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Grit, Personality, and Job Performance: Exploring Nonlinear Relationships

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GRIT, PERSONALITY, AND JOB PERFORMANCE:

EXPLORING NON-LINEAR RELATIONSHIPS

by

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ABSTRACT

Hiring employees suitable for specific jobs is a challenge facing organizations, as the cost of a poor hire is approximately 30% of that employee's first-year earnings, according to the U.S. Department of Labor. Employers look to individual differences, such as cognitive ability and personality, to help match applicants with appropriate jobs, as they are supported by research evidence. However, some variance in job performance is explained by differing combinations of these variables, among others.

Research in education and psychology have recently highlighted *grit* as a potentially strong predictor of success in non-work contexts. Grit was introduced by Angela Duckworth, who defined grit as a trait encompassing "passion and perseverance for long-term goals." Grit is a trait often manifested in the face of adversity and can help individuals overcome challenges and achieve success by persevering despite difficulty. Critics of Duckworth and her colleagues' research point to a lack of conceptual clarity against existing personality factors such as conscientiousness.

The present study explores the overlap between the current grit model and existing models of personality. Prior to the main study, a group of subject-matter experts (SMEs) independently mapped the grit subscales from the shorter grit scale (Grit-S) onto the Five-Factor Model of personality at the facet level. Items from the IPIP NEO-PI personality facets (300-item version) rated by SMEs to closely align with grit were

included in the main study, along with the Grit-S scale. Alternative measurement models for the grit construct (including subscales and higher-order factors) were assessed using items from the Grit-S as well as the IPIP. Results of confirmatory factor analyses guide the models of grit in subsequent analyses of the grit-performance relationship.

Although there have been several published studies on the measurement of grit and how they construct relates to success, further research is needed to determine if the grit measures are sufficiently robust when used to predict individual and work-related performance. The purpose of this study was to fill in the gaps for measurement and understanding of grit's relationship with job success. Specifically, the present study investigated the relationship between grit and performance to determine whether a non-linear model is a better fit than the linear model currently described in the literature. The hypothesized relationships were tested using hierarchical multiple regression with a quadratic term to prove whether a curvilinear relationship exists. The results of this study indicated that there is, in fact, a first-order, two-factor grit model with first-order factors being passion and perseverance.

Interestingly, mapping of personality facets to grit did not yield models with an acceptable fit. Using the first-order model with a satisfactory fit, a significant linear relationship was found between performance and passion and perseverance. There was not a meaningful non-linear relationship between passion and perseverance and performance, however. Although results were not what was expected, they advance the research on the measurement of the grit construct and its relationship with job performance and, ultimately, its usefulness in selection contexts. Research implications, limitations, and recommendations are presented in the discussion.

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CHAPTER 1

INTRODUCTION

Hiring employees suitable for specific jobs is a serious challenge facing organizations as a poor hire can cost employers approximately 30% of an employee's first-year potential earnings, according to the U.S. Department of Labor (2003). Such challenges have led employers to seek to identify specific individual differences that will help them match applicants with relevant jobs (Borman & Motowidlo, 1997). For decades, organizations have relied on individual differences, such as the cognitive ability for selection, training, and leadership promotion decisions (Furnham, 2008). While the evidence is clear that cognitive ability is a strong predictor of performance across an array of jobs, it accounts for less than half of the variance in job success (Cascio, 1995; Ree, Earles, & Teachout, 1994; Schmidt & Hunter, 1998). As a result, substantial effort has been directed to identifying other individual differences besides cognitive ability that may account for the remaining unexplained variance in job performance (Chernyshenko et al., 2011).

Researchers and practitioners have explored a range of possible job performance predictors, including personality traits, locus of control, and self-esteem (Judge & Bono, 2001). The evidence strongly suggests that personality predicts job performance in many circumstances (Barrick et al., 2003; Tett & Burnett, 2003). Incorporating personality characteristics into a selection model may add incremental explanatory power over

that contributed by cognitive ability alone (Chernyshenko et al., 2011). Since the publication of the Five-Factor Model (FFM) (Costa & McCrae, 1992), most investigations relating personality and job success have focused on those specific factors, which include openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (Guion & Gottier, 1965; Rothstein & Goffin, 2006). After testing how personality relates to performance, conscientiousness has emerged as the most consistent predictor of workplace success (Carter et al., 2014).

Many organizations have begun using instruments measuring the FFM as a personality assessment based on the FFM to screen applicants in the hiring process (Mount & Barrick, 1995), and personality dimensions such as conscientiousness may be a better indicator of job success than once expected (Hurtz & Donovan, 2000). Recent research revealed that conscientiousness might be valuable for predicting job performance across various performance dimensions (such as task performance, organizational citizenship behavior, counterproductive work behavior) as well as across job families (various positions within an organization; Carter et al., 2014).

While there is strong evidence to support using conscientiousness for selection, other personality characteristics, such as particular facets of the five factors may predict job success, particularly within the conscientiousness factor (Chernyshenko et al., 2011). Investigations of the personality characteristics that predict effectiveness in activities besides work involving effort and motivation may provide useful insights for predicting effectiveness on the job. For example, prior research has explored what facets of personality are related to success in scenarios ranging from spelling bees to sports (Duckworth et al., 2007). Research in sports

psychology, education, and positive psychology has recently highlighted a construct referred to as *grit* that appears to be predictive of success in these contexts outside of work (e.g., Eskreis-Winkler, Duckworth, Shulman, & Beal, 2014; Ivcevic & Brackett, 2014; Larkin et al., 2016; Von Culin et al., 2014).

The concept of grit was introduced relatively recently and became popularized in a book by Angela Duckworth, a positive social psychologist and education researcher (2016). Duckworth et al. (2007) defined grit as a trait encompassing "passion and perseverance for long-term goals" (p.1087). They proposed that grit is related to other factors such as self-control, engagement, and other individual success outcomes. Based on these assumptions, the researchers created and validated a scale measuring this new concept. In later writing, Duckworth, Quinn, and Seligman (2009) described grit as distinct from conscientiousness but related to it. Both grit and conscientiousness have positive associations with achievement and performance, such that there is a theoretical overlap between the two concepts. Duckworth et al. (2009) differentiated between the two, describing conscientiousness as more short-term, while grit relates to stamina over long periods.

Research on grit is still in its early days. There have been several published studies in the last dozen years exploring how it is measured and how it relates to individual success (e.g., Duckworth et al., 2007; Duckworth et al., 2009; Ivcevic & Brackett, 2014). Currently, two scales have been published to measure grit (Duckworth et al., 2009). These two open-source scales have been the primary instruments used in the published research on grit in the last ten years. The original scale was the Grit-O, which was then shortened into the Grit-S scale (Duckworth et

al., 2007; Duckworth et al., 2009). While the Grit-O and the Grit-S measure the same two facets (passion and perseverance), the researchers reduced the number of items by dropping those that did not load well onto the facets. However, some researchers have questioned whether these measures of grit are sufficiently robust when used to predict individual performance. A recent meta-analysis by Credé et al. (2017) highlighted concerns that grit may not be as clearly differentiated from its facets as it should be (i.e., one facet of grit may be as predictive as grit at the overall level). These authors called for an improvement of the scale, such as scale refinements or the creation of new scales to progress the measurement of the construct. To date, only one group of authors has been responsible for creating and validating these scales. Although their work is ongoing and may lead to modifications (Duckworth et al., 2009), some have suggested that researchers other than the original progenitors of the concept should be involved in creating a new scale or modifying the current one for better internal consistency and predictive validity (Credé et al., 2017).

