

Grit, conscientiousness, and the transtheoretical model of change for exercise behavior

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Abstract

Grit and the Big Five Inventory (BFI) Conscientiousness dimension were examined with respect to the transtheoretical model (TTM) stages of change for exercise behavior. Participants ($N = 1171$) completed an online survey containing exercise-related TTM staging questions, the Short Grit Scale and BFI Conscientiousness. Ordinal regression analyses showed that grit significantly predicted high intensity and moderate intensity exercise TTM stage while BFI Conscientiousness did not. The results suggest that grit is a potentially important differentiator of TTM stage for moderate and high intensity exercise.

Keywords

adherence, conscientiousness, exercise, grit, transtheoretical

Introduction

While a physically active lifestyle is inversely related to coronary heart disease risk factors (e.g. Schofield et al., 2009) and mortality risk (Lee and Skerrett, 2001), adherence to exercise has proven difficult. For example, nearly 30% of Americans report no leisure-time physical activity (Centers for Disease Control and Prevention (CDC), 2008) and only 50% of US adults report regular exercise (Saad, 2008). Even when the environment is favorable (e.g. proximity to exercise facilities), many people with good intentions eventually quit (Morgan and Dishman, 2001), a finding that shows that while the environment may be important, the environment alone is not sufficient for the maintenance of exercise programs (Giles-Corti and Donovan, 2002). Therefore, certain personality traits may be important but overlooked

factors in the study of exercise and exercise adherence.

Psychological 'grit' may be a personality trait worth considering in the study of exercise behavior. Grit is defined as perseverance and passion for long-term goals (Duckworth et al., 2007). According to Duckworth et al. (2007), gritty persons stay the course and work strenuously

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toward challenges and maintain effort and interest in activities for years despite setbacks and plateaus. Grit differs from the need for achievement (McClelland, 1961). Individuals who score high in the need for achievement strive for manageable goals that allow for immediate feedback, but those high in grit deliberately set long-term objectives and do not swerve from them even in the absence of feedback (Duckworth et al., 2007). Grit also differs from state-like individual differences such as self-efficacy. Whereas self-efficacy represents a belief or conviction about one's ability to successfully complete a given task for a given situation, grit taps long-term stamina and persistence in completing a task or accomplishing a goal. Distinct from state-like individual differences, grit assesses a relatively stable trait-like individual characteristic.

Grit shows predictive validity over a closely related personality trait, conscientiousness, in studies of educational attainment, completion of US Military Academy summer training camp (Duckworth et al., 2007), and final round attained among National Spelling Bee competitors (Duckworth and Quinn, 2009). Grit and conscientiousness share psychological space, but grit contains an element of long-term persistence that a conscientious person may or may not possess (Duckworth et al., 2007). While Duckworth et al. (2007) found predictive validity for grit compared to conscientiousness in a variety of situations grit was not examined with respect to an important health-related behavior such as exercise outside a military setting. Although investigators have found conscientiousness to be related to exercise participation (e.g. Courneya and Hellsten, 1998) and to have significant effects on intention and behavior for exercise (e.g. McEachan et al., 2010), the results of Duckworth and Quinn (2009) and Duckworth et al. (2007) give reason to suspect that grit is also associated with exercise behavior.

The adoption and maintenance of many health-related behaviors, including exercise, appear to follow stages of the transtheoretical model (TTM): precontemplation; contemplation; preparation; action; and maintenance

(Prochaska and DiClemente, 1984). Meta-analytical data confirm that exercise and physical activity level is correlated with stage position (Marshall and Biddle, 2001), but less is known about psychological variables and stage position, and individual trait level constructs may provide additional insight. Therefore, the purpose of this study was to examine grit and conscientiousness with respect to TTM stages of change for exercise participation. Given the results of Duckworth and Quinn (2009) and Duckworth et al. (2007) one might expect grit to have predictive validity for exercise TTM stage location and this leads to the following two hypotheses. One, we expected positive associations between grit, BFI Conscientiousness, and TTM stages, and two, we expected grit to perform as well or better than BFI Conscientiousness in predicting exercise TTM stage level.

Method

Participants

Students, staff, and faculty at three midwestern universities received a university-approved informed consent via email to complete an online survey on exercise and individual differences. A total of 1228 participants responded to the survey. Fifty-seven participants did not complete the survey and were removed from the analysis resulting in a working sample of 1171 and a useable survey response rate of 95.36%.

