AN INVESTIGATION INTO WHY GRITTY PEOPLE SUCCEED

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by
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ABSTRACT

AN INVESTIGATION INTO WHY GRITTY PEOPLE SUCCEED

by

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Master of Arts in Psychology,
General Experimental

The study proposed to investigate why those high in grit tend to be more successful, specifically investigating grit’s associations with stress and task persistence.

Part one explored the possibility that grit allows for a more positive interpretation of stress. It was hypothesized that grit would allow individuals to interpret stress more positively. Part two investigated the relationship between grit and an individual’s ability to be persistent. It was hypothesized that when completing a measure of task persistence, with no framing or framed as a competition, individuals would perform similarly regardless of grit. However, when the task was framed as a stepping stone to one of their long-term goals (graduation), individuals high in grit would outperform their low grit counterparts.

Participants (n = 139) completed the short grit scale during pre-screening. Subsequently, in the lab participants were administered the perceived stress scale, life events checklist, then randomly assigned to the control, raffle or goal-directed conditions. Participants then completed a computerized mirror tracing persistence task. Additionally, a second group of participants (n = 329) were tracked for 11 days measuring grit on day 1 and stress daily.

Results revealed that gritty individuals experience a similar number of stressors but may interpret those stressors as more positive. Indicating that grit may allow
individuals to persevere toward long term goals, in part, by allowing for advantageous interpretations of stress, and not because gritty individuals possess superior task persistence. These findings suggest that there may be an underlying mechanism by which gritty individuals are able to be successful.
INTRODUCTION

The history of social psychology is often traced back to an initial investigation into social facilitation (Triplett, 1898; Triplett, 1900). Across this history, many researchers have spent their careers developing a better understanding of the psychological phenomena and individual differences that explain performance. Of these, commonly used, in various forms, has been intelligence (Boake, 2002; Binet & Simon, 1905; Wechsler, 1939). To this day, intelligence tests are widely used to predict and explain individual differences. For example, school aged children are given intelligence tests to determine placement in various academic programs; each branch of the military uses some form of intelligence testing for qualification and placement within their organizations. The Central Intelligence Agency (CIA) requires job applicants to take an intelligence test. The National Football League (NFL) rookie combine, which helps teams evaluate the skills and abilities of incoming players, requires an intelligence test comparing young athletes to the average at their positions.

Psychological research has investigated many other factors in attempts to better understand and predict a person’s ability to unlock their potential. Individual personality traits such as conscientiousness, the ability to be goal-directed and responsible (Higgins, Peterson, Pihl & Lee, 2007), persistence (Cox, 1926), and confidence (Cox, 1926; Terman & Oden, 1947) have each been studied in this context, as well as skills such as goal setting (Locke & Latham, 1990) and deliberate practice (Ericsson & Charness, 1994). As part of this pursuit to better understand factors influencing success, Duckworth, Peterson, Matthews and Kelly (2007) established the construct of grit, perseverance and passion for long-term goals, as a predictor of performance above and
beyond intelligence. The current study proposes to investigate why those high in grit tend to be more successful, specifically investigating grit’s associations with stress and task persistence.

The necessity for a predictor of performance that does not encompass intelligence lies in the fact that there are many successful outcomes that intelligence does not explain. Yet in society today intelligence, quantified as an intelligence quotient (IQ), is generally thought of as a measurement of a person’s aptitude for learning. The field of psychology has many ways of measuring IQ reliably, possibly more so than any other construct. The problem with using this single construct lies not in how much is known, but in how it is applied. The twenty-five year follow-up to the Terman Longitudinal Study (Terman & Oden, 1947) showed that the men with the highest accomplishments scored only five IQ points higher than the men with the lowest accomplishments, while a standard deviation on this measure is fifteen points. Despite the fact that intelligence is not explaining the full range in variability of successful outcomes, it remains widely accepted as a predictor of a person’s potential for success.

Grit describes how individuals are able to achieve extraordinary feats of perseverance, continuing to give their best efforts when others give up. In establishing this construct, Duckworth and colleagues (2007) began their multifaceted study by collecting data via the website authentichappiness.org, from participants ages 25 and older (n = 1,545) in order to perform exploratory factor analysis. They settled on the 12-item grit scale with a two-factor structure, perseverance of effort and Consistency of Interests. They next looked at the educational tendencies across the grit spectrum, finding that when controlling for age, those with higher grit tend to go further in their pursuit of
education, ranging from some high school to post-college graduate degree. Additionally when controlling for education, grit tended to increase with age. The researchers were able to confirm that this trait was increasing for participants, not that their additional experience was altering their responses by eliminating the items that pull from past experience (ex. “I have overcome setbacks to conquer an important challenge”), thus causing no significant change in results.