Despite calls for scale refinement, the published work in this area has generated interest in the concept of grit (including its overlap with other constructs) and how well grit predicts success on the job across a range of criterion measures. Duckworth and colleagues view grit as a trait that is manifested in the face of adversity, which then helps the individual overcome challenges and achieve success (De Vera et al., 2015; Duckworth et al., 2007). Grit has been linked to military school retention, as grittier individuals have a higher commitment to and passion for their long-term goals and are less likely to drop out (Eskreis-Winkler et al., 2014). Grit has also been related to effectiveness among novice teachers. New teachers with higher

levels of grit gave more effort and saw higher academic gains in their students (Duckworth et al., 2009). In one of the very few published studies conducted in a non-educational context, grit has been associated with success for sales professionals as well as for entrepreneurs. In each of these samples, grit manifests as a passion for and commitment to business development, which in turn is linked to venture success (Mueller, Wolfe, & Syed, 2017).

Other than the study by Mueller et al. (2017), little published research has been conducted into the application of grit to work-related performance. This gap in the published research on grit is an opportunity for researchers to examine whether having a higher level of grit improves an employee's likelihood of performing well at work. As such, research on the link between grit and job performance may be a logical extension of research exploring individual differences and how they relate to effectiveness on the job. There is also an opportunity to examine the relationship between grit and conscientiousness.

Statement of Purpose

There are two primary purposes of this study. The first purpose is to explore the grit construct in an attempt to clarify its measurement model by linking it to the five-factor model of personality. The second purpose of the present study is to evaluate an under-explored area by seeking to understand grit's relationship with the job successfully. Specifically, the present research will investigate the relationship between grit and performance to determine whether a non-linear model is a better fit than the linear model currently described in the literature. To date, no research has yet examined whether having too much grit is problematic (Credé et al., 2017; King,

2017; Weston, 2015). Given that an increasing number of organizations have or are considering adopting grit as a tool in their selection protocol (see Credé et al., 2017, for a review), it is essential to establish whether the relationship between grit and individual performance is linear as opposed to non-linear. Once the nature of the relationship between grit and performance better understood, its utility in a selection context may become more evident.

The following sections will review the concept of grit and related constructs, as well as evaluate the role of grit in an organizational context. Personality facets will also be briefly reviewed as a potential measurement option for grit as an alternative to the significant grit scales in existence (Duckworth et al., 2007; Duckworth & Quinn, 2009). Clarification of the grit model is necessary because of conflicting evidence that it has the appropriate fit and that the items measuring the construct using the grit scales yield contradictory results (e.g., Credé et al., 2017; King, 2017; Weston, 2015). Linking grit to another framework (i.e., the five-factor model) that has valid relationships with performance as well as evidence of overlap with grit might be a first step in determining where grit may lie in the nomological network. Additionally, the literature on job performance will be discussed with an emphasis on how job performance relates to personality as well as to the grit construct. The literature review aims to establish a rationale for investigating the concept of grit as it relates to work-related outcomes, such as employee performance.

History of the Grit Construct

The history of grit is relatively brief, as it spans only the last dozen years. The concept of grit emerged from research investigating why some people achieve

success. The social psychologist Angela Duckworth and her research team began interviewing professionals to determine what successful leaders may have in common (Duckworth et al., 2007). As their work progressed, they began to hear specific terms used repeatedly in descriptions of top performers. These terms included tenacity, ambition, and perseverance.

In seeking to connect these themes with prior research on leaders, they explored early research from psychologists such as Sir Francis Galton (Duckworth et al., 2007). Galton (1892) described successful people as having a combination of zeal, ability, and a capacity for labor. In their first publication introducing the concept of grit, they drew parallels to trait theories from William James, James Cattell, and others (Cattell, 1903; Duckworth et al., 2007; Galton, 1892; Webb, 1915). They described grit as relating to traits like perseverance, self-control, and deliberate practice. They explained how these early psychologists described the traits as they related to achievement (Duckworth et al., 2007). For example, they noted that historical researchers argued that non-cognitive qualities such as perseverance and self-confidence might be more predictive of IQ than accomplishment (Terman & Oden, 1947). They also mentioned that self-control might aid in completing daily tasks (e.g., sticking to a diet). Later, Duckworth et al. drew a parallel to this in that self-control does not describe whether a person might remain committed to a job over time, while grit may be able to do so (2007; Galton, 1892). Additionally, Duckworth et al. (2007) interpreted historical literature in psychology as suggesting that grit is related to deliberate practice (i.e., training that is focused on improving performance on specific tasks; Ericsson, 2008) and therefore may be a plausible individual

difference variable that drives the performance of artists and musicians over and above innate talent (Ericsson & Charness, 1994). Additionally, Duckworth et al. (2007) looked to current literature to understand where grit might fit into other individual differences that might be predictive of performance.

Given their historical review, Duckworth et al. (2007) elected to nest grit within the five-factor model of personality (FFM or "the big five;" Costa & McCrae, 1992; Duckworth et al., 2009; McCrae & Costa, 1999). The argument by Duckworth et al. to position grit within the five-factor model was that grit is very similar to the construct of conscientiousness. They differentiated grit from conscientiousness, based on its emphasis on sustained effort and interest over time (Duckworth et al., 2007). In support of their propositions, Credé et al. (2017) explain that Duckworth et al.'s (2007) definition of passion and perseverance for a long-term goal is similar to Costa and McCrae's (1992) self-discipline facet and achievement striving. The grittiness of an individual was seen as distinct from dependability (one aspect of conscientiousness), in that grit involves sustained, consistent goals and interests, Duckworth et al. explained (2007). They also proposed that few adjectives within the lexical representation of the Big Five capture and differentiate the core elements of grit regarding direction and duration of effort (Duckworth et al., 2007) facets of conscientiousness. Interestingly, they suggested that the Big Five taxonomy was not an exhaustive list of traits worth studying, despite its utility as a descriptive framework, according to Duckworth et al. (2007). As such, they envisioned additional variations within the five facets, such as grit within conscientiousness.

Definition of Grit

Grit is the tendency to sustain interest in and effort toward very long-term goals (Duckworth et al., 2007). Duckworth defined grit as having two components: *consistency of interest* and *perseverance of effort* (Duckworth et al., 2007; Duckworth & Quinn, 2009). Consistency of interest (also referred to as passion) describes the attribute that displays constant effort toward or interest in a single goal, such that it is a commitment to specific activities over time (Duckworth et al., 2007; Duckworth & Quinn, 2009). Perseverance of effort (also referred to as perseverance) is a strenuous, unwavering commitment to a goal in the face of challenges, failures, setbacks, or the absence of positive feedback (Duckworth et al., 2007; Duckworth & Quinn, 2009).

Having a clear definition of grit, one could argue that stamina and focus are aspects that aid in having grit as opposed to other factors in a motivational framework. Motivation may help people work hard and may help pursue valued goals over months and years, as it works together with achievement motivation (Duckworth & Eskreis-Winkler, 2013). Grit overlaps with achievement motivation in particular because of the desire to be committed to a goal, rather than other ever-changing states in motivation. Having achievement motivation requires a belief in the likelihood of accomplishing one's chosen goal, which seems to be consistent with grit (Wigfield & Eccles, 2000). Grit was conceptualized by Duckworth et al. (2007) before the researchers began to develop a measure for it. The scale-development process used by many grit researchers is described and summarized below.

Instruments

Much of the history of the grit construct is strongly linked to the creation of Duckworth and colleagues' instruments to assess grit (see Duckworth et al., 2007; Duckworth et al., 2009, for a review). Their scales (2007, 2009) are used in most grit research. Meta-analyses on grit have evaluated many studies using her scales (Credé et al., 2017). As Duckworth et al. (2007) pointed out, theirs were the only scales created to date that sought to measure the grit construct. They also noted that no other grit instruments had demonstrated evidence of psychometric soundness, face validity for children and adults, and low ceiling effects for high potential employees.

