understanding of the relation between grit, trait self-control, and conscientiousness because it partitions the explained variance (R^2) based on the unique (U) and combined (C) contributions of each construct (see Fig. 1; Nimon, 2010; Nimon, Lewis, Kane, & Haynes, 2008). Given that we did not have any specific hypotheses regarding the unique or overlapping relations among grit, trait self-control, and conscientiousness in predicting motivation for academic goals, we took an exploratory-confirmatory approach – Study 1 was used for exploratory analyses to see what patterns emerge from the data, and Study 2 was used to replicate the results from Study 1.

3.1. Statement of transparency

The data used in the following studies was initially collected as part of a series of larger exploratory studies on goal pursuit. Since we are using secondary data, the current studies or analyses were not pre-registered, and instead we took an exploratory-confirmatory approach. All study materials (including all measures from the larger studies), data used in the current studies, and any additional supplementary analyses[1] are posted on the Open Science Framework. Project link: https://osf.io/r35tf/.

4. Study 1: Exploratory

4.1. Participants and procedure

Participants were 291 undergraduate psychology students who completed an online survey focusing on academics and goal pursuit. As part of the larger study, participants identified three personal goals that they planned to pursue over the next year. They then rated their motivation for pursuing each goal, as well as completed a series of personality questionnaires, including grit, trait self-control, and conscientiousness. We also included a series of attention checks, which 108 participants failed[2], resulting in a sample of 183 participants. However, since we were interested uniquely in academic goals, we removed any participants who did not write about at least one academic goal, resulting in a final sample of 163 participants (60% female; M_{age} = 19.52, SD_{age} = 2.51).

4.2. Measures

Goal Setting Task. Participants were asked to list three personal goals that they planned to pursue over the next year, using the following instructions (e.g., Koestner et al., 2008): "Personal goals are projects and concerns that people think about, plan for, carry out, and sometimes (though not always) complete or succeed at. They may be more or less difficult; require only a few or many steps; represent different areas of a person's life; and be more or less time consuming, attractive, or urgent. Please think of your three most important personal goals that you plan to pursue over this coming year." Goals were coded as either academic (e.g., "To get at least an 80% average") or not (e.g., "Spend time with my family"), and only the first reported academic goal for each participant was used for the current analysis.

Goal Motivation. After each goal, participants were asked to rate a series of goal characteristics, including the reasons why they are pursuing each goal. Drawing from self-determination theory, these reasons included five items assessing external, introjected, identified, integrated, and intrinsic reasons for goal pursuit (Sheldon & Elliot, 1999). Responses were made on a five-point Likert scale from 1 (*not at all for this reason*) to 5 (*completely for this reason*). In line with the theoretical consideration of autonomy as a relative continuum (Deci & Ryan, 2000; Sheldon & Elliot, 1999) and consistent with previous research (e.g., Sheldon & Elliot, 1999; Werner & Milyavskaya, 2018), we calculated a relative autonomous index by subtracting the average of the extrinsic and introjected scores from the average of the intrinsic, integrated, and identified scores (i.e., goal motivation = avg. autonomous motivation – avg. controlled motivation), such that higher scores represented relatively more autonomous motivation.

Trait Self-Control. The Brief Self-Control Scale (13-items; Tangney et al., 2004) was used to assess trait self-control. Example items include, "People would say that I have iron self-discipline" and "I often act without thinking through all the alternatives" (reverse-coded). Responses were made on a five-point Likert scale, ranging from 1 (*not like me at all*) to 5 (*very much like me*).

Grit. The Short Grit Scale (8-items; Duckworth & Quinn, 2009) was used to assess trait level perseverance and passion for long-term goals. Example items include, "Setbacks don't discourage me," "I am diligent," and "New ideas and projects sometimes distract me from previous ones" (reverse-coded). Responses were made on a five-point Likert scale, ranging from 1 (*not like me at all*) to 5 (*very much like me*).