The second portion of Duckworth et al.’s (2007) study investigated how grit is related to the Big Five Inventory (BFI; John & Stivastava, 1999), if grit’s relationship with age and educational attainment would remain when controlling for BFI, and if grittier individuals made fewer career switches. In their sample ($n = 690$), grit related the most strongly to conscientiousness ($r = .77, p < .001$). While this relationship can be considered collinear, Duckworth and colleagues (2007) differentiate these constructs theoretically by describing how grit is centered on goals that require effort over an extended period of time, while conscientiousness considers only a person’s ability to be disciplined in the short term. They describe how an individual high in conscientiousness but low in grit could resist temptations to eat poorly or maintain concentration, but might change their interests frequently, since grit is characterized by pursuing an objective for extended periods of time.

To strengthen the idea that grit and conscientiousness differ in their predictive validity, in subsequent portions of Duckworth and colleagues (2007), the authors controlled for conscientiousness while making predictions based on grit. Grit was found to be related to lifetime career changes, controlling for age and conscientiousness. Those who were one standard deviation above average on grit were 35% less likely to change
careers frequently (Duckworth et al., 2007), and grit’s relationship with educational attainment and age remained significant when controlling for BFI.

Subsequently, Duckworth et al.’s (2007) work set to establish that grit is independent from intelligence. To do this, the researchers collected SAT scores (as a measure of general mental ability), Grade Point Average (GPA) and grit scores for university students ($n = 139$). While they found that grit negatively correlated with SAT scores ($r = -.20, p < .03$), they found a positive relationship with GPA ($r = .25, p < 01$), and that when controlling for SAT scores the relationship between grit and GPA grew stronger, ($r = .34, p < .001$). More recently, grit has also been found to negatively correlate with the amount of time undergraduates spend watching television (Duckworth & Quinn, 2009).

The researchers then turned to the United States Military Academy at West Point, where predicting performance can ultimately be the difference between life and death. Duckworth and colleagues (2007) set out to predict retention of cadets during their first summer of training, where 5% drop out on average. In two samples of cadets ($n = 1,218$ and $1,308$), 5.8% dropped out. Cadets who were one standard deviation above the mean on grit were 60% more likely to finish the summer training [$\beta = .48, p < .001$ (first sample); $\beta = .31, p < .02$ (second sample)]. In fact, grit predicted completion better than any other existing measure used, including conscientiousness. Extant research confirms that Cadets higher in grit at the United States Military Academy, West Point were more likely to complete the intensive summer training program prior to their first year than those with lower grit scores (Duckworth & Quinn, 2009; Maddi, Matthews, Kelly, Villarreal & White, 2012).
Lastly, to investigate grit in a setting not related to a career and to probe the process that enables gritty individuals to be successful, Duckworth and colleagues (2007) studied children in the 2005 Scripps National Spelling Bee. Results indicated that grit predicted how far the participants would go in the competition ($\beta = .34, p < .04$). This finding has been confirmed in subsequent studies (Duckworth & Quinn, 2009; Duckworth, Kirby, Tsukayama, Berstein & Ericsson, 2010).

While much work has been focused on what grit can predict, the mechanism which makes grittier people more successful has in a large part been ignored. Most research attributes the success to the two facets of grit outlined in Duckworth and colleagues (2007), Consistency of Interests and perseverance of effort. Consistency of Interests refers to an individual’s ability to pursue the same goal without getting distracted by new objects or ideas for long periods of time. For example, gritty individuals on average achieve higher levels of education and change careers less often (Duckworth et al., 2007; Duckworth & Quinn, 2009). Perseverance of effort describes the ability to overcome setbacks, adversity and plateaus in progress in order to complete these long-term goals. People high in this facet have been shown to expend more effort in pursuit of their goals as shown by measurements of effort-related cardiac activity (Silvia, Eddington, Beaty, Nusbaum & Kwapil, 2013). An example of how these two pieces factors can be combined is deliberate practice, which is the effortful and tedious experience that is required for expertise (Ericsson, 2006, 2007, 2009). Duckworth and colleagues (2010) found that deliberate practice mediated the effect grit had on performance in the National Spelling Bee. That is to say, participants with high grit
tended to partake in more deliberate practice than their less gritty competitors, ultimately leading to more successful performances.

These findings suggest that when competence and talent are equal, individuals who can persist through adverse circumstances are more likely to thrive and succeed. Duckworth, Quinn and Seligman (2009) placed novice teachers in under-resourced school districts, where the ability to overcome these obstacles might be advantageous. They found that students achieved better outcomes when their teachers were higher in grit. Grit has been used as a predictor of performance in areas where prior to its establishment, intelligence had been used as the primary predictor of success. As such, an important finding is that grit correlates negatively with intelligence (Duckworth, Peterson, Matthews & Kelly, 2007). While intelligence has been used widely to measure a person’s aptitude, grit measures a person’s ability to apply themselves to the best of their ability. An intelligent person may have natural ability, but without the means to use it, they have limited ability to realize their potential. Therefore, grit may explain why there are intelligent individuals with less successful outcomes than others with less intelligence who achieve far more.