The work that Duckworth et al. completed in developing the grit scales is central to the history of the grit construct and its development over the past decade. Like James a century before (Cattell, 1903; Duckworth et al., 2007; Galton, 1892; Webb, 1915), they sought to differentiate individuals considered exceptional achievers, as well as to understand why specific individuals achieve more than others with equal intelligence and other comparable attributes. Unlike James, they did not attribute high levels of achievement to the maximal use of ability (Duckworth et al., 2007). Initially, Duckworth and her team focused on personality and other characteristics as possible explanations (Duckworth et al., 2007). They identified some attributes that were more crucial to success than others given the context but sought to find a universal attribute that could be translated across disciplines and be useful to all situations (Duckworth et al., 2007). From this, they conceptualized grit as the tendency to sustain interest in and effort toward very long-term goals (Duckworth et al., 2007). They embarked on a series of studies to create a questionnaire that

would not be confounded by other constructs predicting achievement, such as intelligence, GPA, or experience level (Duckworth et al., 2007; Duckworth & Quinn, 2009). They investigated grit's factor structure and how grit relates to IQ, conscientiousness, and self-control, all of which are predictors of achievement (see Weston, 2015, for a review). The scales were designed to minimize ceiling effects for high-achieving populations, meaning that items would have high discrimination among high achievers (i.e., not all high achievers would score high on the grit scale). Additionally, the researchers wanted the scales to have face validity in many contexts related to achievement (Duckworth et al., 2007; Duckworth & Quinn, 2009).

Grit-O.

The first grit scale was created and termed the Grit-O (as the original) scale in 2007, based on six initial studies, each of which will be outlined briefly below (Duckworth et al., 2007). The series of six studies are all from Duckworth et al. (2007). Initially, they created a twelve-item scale with six items describing each factor of passion and perseverance. They used exploratory and confirmatory factor analyses, as well as replication and longitudinal examinations, to develop and refine the Grit-O. The authors noted that many of their studies used standardized predictor variables before analysis for ease of interpretation. For their results, they reported odds ratios (OR) for most regressions, as well as significant values and betas (β). These will be reported in each of the six studies below. Odds ratios are described in

this context as the likelihood of being in the next category per unit increase in the predictor.

Study 1. Study 1 was a cross-sectional study to develop and validate a self-report measure of grit. To begin, researchers surveyed collected data on 1545 participants age 25 and older using a public website that aimed to assist in the validation of their scale. They generated 27 items that they perceived would describe the grit construct, particularly items that indicated the ability to sustain effort in the face of adversity. Their goal was to capture the attitudes and behaviors of high achieving individuals found in several previous qualitative interviews with high achievers. The authors did not mention what scale-development methodology they used but noted that they considered the item-total correlations, internal reliability coefficients, and redundancies. They eliminated ten items based on psychometric properties, redundancy of content, and the level of difficulty of the vocabulary.

At this point, the researchers used data on 772 participants age 25 and older (a random sample of half of their collected data) for the 17 items they had retained. Using this sample, the researchers conducted an exploratory factor analysis (EFA) on the remaining 17 items. They identified a two-factor oblique solution with a ProMax rotation. Each factor had six items, which they expected to be correlated. The two factors correlated at $r = 0.45$.

Further, they tested the final two-factor solution by confirming that the specificity of each factor (the portion of reliable variance not shared with the other factor) was more significant than the variance for the factor of interest. The factors were described here as passion for long term goals (which they initially referred to as

consistency of interest) and perseverance (which they initially referred to as perseverance of effort), as their items described the nature of those labels. A confirmatory factor analysis (CFA) was conducted with the remaining 773 observations in the sample and supported a two-factor solution (CFI = 0.83, RMSEA = 0.11). Some studies have shown that value higher than 0.90 is needed to ensure that misspecified models are not deemed acceptable (Hu & Bentler, 1999). As such, a standard accepted is a CFI value of 0.95 or higher is considered an indicator of a good fit (Hu & Bentler, 1999).

Additionally, a RMSEA of 0.07 and lower is considered a good fit (Steiger, 2007). Based on these criteria, Duckworth and colleagues have not met the standards specified. Despite not meeting the criteria, the authors justified the use of the scale because their factor loadings were all reporting at acceptable levels, and the scale was predictive of the hypothesized outcomes.

All 12 items yielded at least 0.47 factor loadings with their factors, and they justified using the scale as it yielded internally consistent factors, psychologically made sense (to the primary research team), and they felt it best approximated their simple structure. They reexamined the scale properties using a diverse sample across various ages (they noted that the entire sample was 73% women, 27% men, across various ages) and concluded that the scale was psychometrically sound based solely on the internal consistency metrics, with high internal consistency for the scale (α = 0.85 overall, α = 0.84 for passion and α = 0.78 for perseverance of effort). The authors did not give any detail about potential cross-loadings if any existed. They proceeded to run a two-way ANOVA to test for differences in grit by education and

age. They reported that their interaction term was not significant, indicating that age and education level were separate main effects, F (5, 1535) = 15.48, $p < 0.001$, partial $\eta^2 = 0.05$ for education; F (4, 1535) = 11.98, $p < 0.001$, partial $\eta^2 = 0.03$, for age. After controlling for age, the researchers found that postgraduate students were higher than grit than other (less educated) groups, and so on. After controlling for education, they found that grit increased with age. The majority of their hypotheses were supported (e.g., that age and educational attainment were related to grit), despite having less than ideal fit for their measurement model. This scale was subsequently refined in later publications, but the remainder of studies for this section will be describing this 12-item Grit-O scale.

Study 2. Despite the lack of model fit, they used the 12-item Grit-O scale for the following analyses to determine both predictors and outcomes of grit. For their next study, the researchers decided to test whether relationships between grit, educational attainment, and age would hold when conscientiousness and other big five personality facets were controlled for before testing the relationship. Participants reported how many times they changed careers, completed the Grit-O scale (Duckworth et al., 2007), and completed the Big Five Inventory (BFI; John & Srivastava, 1999). In total, 690 participants age 25 and older participated. Researchers found that grit was related to conscientiousness ($r = 0.77$, $p < 0.0010$) more than neuroticism ($r = -0.38$, $p < 0.001$), agreeableness ($r = 0.24$, $p < 0.001$), extraversion ($r = 0.22$, $p < 0.001$), or openness ($r = 0.14$, $p < 0.001$). Despite the poor measurement model (see Study 1), grit was related to conscientiousness as predicted, as well as to the other personality factors.

Additionally, using a two-way ANOVA predicting grit from education and age, education (F (3, 682) = 11.54, $p < 0.001$, partial $\eta^2 = 0.05$) and age (F (4, 682) = 15.32, $p < 0.001$, partial $\eta^2 = 0.08$) were significant predictors of grit. When all facets of personality were added to the ANCOVA model as covariates, both education (F (3, 653) = 11.48, $p < 0.001$, partial $\eta^2 = 0.05$) and age (F (4, 653) = 6.94, $p < 0.001$, partial $\eta^2 = 0.04$) remained significant predictors. In sum, Duckworth and her colleagues argued support for the incremental predictive validity of the education and age from the grit scale over and above conscientiousness and the other big five traits. After identifying what predictors of grit existed, they evaluated what outcomes grit might predict. For career changes, they used a binary logistic regression to predict high versus low career changes from grit, age, and the big five personality traits, grit was the only significant predictor (OR = 0.65, $\beta = -0.44$, *p < 0.001)*. That one standard deviation above in grit were 35% less likely to change career as frequently as their counterparts. Despite the poor measurement model, grit was predictive of several career changes, as the researchers had hypothesized.