Conscientiousness. We used the nine-item conscientiousness subscale of the Big Five Inventory (BFI; John & Srivastava, 1999) to assess personality characteristics such as efficiency, organization, and self-discipline (e.g., "I see myself as someone who makes

[1] At a reviewer's request, supplemental analyses include correlations between the key study variables, other big five variables, non-academic goal motivation, and GPA (Table 4), item-specific correlations for each of the items in the three scales of interest (Table 5), commonality analyses with non-academic goal motivation and GPA as outcomes (Table 6), and the unique effects of grit and trait self-control over all the big five variables (Table 7).

[2] Two attention check items were embedded throughout the survey: (1) Please select "9: Very true of me" to indicate that you are paying attention, and (2) Please type the number 2 and select "Not at all" to indicate that you've read this, although for this item we only included the first part "Please type the number 2." Participants were removed if they failed to correctly respond to both items.

plans and follows through with them"). Responses were made on a 5-point Likert scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*)[3].

4.3. Results

Table 1 presents the descriptive statistics and bivariate correlations among study variables. Consistent with previous research, grit, trait self-control, and conscientiousness are all highly correlated (*rs* = 0.61–0.72).

To examine whether grit, trait self-control, and conscientiousness predict academic goal motivation, we first examined whether these constructs uniquely predicted academic goal motivation. Using simple regression, we tested a model including grit, trait self-control, and conscientiousness predicting autonomous motivation for academic goals. Results indicate that none of the self-regulatory traits independently predicted goal motivation (β's ranging from 0.03 to 0.17, p's > 0.10), although the model indicated that together these variables accounted for 10% of its variance, $R^2 = 0.10$, $F(3, 159) = 5.985$, $p = .001$. This approach, however, is limited given the high correlations among the predictor variables (Nimon, 2010; Nimon & Gavrilova, 2010; Tabachnick & Fidell, 2013). To address this concern, we then conducted a commonality analysis using the R package 'yhat' (Nimon & Oswald, 2013) to further elucidate how much of the 10% of variance in academic goal motivation is attributable to each of the unique and combined effects of grit, trait self-control, and conscientiousness. As presented in Table 3, results indicate that very little (each less than 2%) of this variance is attributed to the unique aspects of grit (U1), trait self-control (U2), or conscientiousness (U3). Instead, the majority of this variance is attributable to the overlap amongst all three constructs (C4), accounting for approximately 5% of the variance in academic goal motivation.

4.4. Brief discussion

Following a more traditional approach to comparing grit, trait self-control, and conscientiousness, grit did not stand out in predicting autonomous motivation for academic goals. In fact, none of the individual self-regulatory traits uniquely contributed to goal motivation on their own. However, commonality analysis revealed that the combined effect of grit, trait self-control, and conscientiousness explained around 5% of the total variance in academic goal motivation, whereas the unique aspect of each of the individual traits predicted very little (each less than 2%). In other words, based on the data provided in the current study, the best potential predictor of "success" is the overlapping component that underlies all three traits.

5. Study 2: Confirmatory

5.1. Participants and procedure

Similar to Study 1, 934 undergraduate psychology students took part in a larger online study on goal pursuit. Participants identified three personal goals that they planned to pursue over the next year, followed by the same measures that were included in Study 1. Two hundred and eighty-two[4] were duplicates, failed a series of attention checks, or did not complete the survey. As with Study 1, we coded goals by domain and only retained participants who wrote about an academic goal. Therefore, our final sample included 551 participants (69% female; $M_{age} = 20.60$, $SD_{age} = 4.49$). Given the confirmatory nature of this study, the exact same measures were used from Study 1.

5.2. Results

Table 1 presents the descriptive statistics and bivariate correlations among all study variables. As with previous research, grit, trait self-control, and conscientiousness were all highly correlated (*rs* = 0.63–0.71). Consistent with Study 1, results indicate that trait self-control ($\beta = -0.02$, $p = 0.797$) did not significantly predict autonomous motivation for academic goals. However, contrary to the previous study, grit ($\beta = 0.21$, $p = 0.001$) and conscientiousness ($\beta = 0.15$, $p = 0.019$) both positively predicted autonomous motivation for academic goals (see Table 2 for detailed results). Together, these three constructs accounted for nearly 10% of the variance in academic motivation, $R^2 = 0.103$, $F(3, 547) = 20.905$, $p < 0.001$. Results from the commonality analysis indicate the overlapping component of grit, trait self-control, and conscientiousness account for 45.9% of the variance in autonomous motivation for academic goals. All other effects accounted for less than 25% (ranging from 0.1 to 23.4%) of the explained variance in autonomous motivation for academic goals. In other words, out of the 10.3% of total variance explained by these constructs, the combined effect explains 4.73%.