Current Study

Part one of the current study is intended to explore the possibility that grit allows for a more positive interpretation of subjective experiences. Subjective experiences refer to any situation in which two people, experiencing the same physical situation, can and often do report differing versions of the experience, based largely on individual differences. That is, they can each have dissimilar perceptions of the same situation. Specifically, this project proposes to investigate stress. Holmes and Rahe (1967)
suggested that certain life events are stressful for all people, and by listing recent life
events (jail, injury, marriage, etc.), it was possible to tell an individual’s level of stress.
This assumes some fallacious logic, implying that life events are equally stressful for all
people. It is the current understanding that how an individual interprets a stressor is more
important than the stressor itself (Lazarus & Folkman, 1987; Lazarus, 1966).
Additionally, a stressor can be interpreted as a challenge or as a threat, and interpreting a
stressor as a challenge can help motivate an individual to achieve better performance
this fashion, developing the Perceived Stress Scale to measure how much a person feels
that the events in their lives are stressful.

Certain personality traits have been shown to influence how individuals
experience stress. Kobasa (1979) studied how the personality characteristic of hardiness
can alter the effect stress has on illness. Hardiness has been shown to be similar to grit
(Maddi, Matthews, Kelly, Villarreal & White, 2012) in that both are personality
characteristics predictive of performance in stressful situations. However, while a gritty
person is persistent and passionate about their long-term goals, a hardy person is
committed to their work, maintains a high sense of control and sees difficulties as
opportunities to grow. Maddi and colleagues (2012) set out to better understand the
effects grit and hardiness have on individuals in stressful situations by studying cadets (n
= 1,285) at the United States Military Academy at West Point, very similar to Duckworth
and colleagues (2007). Grit and hardiness were used to predict retention and first-year
performance, indicated by Cadet Performance Score (CPT). Both grit ($r = .07, p < .01$)
and hardiness ($r = .12, p < .01$) significantly correlated with CPT. However, logistic
regression analyses suggested that grit was the best predictor of retention when compared to hardiness and other measures established by the military for this purpose. These results seem to indicate that when working in a stressful environment, grit enables individuals to work through the stress at a high level. That is, gritty individuals tended to stay in the academy despite the stress, and they were able to perform at a high level as indicated by their Cadet Performance Score.

It has been shown that stress can have significantly detrimental impacts on an individuals’ physical and mental health if interpreted in a negative light (Ogden, 2012; Hansen & Streltzer, 2005). Perceptions of stress have also been linked to depression (Brindle, Ginty, & Conklin, 2013) as well as having negative impacts on mental and physical health. A better understanding of the differences that influence how an individual perceives subjective experiences may be worthwhile, in that such information may open avenues to better determining the differing ability of people to function in similar situations. It is hypothesized here that grit will allow individuals to interpret stress more positively.

Part two of the current study aims to directly investigate the relationship between grit and an individual’s ability to be persistent. Arguably the most similar concept to grit in the literature is learned industriousness (Eisenberger, 1992) which posits that organisms will persist with effortful tasks when they have been rewarded for such behavior in the past. This might coincide well with grit, if this trait can be improved with training. However, there is not yet clear evidence how much grit can be improved with learning. Moreover, this theory too falls short in its ability to be used as a factor influencing the ability to persist, because it relies on reward structures. Theory on how
extrinsic rewards affect intrinsic motivation (Deci, Koestner, & Ryan, 1999) explains that when extrinsic rewards are removed suddenly, intrinsic motivation may decrease. That is, for some individuals, when they are rewarded for a particular behavior the frequency and perhaps intensity will increase, however when that reward is removed, the desire to continue the behavior will diminish (Lepper, Greene & Nisbett, 1973). Skinner (1956) established the term “extinction” for this effect when he observed that rats rewarded with food for pushing a lever would continue to push the lever for a time, when food was no longer given. However, the rat would do so less and less often over time until it completely stopped the behavior. Gritty individuals should, theoretically, be able to persevere without this extinction of effort, because they do not persist due to external reward but rather in response to an internal drive or desire.

The ability to endure despite physical and/or emotional difficulties is referred to as distress tolerance (Brown, Lejuez, Kahler, Strong, & Zvolensky, 2005). The behavioral component of distress tolerance is task persistence (Brandon, Herzog, Juliano, Irvin, Lazev, & Simmons, 2003), or the ability to persist when attempting a difficult task. Brandon et al. (2003) implemented two measures of task persistence on a group of smokers ($n = 144$) who had enrolled in a smoking cessation clinic. The first measure was an anagram persistence task with five reasonably simple trials (e.g., CEABH = BEACH) and six extremely difficult trials (e.g., LXYIK = KILXY) with the dependent measure being the average amount of time participants spent on the six difficult trials. The second assessment was a Mirror Tracing Persistence Task (MTPT), in which participants traced images while observing their hand through a mirror. While the anagram persistence task did not predict smoking cessation, the MTPT significantly predicted which participants
would enter treatment and, via survival analyses, those who would continue with their abstinence from smoking. For every second participants persisted with the MTPT, the odds of relapsing decreased by 0.2%.