Study 3. In their next study, Duckworth et al. evaluated elite undergraduates to determine if they could predict high achievers using grit scores (2007). They hoped to determine if grit could predict success over and above intelligence. They measured 139 undergraduate students (69% women, 31% men) who had an average SAT score of 1415 (top 4% of students). In addition to completing the Grit-O, participants reported current GPA, expected graduation, gender, and SAT scores. SAT scores were used to indicate general mental ability, following Frey and Detterman's (2004) study. Their results showed that gritty students (those with higher grit scores,

according to Duckworth et al., 2007) outperformed their less gritty peers, as grit scores were associated with higher GPAs ($r = 0.25$, $p < 0.01$), and grit scores were even more substantial when holding SAT scores constant ($r = 0.34$, $p < 0.001$). Again, this study used the same measurement model with poor fit from Study 1 but found significant outcomes in the hypothesized direction. The researchers only gave a brief description of this study and only reported correlation statistics for this study. Further details were not reported.

Study 4. Seeing the individual attributes such as general mental ability (by way of SAT scores), personality traits, age, and experience level holding up against other predictors of performance, Duckworth and her team decided to examine grit among West Point students and compare the results with a battery of predictors used to gauge success and retention in military school. One thousand two hundred eighteen freshman cadets (16% women, 84% men) completed questionnaires as part of a more extensive testing activity upon arrival at West Point. Students were given the Grit-O questionnaire, a self-control scale (Brief Self-Control Scale; Tangney Baumeister, & Boone, 2004), and were assessed on a "whole candidate score" (composite score composed of weighted SAT scores, class rank, demonstrated leadership ability based on extracurricular activity participation, and physical aptitude based on physical exercise evaluation). Their retention rates, their GPA, and a military performance score (performance ratings from military program activities) were also evaluated.

To examine the individual effects of grit, as well as the other predictors mentioned above, the researchers used separate binary logistic regressions, using retention as the dependent variable. They reported beta as the change in log odds of

retention due to a unit change in the predictor and the odds ratio (OR) as the change in the odds of retention associated with a one-unit change of the (continuous) predictor. The results that they reported will be summarized with as much detail as possible, given what was provided in the publication.

The researchers determined that grit was not related to the whole candidate score nor to any of its components, including SAT score, high school class rank, leadership potential score, and physical aptitude exam (all were non-significant). But, as predicted, grit was related to self-control ($r = 0.63$, $p < 0.001$). Given their binary logistic regression analyses, they found that grit predicted summer training program completion better than any other predictor did. Specifically, cadets who were a standard deviation higher than average on grit were 60% more likely to complete their summer training ($\beta = 0.48$, $OR = 1.62$, $p < 0.001$), while cadets who scored a standard deviation above average in self-control were 50% more likely to complete the summer course ($\beta = 0.41$, $OR = 1.50$, $p < 0.01$). The whole candidate score (which is used to admit cadets into West Point) was not found to predict retention significantly. Also, when all three predictors (grit, self-control, and the whole candidate score) were entered simultaneously into a binary logistic regression model, grit predicted retention ($\beta = 0.44$, $OR = 1.55$, $p < 0.01$), but neither self-control nor the whole candidate score had significant relationships with retention. Again, using the model from Study 1 that had previously demonstrated poor fit, the researchers were still able to find hypothesized relationships between grit and retention. With this

additional information, the researchers believed that some outcomes relating to grit were becoming clearer and revealed additional information on directions for research.

Study 5. To further build on the results of Study 4, Duckworth and colleagues replicated and extended the study. The researchers wanted to determine if grit was associated with summer attrition over and above conscientiousness in predictors. Conscientiousness was tested to determine if it was more or less responsible for the outcomes than grit was. Participants (1308 West Point cadets) completed the grit scale as well as the 9-item conscientiousness subscale of the Big Five Inventory (Duckworth et al., 2007; John & Srivastava, 1999). They obtained whole candidate scores and retention data from previous records. The researchers did not provide additional detail on the sample or the method but alluded that the methodology was the same as for Study 4. They first noted that grit and conscientiousness were highly related ($r = 0.64$, $p < 0.001$). They also found that summer retention was predicted better by grit ($\beta = 0.31$, $OR = 1.36$, $p < 0.02$) than by conscientiousness or the whole candidate score (which were both non-significant). However, when all three predictors (grit, conscientiousness, and the whole candidate score) were entered in a logistic regression simultaneously, grit predicted summer retention grit ($\beta = 0.31$, $OR = 1.36$, $p < 0.02$). Contrary to grit, conscientiousness and the whole candidate score did not significantly predict summer retention.

Study 6. In the sixth study, Duckworth and colleagues decided to examine grit as it relates to extracurricular accomplishment, as well as to test grit as a mechanism. To do this, they studied the 2005 Scripps National Spelling Bee participants and their grit levels. The researchers identified 175 children ages seven to 15 (48% girls, 52%

boys) who obtained consent to participate. Participants were given the Grit-O, a self-control measure (Brief Self-Control Scale; BSCS; Tangney et al.,2004), and the Wechsler intelligence scale for children (Wechsler, 1991). Participants also reported how many hours per day they studied for the spelling bee during the week and then separately on weekends. The researchers measured the dependent variables as the number of rounds a participant completed before being eliminated ("final round") and the number of times a participant completed another spelling bee competition ("prior competitions"). Despite the poor measurement model, they wanted to examine if grit affected the final round as mediated by the number of hours studied, as well as the number of final competitions in which the participants had entered.

Because the dependent variables were considered ordinal to one another, the researchers used ordinal regression models to test the effects of each predictor. Age was included as a covariate because older children were more likely to have participated in previous competitions, ($p < 0.02$). Grit ($\beta = 0.34$, OR = 1.41, $p < 0.04$) and age ($\beta = 0.28$, OR = 1.41, $p < 0.04$) predicted advancement for higher rounds in competition with the final round as the dependent variable, with finalists having a standard deviation above the mean across the same age being 41% more likely to advance in competition. When grit, self-control, and age were entered as predictors of final round for the spelling bee, grit ($\beta = 0.62$, OR = 1.86, $p < 0.01$) and age competition ($\beta = 0.29$, OR = 1.33, $p < 0.05$) were the only significant positive predictors. Self-control was not a significant predictor of performance, but verbal IQ predicted final round ($\beta = 0.80$, OR = 2.22, $p < 0.003$). However, grit and verbal IQ were not significantly related. In an ordinal regression with prior competitions as the

dependent variable, grit (β =0 .48, OR = 1.62, $p < 0.002$) was a significant predictor when age was controlled for (β = 0.30, OR = 1.35, $p < 0.07$). The OR for grit at 1.62 suggests that finalists who were a standard deviation above same-aged peers in grit were 62% more likely to have competed in a prior competition. In a simultaneous ordinal regression predicting 2005 final round, several prior completions (β = 1.21, OR = 3.36, $p < 0.001$) remained a significant covariate when age was controlled for, but grit did not.

The researchers suggested that the findings showed that gritty children work harder and longer than their peers and, as a result, perform better. Additionally, as predicted by the researchers, grit may increase with age in children. Grit may be a driver of the observed correlations with success outcomes rather than success outcomes driving grit, despite the poor fit of the model in Study 1. In sum, this study suggests that gritty children work harder and longer than their peers and perform better as a result. The authors noted a limitation that there might be a possibility that these effects of variables on performance are mediated by some mechanism other than grit, but they had reasonable evidence to explore further. Additionally, all favorable relationships between grit and other outcomes were found with a poor-fitting model, prompting the researchers to refine the scale for better model fit.

Grit-S.