6. Post-hoc analysis: combined results for Study 1 and Study 2

To better evaluate the overall evidence provided by these two studies and account for any discrepancies, we conducted a post-hoc analysis where we combined the two samples and re-ran the commonality analysis ($n_{total} = 714$). As presented in Table 3 and depicted in Fig. 2, results indicate that the three constructs (and their overlapping components) explained 9.9% of the variance in academic goal motivation. Upon examining the unique and combined effects of grit, trait self-control, and conscientiousness, results further indicate that the greatest contributor to autonomous motivation for academic goals is the overlapping component among all three constructs (49.6%), with all other components accounting for less than 20% (ranging from 0.1 to 19.4%). In other words, out of the 9.9% of total variance explained by these three constructs, the overlapping components among all three traits explained 4.91%. The remaining components each accounted for less than 2% (ranging between 0.10 and 1.92%) of the variance in academic goal motivation.

7. Discussion

The current research represents a novel approach to increase our understanding of grit. On one hand, we proposed autonomous motivation as a mechanism underlying the well-established relation between grit and academic goal attainment. On the other hand, we used commonality analysis (Nimon & Reio, 2011; Nimon, 2010) to better understand the relation among conceptually similar self-regulatory traits. Across two samples, our results indicate that the overlapping components of grit, trait self-control, and conscientiousness is most predictive of autonomous motivation for academic goals. In other words, it is not necessarily the case that one construct is "better" than the other, but rather, based on the current data, the shared overlap among them is likely the best predictor for success.

The primary contribution of the present research is the use of commonality analysis in order to better understand the overlap

[3] Participants completed the full BFI scale; correlations of our target measures with the other Big 5 factors are presented in online supplementary materials on OSF.

[4] More specifically, 179 (19%) was removed for failing attention checks, 103 (11%) were removed for extensive missing data (e.g., not providing any goals, not completing the majority of the survey, including the measures relevant to the current study), 14 (1.5%) were removed for being duplicate responses, and 87 (9%) were removed for not providing any academic goals.

Table 1
Bivariate correlations, descriptive statistics, and reliability coefficients for predictor variables in Study 1 (n = 163) and Study 2 (n = 551).

				Study 1			Study 2		
	2	3	4	α	*M*	*SD*	α	*M*	*SD*
1. Grit	-	**.63**	**.70**	.73	3.31	0.57	.75	3.30	0.60
2. Trait Self-Control	**.66**	-	**.71**	.83	3.07	0.61	.85	3.09	0.64
3. Conscientiousness	**.72**	**.61**	-	.80	3.45	0.62	.81	3.52	0.60

Note. Correlations along the lower diagonal are results for Study 1, whereas the upper diagonal (highlighted in grey) are the results for Study 2. Correlations in bold are of primary interest and compare the self-regulatory traits, all $p < 0.001$. All correlations are significant at least $p < 0.05$.

Table 2
Hierarchical multiple regression with grit, trait self-control, and conscientiousness predicting academic goal motivation.

	Study 1 (n = 163)					Study 2 (n = 551)				
Predictor	*B*	*SE*	*β*	*p*	95% CI	*B*	*SE*	*β*	*p*	95% CI
Grit	.29	.28	.12	.299	[-.26, .84]	**.48**	**.14**	**.21**	**.001**	**[.21, .75]**
Trait Self-Control	*.40*	*.23*	*.18*	*.082*	*[-.05, .85]*	-.03	.13	-.02	.797	[-.29, .22]
Conscientiousness	.12	.24	.06	.626	[-.36, .60]	**.35**	**.15**	**.15**	**.019**	**[-.06, .65]**

Note. Results in bold are significant predictors of academic goal motivation, whereas italicized results are marginal. Controlling for GPA, the results for both studies remain unchanged. In both cases, GPA is not a significant predictor of autonomous motivation for academic goals.