Investigation into a gritty individual’s ability to tolerate distress and persist, particularly in pursuit of their goals, is warranted as a means of explaining why and under which conditions those high in grit succeed over others. Thus it is hypothesized that grit will assist individuals to persist, especially when in pursuit of a goal. More specifically, it is hypothesized that when simply completing a measure of task persistence individuals will perform similarly regardless of grit. Likewise, when participants believe that their performance on the task will earn them a prize, no difference will be seen between high and low grit individuals. However, when the task is framed as a stepping stone to one of their long-term goals (graduation), individuals high in grit will outperform their low grit counterparts.

The proposed research will investigate the processes that make some individuals successful over others, examining how grit may be independent of the more commonly studied traits. There is potential for these findings to impact hiring practices, selection in academia, employment and athletics. By identifying traits that give individuals a proclivity for success, it may be possible to teach these traits, and increase the likelihood that individuals will realize their potential. Often the focus of psychological research is to identify what successful outcomes can be predicted when the arguably more important aspect of why these variables lead to successful outcomes is under-investigated. Von Culin, Tsukayama, and Duckworth (2014) discuss how gritty individuals differ from lower grit equals in the motivation underlying their persistence. Such research, as well as
the proposed research here, may prove to be important in the pursuit of optimal performance. The current study hypothesizes that:

1) Grit will allow for a more positive interpretation of stress.

2a) When participants are given no source of motivation, grit will not be associated with individual differences on a distress tolerance task.

2b) When framed as a competition for a prize, grit will not be related to task persistence.

2c) When framed as in pursuit of a long-term goal, higher grit will result in increased task persistence.

Hypothesis 1 was tested in two samples; the first hypothesized model can be seen in Figure 1. From the figure it can be seen that a hierarchical model with grit as a second order factor was tested, as specified in Duckworth & Quinn (2009). Subsequently, grit and the number of stressors participants experienced are used to predict the severity of the stressors. The second hypothesized model (Figure 3) is identical; however, the scales used to measure stress here are the Perceived Stress Scale (Cohen, Kamarck & Mermelstein, 1983), used to measure perceived stress (stress severity), and the Life Events Checklist (Cohen, Tyrrell & Smith, 1991), used to measure the number of stressors experienced.

METHOD

Study 1

Participants

Undergraduate psychology students \((n = 357; 66.1\% \text{ female})\) from California State University, Northridge (CSUN) were recruited via the psychology department’s
research subject pool. Participants ranged in age from 18-44 ($M = 19.62$, $SD = 2.82$).
Participants’ ethnic background varied, with 44.4% Hispanic, 17.7% Caucasian, 16.2% Asian/Pacific Islander, 6.6% African American, .5% Native American/Alaskan Native, 13.6% multi-ethnic and 1.0% other. Students participated as partial fulfillment of a requirement for their introductory psychology course. No restrictions were placed on who could participate, with the intention of recruiting a large diverse sample.

Measures

The 8-item Short Grit Scale (GRIT-S) (Duckworth & Quinn, 2009) is a well-validated, brief version of the Grit Scale (Duckworth, Peterson, Matthews & Kelly, 2007). This questionnaire has two four-item sub-factors: 1) Consistency of Interest, with questions including, “I often set a goal but later choose to pursue a different one”, and 2) Perseverance of Effort, with questions including, “I finish whatever I begin”. Responses are set on a five-point Likert scale from “very much like me” to “not like me at all”. Composite scores may be obtained by reverse-coding four items and then averaging responses to all eight.

The Daily Inventory of Stressful Events (DISE; Almeida, Wethington & Kessler, 2002) adapted into questionnaire format (Jaremka, Belury, Malarkey, Glaser, Christian, Emery & Kiecolt-Glaser, 2014; Mroczek, Stawski, Turiano, Chan, Almeida, Neupert & Spiro, 2013) was used to assess the number of stressors and the severity of stressors experienced daily by participants. The scale included questions pertaining to the number of stressful events and their severity experienced each day across a number of domains including arguments, work life, home life, family, health and other. Participants first answered a yes/no question if they encountered a stressor in each of the aforementioned
domains, which was followed by a 4-point scale assessing the severity of that stressor from “not at all” to “very” stressful. For the current study, the number of stressors experienced per day was calculated by summing the questions participants indicated that they had experienced and dividing it by the number of days participated. A severity average was computed by summing the severity responses and dividing this sum by the number of days a person participated in the study.

Procedure

After signing up for the study through the online management system, participants were given an initial set of surveys, including demographics and the GRIT-S. Then for the following ten days, participants were emailed surveys every evening at 6:00pm to be completed by midnight. All surveys were administered through the online survey program Qualtrics.

RESULTS

Study 1

Analyses were performed using SPSS (Version 22) and EQS 6.2 structural equation program (Bentler, 2014). Structural equation modeling (SEM) was performed to test stress-related hypotheses. To evaluate models in SEM, numerous statistics are used, including: the maximum-likelihood chi-squared ($\chi^2$) statistic, the Comparative Fit Index (CFI), the root mean squared error of approximation (RMSEA) and the Standardized Mean-Square Residual (SRMR). Good model fit is indicated by CFI values greater than .95, RMSEA values less than .06 and SRMR values less than .08.