While evidence was accumulating to support the use of the GRIT-O scale, the data was not uniformly supportive of its proposed measurement model (Duckworth & Quinn, 2009). The researchers determined that the model fit of the Grit-O scale (CFI = 0.83; RMSEA = 0.11) failed to meet the criteria described by Kline (2016) and

Byrne (2001). Recognizing the need for improvement in the original grit scale, Duckworth and Quinn (2009) modified the original scale to create the shorter Grit-S scale. The development of the new scale is outlined below in the series of studies that they conducted in Duckworth and Quinn (2009), and all information should be referenced as such. This scale is currently the most commonly used non-proprietary measure of grit and will be described for clarity.

Study 1. The goal of the first study was to create a more efficient measure of grit with a better model fit (Duckworth & Quinn, 2009). First, the researchers selected items from the scale from its original 12 items, based upon which items most clearly loaded onto a two-factor structure. Factor one was "passion" (consistency of interests), and factor two was seen as "perseverance" (perseverance of effort). In selecting items, they considered predictive validity and replication of the two-factor structure of the Grit-O. The researchers computed item-level correlations with outcomes for four samples. They removed two items in each factor that contained the weakest correlations to outcome variables and were left with an eight-item scale, now called the Grit-S scale (with passion ranging from $\alpha = 0.73$ to 0.79 and perseverance ranging from $\alpha = 0.60$ to 0.78). Next, they ran four confirmatory factor analyses (CFAs) to evaluate the two-factor model with each of the four samples. Passion (they referred to as consistency of interest) and perseverance of effort were first-order latent factors loading onto a second-order factor they called grit. They reported overall fit statistics for both West Point samples as good fit, West Point class of 2008, X^2 (19, N = 1218) = 106.36, $p < 0.001$, RMSEA = 0.61, (90% CI = 0.050-0.073), CFI = 0.95, and West Point Class of 2010, X^2 (19, N = 1308) = 135.51, $p < 0.001$, RMSEA =

0.068, (90% CI = 0.058-0.080), CFI = 0.95. They reported slightly worse fit for both 2005 Scripps National Spelling Bee sample, X^2 (19, N = 175) = 71.57, $p < 0.001$, RMSEA = 0.101, (90% CI = 0.077-0.126), CFI = 0.93, and Ivy League undergraduates, X^2 (19, N = 139) = 43.63, $p < 0.001$, RMSEA = 0.97, (90% CI = 0.059-0.135), CFI = 0.93, though they attributed their higher RMSEA and lower CFI values to smaller sample size. The improvement in model fit from the Grit-O to the Grit-S in two of the samples shows the acceptable fit based on cutoff scores such as having a CFI value greater than 0.90 is needed to ensure that misspecified models are not deemed acceptable, or having a CFI value of 0.95 or higher is considered an indicator of good fit (Hu & Bentler, 1999). Additionally, having a RMSEA of 0.07 and lower is considered a good fit (Steiger, 2007). Once they completed these CFAs and determined that at least two of their samples had an acceptable fit, the authors moved on to test additional samples for further evaluation of the Grit-S.

Study 2. The second study conducted using the Grit-S attempted to evaluate the factor structure of the scale and to identify relationships between grit factors and the big five personality dimensions, as was done in the original Grit-O scale development (Duckworth et al., 2007). Voluntary participants went to a website providing free information about psychology research to take the survey. In total, 1554 adults age 25 and older completed the questionnaire disclosing age, gender, education level, and noted the number of career changes. They also completed the BFI (John & Srivastava, 1999) and the 12 items making up both the Grit-S (eight of

the items; Duckworth & Quinn, 2009) and the Grit-O (all 12 items; Duckworth et al., 2007).

This study estimated the predictive validity of grit for particular outcomes (career changes and educational attainment) and determined that the two-factor model (X^2 (19, N = 1554) = 188.52, $p < 0.001$, RMSEA = 0.076 (90% CI = 0.066-0.086), CFI = 0.96) did in fact predict better than one single factor of grit (X^2 (20, N = 1554) = 380.45, $p < 0.001$), with the significant chi-square difference being ΔX^2 (1) = 191.93, $p < 0.001$). When the researchers looked at the fit again for the Grit-O (all 12 items), the chi-square statistic was also significant, but the goodness-of-fit indices had poorer fit than the Grit-S did, (X^2 (53, N = 1554) = 849.36, $p < 0.001$, RMSEA = 0.098 (90% CI = 0.096-.104), CFI = 0.86).

Next, Duckworth and Quinn (2009) looked to evaluate the relationship between grit and conscientiousness (as well as to explore how it relates to all BFI dimensions. When controlling all personality dimensions, the results indicated that individuals with higher grit level had more educational attainment than those at their same age, as grit (B = 0.21, OR = 1.23, $p < 0.001$) and age (B = 0.22, OR = 1.25, $p < 0.001$) were both significant predictors, meaning that one standard deviation above in grit level were 23% more likely to have more education level than participants of the same age. Additionally, in a hierarchical logistic regression, with age and all five personality dimensions entered in Step 1 and grit added in Step 2, Grit-S was a significant predictor of educational attainment over and above personality and age (B = 0.27, OR = 1.31, $p < 0.001$), finding the incremental predictive value of grit over the Big Five dimensions and age. Finally, they looked at how grit predicted high

versus low career changes, controlling for age and BFI dimensions, (B = 0.22, OR = 0.80, p = 0.01), meaning that individuals scoring a standard deviation higher than those of their same age on the Grit-S were 20% less likely to have more than three-lifetime career changes. At this point, the researchers felt that they had sufficient evidence to test a different type of Grit-S version that would involve a different rater rather than a self-report option.

Study 3. Next, Duckworth and Quinn accumulated evidence of validity in what they referred to as the informant report (an other-report rating) of the Grit-S. An informant report is a similar questionnaire to the Grit-S but is given to others to rate one another's grit level (as opposed to self-report). The scale had identical wording to the Grit-S for self-report, except that all first-person pronouns were replaced with third-person pronouns. Participants completed the self-report measure and nominated someone they knew to complete the informant report measure about them. Of these, 161 participants (89% female) completed the study. Internal consistency estimates for Grit-S ratings by family members, peers, and self were $\alpha = 0.84$, 0.83, and 0.83, respectively. Correlations between family members and self were $r = 0.45$, $p < 0.001$ while correlations between peers and self were $r = 0.47$, $p < 0.001$. They argued that they could successfully compare the scale to rate others on their perceived amount of grit with the self-report measure, as other common scales had comparable favorability estimates (e.g., NEO-PI-R self and peer ratings for conscientiousness are r = 0.40; Costa & McCrae, 1992). However, perhaps there are other standards worth considering before determining whether this other-report measure should be used.

Study 4. Next, Duckworth and Quinn examined test-retest stability by measuring individuals' grit levels over time (approximately a year). They tested 279 high school students (from 7^{th} to 11^{th} grade) at the beginning and then again at the end of a school year, administering both the Grit-O and the Grit-S in both instances. GPA was obtained from the school to use for predicting school grades. Students also recorded how many hours they watched television during the school year. The correlation between scores pre- and post-school year was $r = 0.68$, $p < 0.001$. They also found internal consistency at the beginning of the year and the (0.82) end of the year (0.84). Controlling for age, scores on the Grit-S measured at the beginning of the year ($r = 0.30$) were positively related to GPA at the end of the year ($r = 0.32$). Conversely, scores on the Grit-S were negatively related to hours watching television per day at both the beginning of the year ($r = -0.24$) and the end of the year ($r = -0.22$).

Study 5. Duckworth and Quinn then examined grit among West Point students and compare the results with predictors used to gauge success and retention in military school. One thousand two hundred forty-eight freshman cadets (15% women) completed questionnaires as part of a more extensive testing activity upon arrival at West Point. Students were given the Grit-O questionnaire (which includes the Grit-S items) and were assessed on a "whole candidate score" (composite score composed of weighted SAT scores, class rank, demonstrated leadership ability based on extracurricular activity participation, and physical aptitude based on physical exercise evaluation). Their retention rates were also collected and coded as a dichotomous variable (1=retained, 0=separated).