Instruments

TTM staging. Participants responded to three TTM staging algorithms: low, moderate, and high intensity exercise. The staging recommendations of Reed et al. (1997) were used and included: a complete and clear definition of the behavior, a well-defined description of the stages, and a five-choice response format to assess behavior stage. Based on the guidelines of Ainsworth et al. (2000), exercise was defined as a planned behavior and examples of low, moderate, and high intensity exercise were

given. Exercise was staged relative to a minimum frequency and duration of exercise per week. For example, the moderate intensity staging question read as, 'Do you exercise at a moderate intensity at least three times per week for more than 15 minutes?' Responses to this question contained the following five choices: Yes, I have been exercising at a moderate intensity for more than six months (maintenance); Yes, I have been exercising at a moderate intensity for less than six months (action); No, but I plan to start exercising at a moderate intensity in the next 30 days (preparation); No, but I plan to start exercising at a moderate intensity in the next six months (contemplation); No, and I don't plan to start exercising at a moderate intensity in the next six months (precontemplation). The low and high intensity TTM staging algorithms were constructed similarly.

Grit. The Short Grit Scale (Grit-S; Duckworth and Quinn, 2009) was used to assess grit. The Grit-S has eight items rated on a five-point scale from 1 = not at all like me to 5 = very much like me. The Grit-S score is the average of the eight items. Grit-S shows adequate alpha (α) internal consistency ($\alpha = .73-.83$), one-year test-retest reliability ($r = .68$, $p < .001$) and scores do not differ by gender (Duckworth and Quinn, 2009). Internal consistency for the present study was $\alpha = .79$.

Conscientiousness. Participants completed the Big Five Inventory Conscientiousness dimension (BFI; John and Srivastava, 1999). The sentence 'I see myself as someone who ...' was followed by short phrases based on prototypical trait adjectives associated with the dimension. Participants rated themselves on characteristics identified by the short phrases using a five-point scale from 1 = disagree strongly to 5 = agree strongly. The score is the sum of the ratings for the items. John and Srivastava (1999) reported α reliabilities of .75-.80, three-month test-retest reliabilities of .80-.90 and a mean corrected pairwise convergent validity coefficient of .91 ($SD = .08$) relative to the Neuroticism-Extroversion-Openness Five Factor Inventory (NEO-FFI; Costa and McCrae,

1992) and the Trait Descriptive Adjectives Inventory (TDA; Goldberg, 1992). Internal consistency for the present study was $\alpha = .78$.

Procedure

The survey was developed using Survey Monkey™ software. A pilot survey was conducted and resulted in small adjustments to the email consent statement and the wording of several survey questions. The remaining participants completed the survey via an email to students, staff, and faculty at three universities. The university-approved consent form encouraged exercisers and non-exercisers to complete an online survey on exercise and individual differences. Participants completed biometric questions (e.g. gender, height, weight) and information on competitive sport status (currently involved, not currently involved but have been in the past, never involved), followed by exercise and TTM stage questions, the Grit-S, and BFI Conscientiousness. The survey required five to seven minutes to complete and remained available for approximately three weeks to allow potential participants to respond. After the availability period, data were downloaded to IBM SPSS version 18.0 (SPSS, Chicago, IL) for analysis.

Analysis

Pre-analysis screening. Prior to the analysis the data were screened for outliers and missing values (Mertler and Vannatta, 2010). There were 35 univariate outliers (defined as values greater than or equal to three standard deviations (SD) from a respective variable mean) and six multivariate outliers (defined as cases with a Mahalanobis distance greater than a critical χ^2 (7) at $p < .001$) resulting in the removal of 35 data points and six cases. There were 18 missing values sporadically located throughout the database and therefore these values were replaced with the mean of the corresponding variable. The final sample size including the removal of the initial non-completers was 1165 (i.e. 1171 less six cases).

TTM stage comparisons. To validate the TTM stages with respect to exercise behavior, a one-way analysis of variance (ANOVA) was conducted to test the association between self-reported exercise frequency and TTM stage level. Post-hoc analyses were performed using Tukey’s test. Eta squared (η^2) was used to evaluate the proportion of variance in TTM stages accounted for by differences in exercise frequency. Cohen’s (1988) η^2 criteria for small (.01), medium (.06), and large (.14) differences were used to quantify the proportion of TTM stage variance accounted for by the ANOVA.