Table 3
Commonality Matrices for Study 1, Study 2, and the combined sample representing the percentage of variance in academic motivation explained by grit, conscientiousness, self-control, and their combinations.

		Study 1: Exploratory		Study 2: Confirmatory		Combined Sample	
	Predictors	Commonality coefficients (R^2)	Percentile (% R^2)	Commonality coefficients (R^2)	Percentile (% R^2)	Commonality coefficients (R^2)	Percentile (% R^2)
Unique Effects (*U*)	Grit	.006 [.00, .06]	6.0	.020 [.00, .05]	19.5	.017 [.00, .04]	17.3
	SC	.017 [.00, .07]	17.1	.000 [.00, .01]	0.1	.001 [.00, .01]	0.1
	Con	.001 [.00, .03]	1.3	.009 [.00, .03]	8.9	.006 [.00, .02]	6.0
Common Effects (*C*)	Grit & SC	.014 [-.01 .05]	13.8	.001 [-.01, .01]	0.6	.004 [-.00, .01]	3.6
	Grit & Con	.007 [-.01, .03]	7.0	.024 [.01, .05]	23.4	.019 [.00, .04]	19.4
	Con & SC	.004 [-.01, .02]	4.2	.002 [-.01, .01]	1.5	.003 [-.00, .01]	3.5
	Grit, Con & SC	**.051 [.01, .11]**	**50.5**	**.047 [.02, .08]**	**45.9**	**.049 [.03, .08]**	**49.6**
Total		.101	100	.103	100	.099	100

Note. Con = Conscientiousness, SC = Trait self-control. 95% CI are presented alongside the commonality coefficients.

among grit, trait self-control, and conscientiousness. While certainly not a new technique (e.g., Mood, 1971; Rowell, 1991; Thompson & Miller, 1985), the use of commonality analysis has been quite scarce in modern psychological research. Because of the high correlations among the variables of interest, estimates from a standard multiple regression are likely to be unstable, as was demonstrated across Study 1 (no individual predictors were significant) and Study 2 (grit and conscientiousness were positive predictors). Thus, while the goal of hierarchical regression is to evaluate the contribution of a set of predictors, these results become muddled when the predictors are highly correlated with one another. By using commonality analysis, we were able to take this multicollinearity issue into account by examining the extent to which the redundancy, or the overlapping component of grit, trait self-control, and conscientiousness, predicts academic goal motivation. This analysis and the results from the current research are quite pertinent and timely given the on-going debate surrounding grit and whether or not it is a unique construct, as previous research has simply relied on multiple regression or other insufficient techniques in order to establish its unique predictive ability.

Based on the results of the commonality analysis, the present findings suggest that a large portion of autonomous motivation is explained by shared overlap among trait self-control, conscientiousness, and grit. If this is indeed the case, it is imperative that the field comes to a consensus as to how to best label and operationalize this underlying "core" construct. One such possibility put forth by personality psychologists is that both grit and self-control are simply facets of conscientiousness (Roberts et al., 2014). This assertion certainly seems reasonable given that personality psychologists have long considered self-control as a primary facet of conscientiousness (Roberts et al., 2014). Further examining the items from the scales used to assess consciousness, self-control, and grit also supports this view, as the wording of the items used to assess all three constructs are quite similar (e.g., "I am lazy" from the trait self-control scale, and "I am someone who tends to be lazy" from the conscientiousness scale; see Table 5 in supplementary materials where we highlighted all of the simi-