To test Figure 1, first a hierarchical confirmatory factor analysis (CFA) with grit serving as the second order factor was conducted. A test of fit for this CFA was not
rejected ($\chi^2_{18} = 18.41, p = .24$), suggesting good model fit; fit statistics further suggested that the model did fit the data very well (CFI = .99; RMSEA = .03; SRMR = .03). With fit established, the structural component was added to the model. A test of fit for this full SEM was also not rejected ($\chi^2_{32} = 31.91, p = .52$); fit statistics suggested that the model did fit the data very well again (CFI = 1.00; RMSEA = .00; SRMR = .05). See Figure 2 for this model, with the standardized solution included. See also Table 1 for correlations among variables, and their means and standard deviations.

Reliability for the grit sub-factor, perseverance of effort, was weak (Cronbach’s $\alpha = .55$); this was likely due to the apparent uniqueness of responses to the first item (“Setbacks don’t discourage me”). While this item’s loading as part of the above CFA was low (.14), the Wald test had revealed that it could not be dropped from the factor without significant loss of model fit. Thus, since the fit of the CFA was strong as noted above, this item was retained for the purposes of analysis. Meanwhile, reliability was a bit stronger for the other sub-factor, Consistency of Interests (Cronbach’s $\alpha = .72$), as well as the second order factor, grit (Cronbach’s $\alpha = .70$).

METHOD

Study 2

Participants

Undergraduate psychology students ($n = 141$; 72.3% female) from California State University, Northridge (CSUN) were recruited via the psychology department’s research subject pool. Participants ranged in age from 19-33 ($M = 19.27, SD = 2.18$). Participants’ ethnic background varied, with 62.4% Hispanic, 19.1% Caucasian, 10.6% Asian/Pacific Islander, 6.4% African American and 1.4% Native American/Alaskan
Native. As in Study 1, students participated to partially satisfy a requirement for their introductory psychology course, and no restrictions were placed on who was allowed to take part.

Measures

The GRIT-S (Duckworth & Quinn, 2009; see Study 1) was administered as in Study 1, with responses again set on a five-point Likert scale.

The Perceived Stress Scale (PSS; Cohen, Kamarck & Mermelstein, 1983) is a 10-item well-validated measure of global stress. The measure asks questions regarding how overwhelming individuals feel that their lives are, such as, “In the last month, how often have you been upset because of something that happened unexpectedly?” with answers ranging from “never” to “very often” on a five-point Likert scale. The survey includes four reverse-coded items, and composite scores may be generated by averaging responses to all ten questions.

The Life Events Checklist (LEL; Cohen, Tyrrell & Smith, 1991) is a measure used to identify the number of stressors an individual has encountered in the month previous to its administration. Participants respond to initial yes/no questions asking if an event happened; this is then followed up by various appraisal items, some asking who the event happened to, and others asking participants to rate the event on a six-point scale ranging from “very good” to “very bad”. The final items of the questionnaire ask participants if any stressful events happened that were not included previously, for which participants may write a short explanation and answer the appraisal questions.

The Computerized Mirror Tracing Persistence Task (MTPT-C; Strong, Lejuez, Daughters, Marinello, Kahler & Brown, 2003; Quinn, Brandon, & Copeland, 1996) is a
standard mirror tracing procedure in which participants use the mouse to trace images on the screen with both axes inverted. That is, when the mouse is moved up the cursor goes down and vice versa, and when the mouse is moved left the cursor goes right and vice versa. Participants are asked to outline a black shape with a red cursor from one end to the other. If the cursor comes off the line, a buzzer is sounded and the cursor is moved back to its starting position, requiring the participant to start over. The task starts by asking participants to adjust sliders indicating their irritability, frustration, anxiety, urge to smoke, difficulty concentrating and discomfort. There are then two practice trials, each of which end when the red cursor reaches the end of the image or after one minute’s time. Instructions then appear on screen informing participants that they may choose to end the task at any time by pressing any key on the keyboard; however, depending on condition, participants will be given a different source of motivation for the task. Participants then begin the test trial whereby they trace a star; the task ends either when participants give up, by pressing any key on the keyboard, or after they have spent five minutes attempting the trial. In the test trial, the program records the amount of time spent attempting the task as well as the number of errors made.

_Procedure_

Participants began the study by giving verbal consent. Then, sitting at an individual computer station, participants completed a demographic questionnaire, the Grit-S and the PSS through the online survey program Qualtrics. After completing these, participants saw a screen thanking them for their participation thus far and randomly assigning them to one of the three framing conditions. The first condition explained that they were participating in the study as partial fulfillment for a class requirement, a class
which they must pass in order to graduate. The second condition stated that the better participants performed on the task, the more times they would be entered to win a raffle for a prize at the end of the semester. The final condition was a control, in which participants were not given an additional source of motivation. While the conditions framed the task differently, after completing the study all participants were offered the same number of raffle tickets, on which they could write their email address and drop into a bin to enter.