Hypothesis tests. To test the first hypothesis, correlations were calculated between grit, BFI Conscientiousness, and low, moderate, and high intensity exercise TTM stage. Because TTM stages can be considered an ordinal level variable, grit and BFI Conscientiousness were converted to ranks and correlated with TTM stage using Spearman correlations. To test the second hypothesis concerning the predictive capability of grit and BFI Conscientiousness for each exercise intensity level, three separate ordinal logistic regression analyses were conducted using low, moderate, and high intensity TTM stage as the dependent variable. Standard ordinal regression procedures were followed (see Norusis, 2010). Gender and athletic status were the factors and grit, BFI Conscientiousness, body mass index (BMI), and age were the covariates. The control variables were gender, age, BMI, and athletic status and the variables

of interest were grit and BFI Conscientiousness. To facilitate interpretation of the odds ratios (OR), covariates were standardized (as z-scores) before fitting the regression models and the OR represented the probability being in a higher TTM stage per SD increase in the covariate (Duckworth and Quinn, 2009). For all analyses, *p* values less than .05 were considered statistically significant.

Results

Descriptive statistics

Compared to females (*n* = 759), male participants (*n* = 406) were older (*M* = 36.10 years, *SD* = 14.31 vs *M* = 33.89 years, *SD* = 13.85), taller (*M* = 179.32 cm, *SD* = 7.70 vs *M* = 165.95 cm, *SD* = 7.10) and heavier (*M* = 87.90 kg, *SD* = 17.59 vs *M* = 73.54 kg, *SD* = 19.31).

TTM stage comparisons

The ANOVA results validated the expected increase in reported exercise frequency across the five TTM stages: $F(4, 1164) = 363.92, p < .0001$. Post-hoc tests revealed significant differences between the first two stages (precontemplation and contemplation) and the last three stages (preparation, action, and maintenance) and between each of the last three stages. Differences in exercise frequency accounted for 56% of the variation in TTM exercise stages ($\eta^2 = .56$), a large amount of variance based on Cohen’s criteria. See Table 1.

Table 1. One-way ANOVA for reported exercise frequency across TTM stages.

		TTM stage					
		PC	C	P	A	M	F
Exercise frequency	<i>M</i>	0.00 _a	0.54 _a	1.19 _b	2.54 _c	3.84 _d	363.92*
	<i>SD</i>	0.00	0.73	0.95	1.07	1.37	

Note: PC = Precontemplation; C = Contemplation; P = Preparation; A = Action; M = Maintenance. Means sharing a common subscript are not statistically different at $\alpha = .05$ based on Tukey’s test.

**p* < .0001.

Table 2. Spearman correlations for scores on low, moderate and high intensity TTM stage, grit, and BFI Conscientiousness.

Measure	1	2	3	4	5
1. Low Int. Ex. Stage	–	.32***	.12***	.04	.03
2. Moderate Int. Ex. Stage		–	.52***	.15***	.13***
3. High Int. Ex. Stage			–	.16***	.10**
4. Grit				–	.72***
5. Conscientiousness					–

* $p < .05$; ** $p < .01$; *** $p < .001$.

Hypothesis tests

Low, moderate, and high intensity exercise TTM stages were positively correlated. Moderate and high intensity TTM stage showed the strongest relationship while low and high intensity TTM stage produced the weakest association. Grit and conscientiousness were significantly positively related to moderate and high intensity TTM stage indicating that higher scores on Grit-S and BFI Conscientiousness were associated with higher TTM stage levels for moderate and high intensity exercise. Neither grit nor BFI Conscientiousness was significantly associated with low intensity TTM stage ($p > .05$). As expected, grit and BFI Conscientiousness were positively correlated ($p < .001$). With the exception of low intensity TTM stage, these results support the first hypothesis regarding the interrelationships between the variables of interest. See Table 2.

The ordinal regression analyses produced the following results. Grit predicted high intensity TTM stage ($\beta = .26$, OR = 1.30, 95% CI 1.10–1.50, $p = .001$) indicating that individuals who were a SD higher in grit were 30% more likely on average to be in a higher TTM stage after controlling for age, BMI, gender, and athletic status. BFI Conscientiousness did not show a significant association with high intensity TTM stage ($\beta = .07$, OR = 1.07, NS). Grit predicted moderate intensity TTM stage ($\beta = .19$, OR = 1.21, 95% CI 1.04–1.38, $p = .045$) indicating that participants who were a SD higher in grit were 21% more likely on average to be in a higher TTM stage after controlling for age, BMI, gender, and athletic status. BFI Conscientiousness failed to

show a significant association with moderate intensity TTM stage ($\beta = .08$, OR = 1.08, NS). For low intensity exercise, neither grit ($\beta = .09$, OR = 1.09, NS) nor BFI Conscientiousness ($\beta = .05$, OR = 1.05, NS) predicted TTM stage.