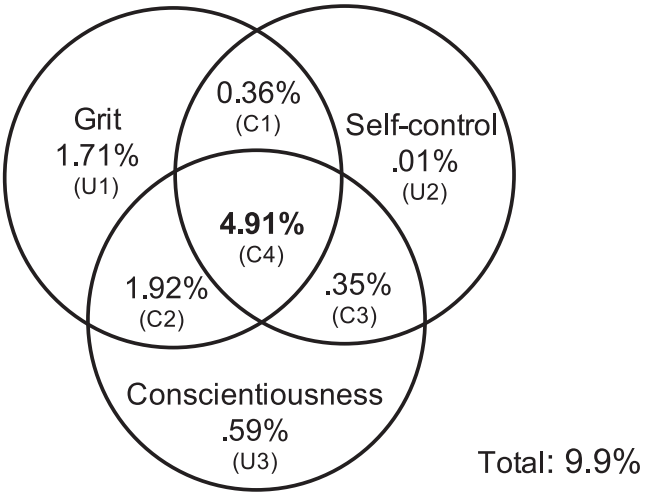

Fig. 2. Results from the commonality analysis using the combined sample (n = 714). The total percent represents how much of the total variance in academic motivation is accounted for by grit, trait self-control, and conscientiousness, whereas the percentages within the diagram represents the decomposition of R^2 for each of the unique (U) and combined (C) components. These numbers were calculated by multiplying the total variance accounted for (9.9%) by %R^2 (see last column in Table 3).

larly worded items). That said, while the present findings suggest that a "core construct" likely exists, it is up to the field to decide how to best label this construct (e.g., although a plausible explanation, the data cannot speak to whether conscientiousness, or either of the other two constructs for that matter, is indeed the higher order factor). In fact, it may even be the case that these three constructs operate on the same level and instead all fall under some other broader term (e.g., self-regulatory ability at the trait level). To gain further insight into this question, future research would benefit from using longer measures that would better tap into the underlying latent variables (e.g., NEO PI-R to measure conscientiousness). By using more refined measures, the overlap between the constructs might become even more prominent and therefore account for a larger proportion of the explained variance in relevant outcomes.

That said, our results also showed that grit had a small independent contribution to autonomous motivation for academic goals (1.7% of the total variance; 17% of the variance explained by the three constructs), providing some support for the assertion that grit has the potential to be a theoretically and practically separate construct with a unique effect on important outcomes (Duckworth & Gross, 2014). These results, however, do not preclude the possibility that grit may be a facet of conscientiousness (as suggested by Roberts et al., 2014), since within a hierarchical framework of personality the separate facets of each trait are meant to provide unique information (Roberts, Chernyshenko, Stark, & Goldberg, 2005).[5] Moreover, it is possible that grit is indeed meant to be theoretically different, and instead there may be a mismatch between the individual constructs and their operationalization, therefore raising concerns about construct validity (Brewer & Crano, 2014; Shadish, Cook, & Campbell, 2001). This is often one of the most challenging aspects of social and personality psychology, as most of the processes we assess are not directly observable. As a result, we often rely on our own theories and judgements in determining what a construct is and how it is measured, often leading to the proliferation of the same constructs under different labels (e.g., Hulleman, Schrager, Bodmann, & Harackiewicz, 2010). Such perils are not unique to the grit literature (e.g., Hershcovis, 2011; Hulleman et al., 2010; Suls & Bunde, 2005), and in fact, there seems to be a much broader measurement issue within the social and personality field as a whole (cf. Flake, Pek, & Hehman, 2017). However, if grit is to maintain its status as a unique higher order construct, the grit questionnaire will need to be critically revised in order to better reflect its more refined and distinct components (e.g., perhaps consider removing the reverse-coded items related to distraction, as they are almost identical to items used in the other measures and are not necessarily the opposite of passion, effort, and perseverance, which are the core aspects of grit).

These results are also interesting in the context of recent research on trait self-control as a predictor of autonomous goal motivation (Converse, Juarez & Hennecke, 2019). In a series of studies, trait self-control was found to predict more autonomous goal pursuit. However, this research did not examine whether other related constructs, such as conscientiousness or grit (or their overlap) could be responsible for these findings. In the current studies, we found that while trait self-control by itself was correlated with autonomous motivation, this was primarily due to its shared variance with grit and with conscientiousness. Future research is needed to better understand if it is truly trait self-control that is responsible for increased goal autonomy, or some other related construct that underlies both trait self-control and grit.