Grit-S predicted completion of the summer training program better than the whole candidate score, $\Delta X^2 = 35.32$, $p < .001$, (95% CI = 1.57-2.53)., The researchers used standardized odds ratios and indicated those cadets who scored a standard deviation higher than average on the Grit-S than their peers were 99% more likely to complete the summer training program. Additionally, the whole candidate score did not significantly predict summer retention. Then, they used a hierarchical binary logistic regression to compare the whole candidate score (entered in Step 1) to grit (entered as Step 2) as predictors of retention. They compared each person's scale scores to his or her whole candidate score, and they found that the Grit-S scale predicted completion and retention better than the whole candidate score did (which had been West Point's composite score of predicting success until this point), B = 0.69, OR = 1.99, $p < 0.001$. Grit predicted completion of the rigorous summer training program over and above than the whole candidate score. The observed internal consistency of the Grit-S was $\alpha = 0.77$ in this instance.

Study 6. Finally, Duckworth and Quinn (2009) tested the predictive validity of the Grit-S scale for behavioral performance using 190 participants from age ten to 15 (47% female) entered in the 2006 Scripps National Spelling Bee. Participants completed all 12 items, including the eight in the Grit-S as well as the BFI (John & Srivastava, 1999). They also answered questions relating to their study habits, such as time spent studying per week and time spent practicing in previous years (later computed into cumulative hours practicing score) that the researchers identified as behavioral measures of performance. Their final round (which is based on the number of words spelled correctly) was considered ordinal, so the researchers used ordinal

logistic regression models to test the effects of the predictors. Odds ratios once again were standardized for interpretation.

Grit scores were more strongly related to the BFI-C than to any other BFI trait. Researchers found that grit was related to conscientiousness ($r = 0.70$, $p < 0.001$) more than neuroticism ($r = -0.28$, $p < 0.001$), agreeableness ($r = 0.44$, $p < 0.001$), and openness ($r = 0.18$, $p < 0.02$) and was not related to extraversion ($r = 0.12$, $p < 0.10$). As the researchers anticipated, scores on the Grit–S completed before competition predicted participant final round. Specifically, participants who scored one standard deviation higher on the Grit–S than same-aged peers were 38% more likely to advance to further rounds ($B = 0.32$, $OR = 1.38$, $p = 0.04$). Following that, Duckworth and Quinn (2009) conducted a hierarchical ordinal logistic regression with age, conscientiousness, agreeableness, extraversion, neuroticism, and openness entered in Step 1. They entered Grit–S scores in Step 2 and found that Grit–S was a significant predictor of final round attained over and beyond Step 1, $B = 0.55$ $OR = 1.73$, $p = 0.03$. Participants that were at least one standard deviation above peers on the Grit-S were more likely to advance on in the spelling bee competition.

Grittier competitors outperformed their less gritty counterparts partly because they had accumulated more practice in spelling. They conducted two analyses separately that supported their theory that the effect of grit on performance was mediated by both more accumulated spelling practice and experience in more spelling bee competitions. They noted that there are three criteria to be met for a variable to be considered a mediator, according to Baron and Kenny (1986). To be considered a mediator under these criteria, the independent variable must predict the mediator; the

independent variable must predict the dependent variable, and the mediator must predict the dependent variable when the independent variable is held constant. Using this framework, the researchers felt that they had recognized that Grit-S predicted the final round in an ordinal logistic regression controlling for age (as mentioned earlier in this summary of Study 6).

Supporting this framework, the researchers conducted a simultaneous multiple regression with cumulative spelling practice as the dependent variable and controlling for age. Grit–S was a significant predictor ($\beta = 0.27$, $p < 0.001$), while age ($\beta = 0.03$, $p = 0.65$) was not. Then, in a simultaneous ordinal regression model predicting final round, cumulative spelling practice ($B = 1.20$, OR = 3.32, $p < 0.001$) was a significant predictor, but Grit–S (B = 0.17, OR = 1.19, p = 0.32) and age (B = –0.17, OR = 0.84, $p = 0.24$) were not. The authors also completed this process for experience in final competitions as a mediator for grit and final round. Grit–S predicted participation in prior spelling bee competitions. In an ordinal regression model with prior competitions as the dependent variable, Grit–S was a significant predictor controlling for age ($B = 0.53$, OR = 1.70, $p = 0.004$). Then, the researchers evaluated a final model to test a simultaneous ordinal logistic regression predicting final round, they found that the number of prior competitions ($B = 1.42$, OR = 4.14, $p < 0.001$) remained a significant covariate when age (B = −0.20, OR = 0.82, p = 0.17) was controlled, but Grit–S ($B = 0.14$, OR = 1.19, $p = 0.37$) did not.

In addition to revealing more about the nature of grit as it relates to outcomes, Duckworth and Quinn (2009) gained clarity on which scale measures grit in a better way. They concluded that the 8-item scale has a better fit than the original 12-item

scale and that it does not compromise any predictive validity, despite being more efficient with fewer items. After determining the better way to measure grit, the authors provided evidence toward predictive validity, test-retest reliability for the Grit-S. They also felt that it related to other constructs that may mediate its relationship with outcomes, such as deliberate practice and years of experience toward attaining a goal (which may be represented by performance in a spelling bee, for example). However, a thorough review of the current literature regarding other competing concepts, antecedents, and outcomes of grit is needed, as one has not been found in the literature and would help clarify where grit belongs in the nomological network to which it relates.

Personality and grit.

As stated earlier in the review, there is a distinct relationship between conscientiousness and grit, such that grit may make up a facet of the global conscientiousness, thus being different yet related (Duckworth et al., 2009). As grit is such a new construct, more research is needed to determine its predictive relationships with conscientiousness and outcomes like performance. Both grit and conscientiousness focus on achievement, but conscientiousness is more short-term than the long-term, while grit relates to stamina over long periods (Duckworth et al., 2007).

Many researchers have suggested evaluating the grit-conscientiousness relationship further in-depth, as there is so much to learn about whether it is a facet entirely of conscientiousness, or if it is its entity (Credé et al., 2017; Eskreis-Winkler et al., 2014). However, researchers have often called for more studies to explore the

relationship between grit and conscientiousness (Credé et al., 2017; Eskreis-Winkler et al., 2014; Ivcevic & Brackett, 2014). There may be some reason to believe that the current methods of measuring grit (e.g., with the Grit-S scale) may not be most effective (Credé et al., 2017). As such, using a different scale to measure grit or clarifying the relationship using the current scale (Duckworth et al., 2007) would reveal more direct relationships of grit to conscientiousness, and perhaps clear up some of the inconsistent findings that have occurred when defining what is considered grit.

Although some researchers have hypothesized that grit is a facet of conscientiousness, grit may comprise some other combination of attributes, such as particular facets of certain factors rather than a single factor itself (like conscientiousness). A list of facets within each factor can be found in Table 1.