After having the task framed by the manipulation, participants saw a screen which stated: 1) that the next portion of the study would be in a different window, and they would be asked to trace shapes with the mouse on inverted axes (when the mouse is moved right, the cursor moves left, etc.), and 2) that when they get to the final image, they can end the task by pressing any key on the keyboard. Participants were then asked to read all instructions carefully, and to continue, they must minimize the currently open window. The MTPT-C is open in a window behind the questionnaires so that it is at the forefront when the Qualtrics window is minimized. In addition to these reminders, a note was placed next to the computer stating that for the task the axes are inverted, and to end the final portion of the task, they could press any key on the keyboard. Multiple reminders were presented in order to avoid minor confusion observed during pilot testing. After completing the task, participants were offered the chance to write their name on the raffle tickets and place them in the bin. They were then debriefed, thanked for their participation and dismissed.
RESULTS

Study 2

Analyses: Stress

As in Study 1, analyses were performed using SPSS (Version 22) and EQS 6.2 (Bentler, 2014). SEM was performed to test stress-related hypotheses (Figure 3). To do this, as in Study 1 a CFA was first performed on grit in an attempt to fit it to the hierarchical structure with a second-order factor (as in Duckworth & Quinn, 2009). A test of fit for the SEM was rejected ($\chi^2_{17} = 37.20, p = .003$; fit statistics suggested that the model fit was moderate (CFI = .89; RMSEA = .10; SRMR = .06). Thus, a bi-factor model, a model in which the sub-factors are unrelated to each other or the general factor (Reise, Moore & Haviland, 2010), for grit was tested next.

A test of fit for the bi-factor model was not rejected ($\chi^2_{12} = 14.98, p = .24$; fit statistics suggested that this model did fit the data very well (CFI = .98; RMSEA = .04; SRMR = .05). To test which of these two competing models is best, the Akaike Information Criterion (AIC) were compared (Anderson, Burnham, & Thompson, 2000). AIC is a way to compare two models that explain the same data in different ways, measuring fit and controlling for complexity, with less complex models being favorable. The model with the lower AIC value is considered to be the model that explains the model most accurately without being too complex. The AIC (3.20) for the hierarchical model was greater than that for the bi-factor model, (-9.02). Thus, by these standards, the bi-factor was selected for use in the full SEM.

Post hoc model modifications were then made to the CFA in accordance with the Wald Test for eliminating paths without significant loss of model fit. Specifically, the
paths removed were the path from the general factor Grit to item 2, and that from the sub-factor Consistency of Interests with item 6. Fit statistics for this model were slightly improved over the original CFA; a test for fit was still not rejected ($\chi^2_{14} = 15.51, p = .34$), and fit statistics suggested that the model still fit the data well (CFI = .99; RMSEA = .03; SRMR = .05).

With good fit established for the CFA via the bi-factor model, structure was inserted into the model to test the hypothesis, with grit predicting perceived stress composite score controlling for the number of stressful events. A test for fit was not rejected ($\chi^2_{28} = 37.69, p = .13$); fit statistics suggested that the model did fit the data well (CFI = .96; RMSEA = .05; SRMR = .07). For the standardized solution, see Figure 4. See also Table 2 for correlations among variables, and their means and standard deviations.

Reliability among the 10-item PSS was acceptable (Cronbach’s $\alpha = .76$). Reliability for the grit sub-factor, perseverance of effort, was again weak (Cronbach’s $\alpha = .49$); as in Study 1, this was due to the divergent first item. This item was again retained for analysis, however, since the Wald test above suggested loss of model fit if it were to be removed. For the other sub-factor, Consistency of Interests, one item had been removed (see above); among the remaining three items, the reliability was acceptable (Cronbach’s $\alpha = .72$). One item was also removed from the eight-item general factor (see above); reliability of the remaining seven items was adequate (Cronbach’s $\alpha = .74$).

**Analyses: Task persistence**

As noted above, participants were randomly sorted into the three conditions, resulting in 49 participants in the control condition, 49 participants in the raffle condition and 41 participants in the graduation condition. A grit score was obtained for this sample
by averaging the seven items indicated by the SEM to be related to the general Grit factor; that is, the question “setbacks do not discourage me” was excluded from the original eight due to its non-significant loading ($\beta = .05, p = .28$). Then to assess participants’ persistence, the time in seconds participants spent attempting the test trial was recorded, as well as the number of errors they made per second as a marker of skill.

A series of multiple regressions were then run across conditions, with grit and skill serving as independent variables, and persistence serving as a dependent variable. In the control condition, no significant relationship was found between grit and persistence, controlling for skill ($\beta = -.21, t(46) = -1.39, p = .17$). In the Wii condition, no significant relationship was found between grit and persistence, controlling for skill ($\beta = -.12, t(46) = -.86, p = .39$). Finally, as for the other two groups, in the graduation condition no significant relationship was found between grit and persistence, controlling for skill ($\beta = .03, t(36)=.17, p = .86$).