Discussion

The purpose of this study was to examine the predictive validity of grit (defined by Duckworth et al., 2007) and conscientiousness as defined by the BFI (John and Srivastava, 1999) with respect to the TTM stages of change within the context of exercise behavior. Grit and BFI Conscientiousness were positively correlated with moderate and high intensity TTM stage, but neither variable was related to low intensity TTM stage. In ordinal regression analyses, grit predicted high and moderate intensity TTM stage while BFI Conscientiousness displayed little, if any, predictive capability.

The results support the hypothesis of positive associations between grit, BFI Conscientiousness, and exercise TTM stage with the exception of low intensity exercise. The lack of association for low intensity exercise hints at the notion that these constructs are not crucial for the initiation of an exercise program, but may be important for higher TTM stages such as action and maintenance.

Despite the significant positive associations between BFI Conscientiousness and TTM stage for moderate and high intensity exercise, regression analyses showed that grit outperformed BFI Conscientiousness in predicting TTM stage. Analogous to the results of Duckworth

et al. (2007) who found grit predicted completion of the rigorous summer training at West Point better than BFI Conscientiousness, our data show that grit predicted high and moderate intensity exercise TTM stage while BFI Conscientiousness did not. One possible explanation for this finding is that exercise requires effort and consistent exercise requires consistent effort. That is, exercise often involves progression to higher intensities as fitness improves and one must persist month after month to reach higher exercise intensities and fitness levels. Grit appears to tap this behavioral trait better than BFI Conscientiousness, at least for exercise behavior. Additionally, long-term exercise often entails setbacks such as injuries and persons higher in grit may be more likely to stay with an exercise program long enough to improve fitness in spite of setbacks and temporary layoffs.

From a theoretical standpoint the present results, in contrast to the exercise literature (e.g. Courneya and Hellsten, 1998; McEachan et al., 2010) suggest that traits not represented by the Big Five model may also be important to health related behaviors such as exercise. Our findings parallel the results of Duckworth and Quinn (2009) and Duckworth et al. (2007) and extend those results to the health-related behavior domain. The findings however do not clarify how grit might interact with other variables related to exercise adherence. For example, in the Theory of Planned Behavior (Ajzen, 1991), intention explains roughly 25% of exercise behavior (e.g. De Bruin et al., 2012). Grit may or may not act as a distal personality variable to influence exercise intentions. Within Social Cognitive Theory (Bandura, 1986), self-efficacy is a consistent correlate of exercise in adults and children (Lewis et al., 2002), but the relation between grit, self-efficacy and exercise adherence has not been tested. Self-efficacy is also related to TTM exercise stages. For example, Bogg (2008) found a positive association between exercise self-efficacy and TTM stage and exercise self-efficacy mediated the association between the conscientiousness-related trait of industriousness and TTM stage. Future

research is necessary to test whether self-efficacy mediates the relation between grit and exercise TTM stage or whether grit is a unique predictor of exercise adherence.

A practical implication of this study involves the continued refinement of research for the study of health behavior and the design of behavior change programs that take personality into consideration. In as much as personality affects lifestyle, further understanding of personality-related factors in exercise behavior can help refine exercise guidelines to improve adherence to exercise programs. Because data suggest grit may increase slightly with age (see Duckworth et al., 2007), exercise goals could be tailored to match age-related tendencies to pursue and accomplish those goals. For example, for college students in their early 20s, exercise goals would be designed as attainable and relevant, but shorter term and more flexible than goals for individuals in their late 40s.

There are several strengths associated with this study. First, the sample size provided adequate statistical validity for the results. Second, valid and reliable inventories were employed to assess the constructs of interest. Third, this study is unique, and to the knowledge of the authors, provides the first analysis of the psychological trait of grit and TTM stages within the context of exercise. However, there are limitations. One limitation is that the data collection method and survey results do not imply causation and although grit was referred to as a predictor, the term only applies in the statistical sense of the word. The sampling procedure also limits the generalizability of the results because those who volunteered may differ from those who did not participate. Future studies should consider random sampling techniques as well as examining special populations (e.g. cardiac rehabilitation patients). Additionally, exercise data were based on self-report and researchers should consider the use of more objective measures such as diaries or attendance records to improve the validity of the results. Finally, although the staging algorithm was based on a validated protocol, the length of time for the

maintenance stage was six months. Researchers planning future studies of grit and exercise behavior using the TTM might consider a longer time period for the maintenance stage. Aside from these limitations, the results provide initial support for a link between grit and exercise TTM stage.

In conclusion, the results show that the predictive validity of grit for exercise TTM stage level was superior to BFI Conscientiousness after controlling for age, BMI, gender, and competitive sport status. Grit may therefore be an important differentiator of TTM stage for moderate and high intensity exercise.

Competing Interests

None declared.

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