Table 1

IPIP – NEO Inventory Facet Levels

Variable	Factor
Anxiety	N1
Anger	N2
Depression	N3
Self-consciousness	N4
Immoderation	N5
Vulnerability	N6
Friendliness	E1
Gregariousness	E2
Assertiveness	E3
Activity level	E4
Excitement-seeking	E5
Cheerfulness	E6
Imagination	O1
Artistic interests	O2
Emotionality	O3
Adventurousness	O4
Intellect	O5
Liberalism	O6
Trust	A1
Morality	A2
Altruism	A3
Cooperation	A4
Modesty	A5
Sympathy	A6
Self-efficacy	C1
Orderliness	C2
Dutifulness	C3
Achievement-striving	C4
Self-discipline	C5
Cautiousness	C6

Some research even argues that facets are better predictors than the overarching five domains are and that the level of detail provided by the facets is beneficial to the personality field (e.g., Johnson, 2000; Paunonen & Ashton, 2001). Repeatedly, researchers are finding that the NEO domain-and-facet approach appears to be a more promising method for mapping the subdomains of the major personality domains than any other and that they might be more useful in a clinical or assessment setting (Johnson, 2000; Sprock, 2002).

Another benefit of employing the IPIP-NEO is its reliable and valid measurement (see Johnson, 2000, for a review). Additionally, using this facet-approach appears to be useful in studies measuring various outcomes from anxiety and depression (Lewis et al., 2010) to competitiveness (Fletcher & Nusbaum, 2008) to helping behaviors at work (Conway, Rogelberg, & Pitts, 2009) to job performance (Griffin & Hesketh, 2004; Wallace & Chen, 2006), and leadership style (Ali, Nisar, & Raza, 2011). Some researchers progressively called for the use of narrow scales (facet-level) in place of scales measuring only the broader, multidimensional factors (Oswald & Hough, 2012).

As the grit construct seems to have some disagreement among researchers relating to its measurement, perhaps subject matter experts (SMEs) might identify which facets from the IPIP-NEO they believe relate to the grit construct as a way to test whether the IPIP-NEO facets might be a better measurement model to grit than the existing scales. If SMEs were to take the Grit-O scale and determine what facet-level items relate to the existing items, models could be tested to determine the best way to measure grit, as researchers currently suggest a need for refinement of how grit is measured. This might explain how grit relates to so many other outcomes but struggles to identify where in the

nomological network it belongs. Once grit can be established within the facets of the IPIP-NEO, a better understanding can be achieved around how grit relates to antecedents and outcomes. A review of where grit has overlapped with other constructs will be described to appreciate the complexity and disorganization of the grit literature. The current nomological network seems to be a series of independent studies that do not have any underlying framework or common principles, thus making the review segmented and challenging to conceptualize.

Nomological Network Relating to Grit

Although the work that Duckworth and her colleagues completed laid the groundwork for further exploration of grit, other researchers investigated how grit might fit into other psychological constructs within respective disciplines. Navigating through this nomological network of what grit entails helps in understanding its relationship with other relevant concepts. Because grit is a new construct for psychological research, most studies have been conducted in the last decade. A thorough review of what research exists thus far will be discussed in the following sections. Some overlap exists between grit and other psychological constructs, but there are some differences between them. The nebulous nature of how constructs overlap with and relate to grit makes the organization of any overarching model challenging to envision. As such, little exists in the way of offering a theoretical framework to understand grit within the network of related constructs, and has some researchers arguing that it is merely “old wine in new bottles” (Credé et al., 2017). A description of overlap with grit and other related constructs within the literature will be discussed before proposing a new framework through which to look at grit.

Overlap with Other Constructs

Resilience.

Resilience has many definitions among researchers in the literature. Despite the disagreement, the most common explanation is being able to bounce back from failure or adversity in the most optimistic way (Perkins-Gough, 2013). Grit and resilience both include a positive response to a failure or adversity. Where resilience differs from grit is that it only encompasses part of the traits needed to be what is determined as "gritty," but misses the aspect of passion over extended periods (Perkins-Gough, 2013). So, an individual may be resilient, but unless he or she commits to the same goals over time, he or she would not be considered gritty.

Hardiness.

Similar to resilience, hardiness is yet another concept that has been grouped with grit, as it shares some of the same qualities as maintaining control and having perseverance (Ray & Brown, 2015). Hardiness has appeared as a pattern of attitudes that aids in changing stressful circumstances from potential adversities into growth opportunities (Maddi et al., 2013). According to some researchers, hardiness is even considered a pathway to resilience (Bonnano, 2004). Hardiness is described as a trait that strengthens a person's resilience (the hardiness literature sees resilience as more situational, or state-like; Lo Bue, Taverniers, Mylle, & Euwema, 2013). Lo Bue et al. were able to find that increased levels of hardiness were related to increased military success, which is like the West Point studies from Duckworth et al. in the grit literature (2007). Hardiness encompasses a variety of attitudes and beliefs that includes being

highly committed and engaged to life activities while having an openness to new challenges (see Kelly, Matthews, & Bartone, 2014, for a review).

Hardiness is described as a personality dimension that develops early in life and can remain stable over time while being amenable to change. Those who rate higher in hardiness tend to be more resilient when faced with challenges (Bartone, 2000). Although similar to grit, hardiness emphasizes the ability to adapt to new challenges, particularly negative ones, whereas grit emphasizes the long-term stamina over time. Kelly et al. found that when comparing grit and hardiness, only grit could predict attrition over a series of years, and thus show the utility of grit over hardiness (2014). In sum, while hardiness does overlap with grit, grit can reveal more about the long-term implications of being committed to something than hardiness can do (Maddi, Matthews, Kelly, Villarreal, & White, 2012).

IQ and Academic Achievement. As mentioned previously in Angela Duckworth's research and development of the Grit-O scale, there is some emphasis that grit and IQ have cognitive overlap, especially regarding how the two concepts relate to success (Duckworth et al., 2007). Before the birth of grit, Linda Gottfredson stressed the importance of intelligence in her 1997 article showing that IQ could be related to performance and could be advantageous when work tasks become more complex. Since her revelations, researchers have been focused predominantly on finding outcomes related to intelligence but have perhaps left out alternatives that could account for some of the remaining variance attributed to success. Gottfredson herself mentioned that

intelligence would vary across social classes and contexts (1997). Grit may fill in some of those gaps in determining successful people, despite their background.

Interestingly, Duckworth et al. have found that intelligence is either unrelated or inversely related to grit level; specifically, a person who is low on intelligence might be high on grit level (e.g., Duckworth et al., 2007; Duckworth & Quinn, 2009). The implications for this research suggest that perhaps there is more than one way to achieve success, and grit could be an answer for how some less intelligent individuals can be successful, among other questions.

Motivation.

Motivational theories usually emphasize how people energize or direct their behavior; being motivated in this way relates to grit by enabling behaviors through setting long-term goals and pursuing them. However, consider the paradigm of a marathon versus a sprint when comparing grit and motivation. Motivation is more about why a person might be doing something, as it is a deliberate investment of effort and time, but can change quickly, as opposed to the nature of grit (Maehr & Meyer, 1997). Stamina and focus are what distinguish grit from other factors in a motivational framework (Duckworth & Eskreis-Winkler, 2013). Motivation will help people to work hard, but stops short at being the driving force for helping people pursue and attain goals that take time over months and years to complete. In contrast to grit, being motivated commands a person to believe that attaining his or her goals is feasible (Wigfield & Eccles, 2000).

Some similarities between motivation and grit can be seen through what drives happiness. Grittier individuals are more likely to seek happiness through engagement and

are also more likely to seek meaning in life (Von Culin et al., 2014). In pursuing both engagement and meaning, those individuals are seeking the motivational equivalents of grit; the desire to seek purpose in life contributes to grit given the sustained effort over time as opposed to immediate gratification (found in motivation), which further shows how grit and motivation relate but are different (Von Culin et al., 2014).

Motivation is rarely mentioned within the grit literature, but should not be ignored nor overlooked, as it is distinct from grit (see Weston, 2015, for a review). Motivation is much more temporary and state-like than being gritty over time but is nonetheless related to grit. Motivated individuals can set a goal that is neither too easy nor too hard so that they can receive additional motivation (through success) to continue (Ryan & Deci, 2000). In contrast, gritty individuals will deliberately set difficult goals with long-term objectives, and those individuals won't waver from those objectives, even when facing setbacks (Duckworth et al., 2007).