DISCUSSION

The purpose of this study was to investigate the effect grit has on interpretations of stress and task persistence. The data from Study 2 suggested a negative relationship between grit and perceived stress. This study measured stress at one time point, asking participants to reflect on the past month. Figure 4 shows that the general factor, grit, has a significant, negative relationship with the perceived stress scale, controlling for the number of stressful events they encountered (total events).

Study 2 suggested that grit predicts perceived stress, while results from Study 1 did not. This lack of congruity between studies might be explained because grit has been shown to predict long-term behavior (Duckworth et al., 2007; Duckworth et al., 2010;
Duckworth & Quinn, 2009; Duckworth et al. 2009; Maddi et al., 2012), and while Study 1 was longitudinal, in total it asked participants to document stressors from only ten days. Meanwhile, the scales used in Study 2 asked participants about perceived stress in the past month and the number of stressors over the past twelve months. It is important to note that, across both samples, grit did not significantly correlate with the number of stressors an individual experienced.

These findings indicate that grit does not influence how stressful people’s lives are, but it does influence how they interpret that stress. That is, regardless of grit, people report experiencing an equal number of stressors throughout their day; however, grit does appear to help individuals to perceive the stress as less severe or overwhelming. Thus, while grit does not appear to reduce the number of stressors experienced, it does seem to affect the interruption of those stressors, and the impact on individuals. This finding is particularly important since research suggests that interpretations of stress are more important than the stressors themselves (Lazarus & Folkman, 1987; Lazarus, 1966). This perception of stress has been linked to physical and mental health breakdowns (Ogden, 2012; Hansen & Streltzer, 2005), including depression (Brindle et al., 2013).

The first aim of this study was to investigate if grit, as a measure of individual difference, influences how individuals interpret the subjective experience of stress. Specifically, it was hypothesized that grit allows for a more positive interpretation of stress. This hypothesis is considered partially confirmed, particularly regarding stress over a longer term.

It was hypothesized that when the Mirror Tracing Persistence Task (Strong et al., 2003) was framed as a competition for a prize or was not framed at all, grit would not be
associated with task persistence. These hypotheses were confirmed. However, it was also hypothesized that when the task was framed as a stepping stone toward their long-term goal of graduating, grit would have a positive correlation with task persistence. This was expected because individuals high in grit persist due to an internal drive to accomplish their long-term goals, and not in pursuit of external rewards. While this hypothesis was not supported, it may serve to strengthen the foundation for grit, in that grit is not simply showing that persistent people persist.

There remained no significant grit-task persistence relationship across conditions when controlling for GPA and age, which have been shown to relate to grit and have been used as covariates in prior research (e.g. Duckworth et al., 2007). When controlling for GPA, no significant relationship was found in the control condition ($\beta = -.22, t(31) = -1.23, p = .21$), in the Wii condition ($\beta = -.05, t(29) = -.24, p = .82$) or in the graduation condition ($\beta = .14, t(23) = .68, p = .51$). Sample sizes were smaller for this analysis because 43 participants declined to enter their GPA (35 in the control condition, 33 in the Wii condition, and 27 in the graduation group). When controlling for age, similarly no significant relationship was found in the control condition ($\beta = -.21, t(45) = -1.37, p = .18$), in the Wii condition ($\beta = -.13, t(45) = -.91, p = .37$) or in the graduation condition ($\beta = .02, t(35) = .14, p = .89$). In all, these findings suggest that gritty individuals are no better at tolerating distress on a short-term scale, thus perhaps reaffirming the definition of grit, perseverance and passion for long-term goals (Duckworth et al., 2007).

Prior exploratory and confirmatory factor analyses have used a hierarchical model with grit as a second order factor (Duckworth et al., 2009), and thus this type of model was posited for the hypothesized models (Figures 1 and 3). This model was supported in
Study 1, thus endorsing the hierarchical structure for grit. While good model fit was achieved, the non-significant path from grit to stress severity was counter to the hypothesis. In Study 2, the hierarchical structure for grit was not supported, as this model did not fit as well as did the bi-factor model. However, even with this new model, post hoc modifications were needed. These adjustments were made such that one item (“I have difficulty maintaining my focus on projects that take more than a few months to complete”) was removed from the Consistency of Interests sub-factor, but not from the general factor (Grit). Additionally, a second item (“Setbacks don’t discourage me”) was removed from the general factor but not from the Perseverance of Effort sub-factor. With grit structured in this way, its prediction of perceived stress controlling for the number of stressors experienced was supported.

Unique in this study was this use of the bi-factor model for grit. This could begin to explain the misfit found in the first study on grit (Duckworth et al., 2007), where reported CFI and RMSEA are slightly outside of the ranges generally thought to indicate good fit. Bi-factor models have distinct advantages over hierarchical models (Chen, West, & Sousa, 2006), including the ability to make predictions using the sub-factors. That is, there may have been situations, in previous literature, in which an effect was attributed to the general grit factor, when in reality one sub-factor was at the root of the results. With a hierarchical approach, it is not as easy to account for the unique effects of these sub-factors.