7.1. Limitations and directions for future research

One of the most prominent limitations of the current research is that, although we proposed autonomous motivation as a potential mechanism for the relation between grit and academic goal attainment, we did not actually assess how much progress people made on their goals. The current studies were only cross-sectional in nature, and although there is a plethora of research that demonstrates the positive relation between autonomous motivation and goal progress (in cross-sectional and longitudinal studies, across different domains, and across cultures), future research would benefit from testing the complete model in a longitudinal sample. Even though we collected participants' GPAs, for many of them this was their high school GPA (since approximately half of our sample were first-year students in their first semester of university). There is likely quite a large difference between high school and university GPAs; we were thus reluctant to use this variable as it likely assesses different things for different students. Additionally, this GPA reflects an outcome that was obtained prior to the measurement of our predictor variables (i.e., based on grades from the previous year), so that it is likely that a person's GPA may have influenced how they responded to the grit, conscientiousness, or self-control questionnaires. Conversely, goal motivation was specifically assessed for goals that the participants have just set; it less likely (although not impossible) that goal motivation for a new goal could have influenced responses on personality questionnaires. Using academic goal motivation as a single outcome measure thus represents another limitation of the current research.

Another potential limitation to the present study is the time frame of the goals participants specified, as they were asked to list three goals that they planned to pursue over the coming year. While this time frame is consistent with previous research on grit (e.g., Duckworth et al., 2007; Eskreis-Winkler et al., 2014), it has been proposed that "grit is more tightly coupled with exceptional achievements that often take decades—or even an entire lifetime—to accomplish" (Duckworth & Gross, 2014, p. 322-323). Although quite challenging, future research would benefit from examining the overlap amongst these constructs during longer periods of goal pursuit (e.g., over multiple years), as well as examine the potential for changes in grit over time.

Another interesting avenue for future research is understanding whether there are boundaries where being "gritty" ends and

[5] We thank an anonymous reviewer for suggesting this interpretation.

maladaptive goal engagement begins. While grit focuses on the unwavering commitment and persistence in the pursuit of one's goals, the reality is that some of the goals we pursue will be futile. That is, we cannot be successful all the time. Whether it stems from limited resources (cognitively, monetarily, or in time) or our own physical limitations, a core component of goal pursuit is knowing when it is actually more strategic to disengage (e.g., Dunne, Wrosch, & Miller, 2011; Miller & Wrosch, 2007; Shah, 2005; for an in-depth review, see Jostman & Koole, 2009). For example, past research indicates that actively disengaging from an unattainable goal and subsequently re-engaging in some alternative pursuit confers benefits to subjective well-being (e.g., Wrosch, Scheier, Miller, Schulz, & Carver, 2003). Research from self-determination theory also indicates that motivation plays a key role in disengagement – although it may be difficult to disengage from an unattainable goal, people may be better off disengaging earlier on rather than trying to stick it out, especially in the case of pursuing a goal that is tied to one's sense of self (i.e., an autonomous goal) (Ntoumanis, Healy, Sedikides, Smith, & Duda, 2014).

8. Conclusion

The present research proposes that the quality of motivation, namely autonomous (want-to) relative to controlled (have-to) motivation, is a potential underlying mechanism explaining the relation between grit and academic goal attainment. At the same time, we also directly addressed the theoretical concern surrounding the grit construct, specifically examining its unique predictive ability when also considering trait self-control and conscientiousness. Results showed that the core component underlying the three traits accounted for the most variance in autonomous goal motivation. Together, these results support the use of commonality analyses to isolate the unique and shared effects of similar constructs on outcomes of interest.

8.1. Constraints on generality

In the current studies, we are interested in examining how self-regulatory traits influence motivation for academic goals. In this regard, we aptly collected data from undergraduate students. All questionnaires were completed online at the participants' leisure and without any influence from the authors or other research assistants. While we did not personally collect data from various types of students (e.g., high school students, elementary school students), grit has been previously examined across various age groups (including using the measures from the current studies), and so we have no reason to believe that the results depend on other characteristics of the participants, materials, or context.

9. Statement of contributions

MM came up the research question and proposed analytic strategy. KW and RK collected the data. KW coded and screened the data (RK initially coded and screened the data, but was later replaced by KW due to issues brought forth by a reviewer during the peer review process). Both MM and KW conducted the analyses. KW and MM wrote the paper with assistance on the results and general feedback from SL.

Funding

This research was supported by a grant from the Social Sciences and Humanities Research Council of Canada awarded to M. Milyavskaya from (Grant # 435-2016-0991).

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jrp.2019.06.003.

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