Limitations, future directions

This research adds to our understanding of grit and individual differences in performance, though these findings do have certain limitations. The generalizability of
these findings may be limited due to the use of undergraduate university participants. However, the demographics of the students at CSUN are more diverse than most, both in age and ethnic background. Further investigation should be done to determine if these findings generalize to non-student populations; and, to see if interpretations of stress mediate grit and deliberate practice. That is, perhaps, people high in the construct of grit are able to partake in more deliberate practice because they do not view the stress associated with the tasks as overwhelming.

Additionally, with the conditions used to investigate task persistence, in the second study it is possible that the manipulation was not strong enough. If participants did not see the task as relevant to their graduation, this might help to explain why significant differences were not reached. Furthermore, the null findings in study two could suggest that the task did not accurately utilize grit. As grit is a long-term trait, perhaps a longer-term persistence measure (e.g., longitudinally measuring persistence) would better tap into what makes gritty people succeed. Alternatively, it has been found that affective conditioning is less effective on racially non-biased individuals (Livingston & Drwecki, 2007). Similarly, it could be the case that grit is another variable which can predict the extent to which conditioning is effective. If gritty people are less likely to be impacted in affect by such an experimental manipulation, then that may clarify further why ours did not seem very powerful.

Regarding theoretical limitations, there are a few variables which can be viewed as conceptually similar to grit. Of these, conscientiousness is most often mentioned in the literature (e.g. Duckworth et al., 2007). Grit and conscientiousness have often been viewed as collinear; the main explanation differentiating the two in the literature is the
long-term focus of grit. If grit is theoretically long-term conscientiousness, it may either be a different construct, or might just suggest an additional facet of conscientiousness. Either way, more work should continue to be done to clarify the nuanced differences between these constructs.

Additionally, the theoretical similarity between grit, particularly the Consistency of Interest sub-factor, and the need for cognitive closure deserves further investigation. Kruglanski (1989) defined this need as the motivational tendency to search for answers and solve problems. Part of the definition of grit is long-term persistence in the face of failure, adversity and stagnation (Duckworth et al., 2007). This can be viewed as similar to stubbornness, or long-term resistance to change (Oreg, 2003), which has facets of routine seeking, emotional reaction to imposed change, cognitive rigidity, and short-term focus. Thus, differences between grit and these constructs too should be investigated in future research.

Current results suggest that future work on the construct of grit should attempt to utilize a bi-factor model for analysis. This may allow the researcher to see if there are cases in which the sub-factors have better predictive validity than the grit general factor. Additionally, to further establish the independence of grit from other constructs shown to be statistically or theoretically similar, such as conscientiousness, future research should attempt to factor analyze the items from these constructs’ scales simultaneously. Exploratory factor analyses (EFA) here might return a single factor, meaning that the scales are measuring the same latent variable, or multiple factors, meaning that the scales are indeed measuring independent constructs.
**Conclusion**

Throughout the history of social psychology, much researched has focused on the prediction of performance. Grit has been identified as a strong predictor of performance across multiple domains (Duckworth et al., 2007; Duckworth & Quinn, 2009; Duckworth et al., 2010; Maddi et al., 2012). However, little work has been done to explain why people high in the construct are successful. Most often, their success is attributed to grit as it is defined, persistence and passion for long-term goals (Duckworth et al., 2007); in addition, grit has been shown to be a predictor of deliberate practice (Duckworth et al., 2010), which is also used to explain why individuals high in grit tend to succeed.

This project addresses additional factors which might contribute to gritty individual’s success; namely, that grit enables people to interpret stress as less overwhelming and more manageable. This could imply that individuals are able to partake in deliberate practice, and ultimately are able to succeed, because they do not view the events they experience to be as stressful as a less gritty person would. Additionally, grit was not found to be related to task persistence across any of the experimental conditions. This finding serves to strengthen the validity of the scale by showing that grit does not measure short term persistence, but perseverance and passion long-term goals.
References


Hypothesized structural equation model to predict perceived stress. Circles indicate proposed latent variables (factors). Rectangles indicate proposed measured variables. Straight arrows represent regressions. Minuses indicate predicted direction (negative) of regression coefficients.
Final SEM to predict perceived stress, after post hoc modifications. Circles indicate proposed latent variables (factors). Rectangles indicate proposed measured variables. Straight arrows represent regressions. *p < .05
Figure 3

Hypothesized structural equation model to predict perceived stress. Circles indicate proposed latent variables (factors). Rectangles indicate proposed measured variables. Straight arrows represent regressions. Minuses indicate predicted direction (negative) of regression coefficients.
Final SEM to predict perceived stress, after post hoc modifications. Circles indicate proposed latent variables (factors). Rectangles indicate proposed measured variables.

Straight arrows represent regression. *p < .05
Table 1

*Correlations for measured variables used in the SEM used to predict grits relationship with stress*

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**. Correlation is significant at the .01 level (2-tailed)
*. Correlation is significant at the .05 level (2-tailed)
Table 2

*Correlations for measured variables used in the SEM used to predict grits relationship with stress*

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** Correlation is significant at the .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)