Growth mindset.

According to current literature, growth mindset is the belief that intelligence is malleable and given consistent effort, intelligence, or talent can be developed or improved, to some extent (see Duckworth & Eskreis-Winkler, 2013, for a review; Dweck, 2006). Some researchers believe that a positive mindset influences success, and as such, a positive mindset can overlap with the idea of grit (Weld, 2016). Someone with a growth mindset is fixed on developing and growing knowledge for the future, which lends its relevance to grit. Working hard to achieve goals is part of the necessary process within the growth mindset, as well as in gritty individuals (Weld, 2016). Growth mindset and grit both share a common form of resiliency to have successful outcomes (Weld,

2016). However, where grit may be a better predictor achievement is when a person's goals can be self-selected. The passion for attaining the goal will supersede any generic effort given that would have been driven by a growth mindset, and affects more than increasing intelligence, as effort sustains over time (Ivcevic & Brackett, 2014).

Emotional intelligence.

Psychology literature disputes whether emotional intelligence is its construct, despite much research that has been conducted around the popular idea (Maddi et al., 2013). Emotional intelligence can be seen as the recognition of and management of emotions that influence action and performance (Maddi et al., 2013). Emotional intelligence has some overlap with grit, as it relates to individual performance in addition to decision-making and emotionally motivated interpretation (Côté, 2014). The ability to perceive a situation accurately, and also to act upon current emotions in an appropriate response can aid individuals in performing effectively to achieve their goals. Successfully managing those emotions enhances performance and interaction and can improve mental and physical health when an individual is under stress (Maddi et al., 2013). Both grit and emotional intelligence have been found to decrease spending, gambling, and other addictions (Maddi et al., 2013).

Emotional regulation ability.

Emotional regulation ability (ERA) is a component of emotional intelligence that describes an individual's maximal capacity to evaluate emotion regulation strategies and to influence their affective experience (Ivcevic & Brackett, 2014). Hence, the ability to regulate emotion in a given context can help improve focus and performance instead of focusing on disruptive emotions (e.g., fear, panic, sadness). In doing so, ERA can

influence how a person acts by affecting the ways that goal attainment is promoted. Grit can differ from ERA because it focuses more on self-selected, narrower goals related to performance rather than overall performance (Ivcevic & Brackett, 2014; Weston, 2015). Additionally, grit may be a better indicator of success for narrow goals that are selected by the individual (not by others), which delineates grit from C or other overall predictors of success, as this is goal specific and goal dependent (Ivcevic & Brackett, 2014).

Affect and life satisfaction.

The overall affect in a person relates to how much grit he or she has. Grit is a predictor of life satisfaction and happiness while having negative affect can relate negatively with grit (Singh & Jha, 2008). Together, Singh and Jha found that 19 percent of life satisfaction was attributed to grit, negative affect, and positive affect (2008). They believed that grit is the character strength of perseverance that is described in positive psychology literature. As such, grit and life satisfaction also seems to be proximal contributors to the performance and effectiveness of teachers in their workplace (Duckworth et al., 2009). Additionally, grit and gratitude work synergistically, according to one study, as they reduce the number of suicide intentions (Kleiman, Adams, Kashdan, & Riskind, 2013). Overall, affect, and general satisfaction with life seem to work hand in hand with grit, coinciding in some way to affect outcomes such as performance and wellbeing.

Self-control.

Self-control has a significant amount of overlap with grit, as it is a concept that requires inhibitory control and decision-making (Kleiman et al., 2013). Self-control includes the capacity for a person to regulate attention, emotion, and behavior as it

associates with values when presented with any sort of temptation (Duckworth & Gross, 2014). Grit and self-control are different, but related, as self-control is more of a skill or capacity to achieve everyday success, while grit is more related to the volition to accomplish a long-term goal (Duckworth & Gross, 2014). Self-control is associated with prosocial behavior, employment, and positive workplace outcomes (Duckworth & Gross, 2014). Grit and self-control are also highly correlated (r = .6) and predict successful outcomes over and above intelligence (Duckworth & Gross, 2014). In sum, grit and self-control are not identical, but likely play part of a hierarchical goal framework as lower-order goals serve higher-order ones.

Individuals with grit usually possess self-control. Additionally, the meaningful pursuits of the gritty allow them to bridge the gap between present and ideal selves (Kleiman et al., 2013). Gritty individuals may be able to suppress competing goals to focus on their larger goal in a way that those with only self-control may struggle (Duckworth & Gross, 2014). Although there is quite a bit of overlap, it seems that grit and self-control are, in fact, different from one another.

Goal-setting.

In addition to having self-control, a gritty person might have some overlap with grit through goal-setting. This behavioral mechanism can be used to help achieve ambitions, especially large ones, successfully to improve commitment to achievement or performance (Locke & Latham, 1990). Goals can define what constitutes a satisfactory level of performance, or even a direction for a person's actions to work toward (Locke & Latham, 1990; Locke & Latham, 2013). According to Latham and Locke's goal-setting theory, goals are immediate precursors to and regulators of human behavior (2017).

Goals can be short term (proximal) or long term (distal), where more difficult goals lead to a more significant effort and more persistence than those more straightforward goals (Latham & Locke, 2017). The overlap between grit and goal-setting can be found here, where effort and persistence are common factors between the two concepts.

However, grit balances between its trait-like attributes and this state-likeability to increase grit levels as effort increases. According to Angela Duckworth et al., academic goal-setting interventions can increase persistence (2009). She has even found some success in using goal-setting as a mechanism for increasing grit levels among people (Duckworth et al., 2009). Less gritty people can improve their grit levels when they are trained on goal-setting strategies of sustained effort and practice (Chang, 2014). Moreover, though goal-setting has overlap and relates to motivating a person to achieve his or her goals, it does not encompass grit's nature in its entirety; thus, it is a different construct.

Deliberate practice.

Ericsson, Krampe, and Tesch-Römer (1993) determined that deliberate practice is a deliberate amount of effort given toward some goal to improve performance. Ericsson and Charness (1994) concluded that deliberate practice was the mechanism that set expert performers apart from the rest, in the arts, sports, and music industries. They claim that having a deliberate practice is what separates adept performers from less ideal performers. Deliberate practice describes the process of expending the most effort while enjoying the preparation action least (Duckworth, Kirby, Tsukayama, Berstein, & Ericsson, 2011). Duckworth et al. (2007) found that those with deliberate practice predicted performance better than using any other method and that those engaging in

more hours of practice were also higher in grit level. In a study on spellers from the national spelling bee, Duckworth et al. found deliberate practice mediated the grit-performance relationship among spellers. In sum, grittier spellers were more successful at spelling bees because of deliberate practice.

Passion and self-regulatory mode.

Passion has been explained as one of the reasons that some individuals can be more successful than others are (Cardon, Wincent, Singh, & Drnovsek, 2009). For example, entrepreneurs continually struggle with business endeavors over time, and having passion may help explain how persistence helps overcome challenges (Mueller et al., 2017). In this instance, passion leads to a better entrepreneurial performance by way of grit, which explains how it is indirectly an antecedent of grit. Using longitudinal research, Mueller et al. identified self-regulatory mode and grit as mediums of the passion-performance relationship (2017). Both grit and self-regulatory modes were used as mechanisms by which passion leads to grit, which leads to venture performance among entrepreneurs. In this study, passion leads to self-regulatory mode, which includes locomotion (orientation toward actively pursuing goals) and assessment (appraising options for goal pursuit), which leads to grit. In sum, passion successfully predicts having those self-regulatory modes, which leads to a grit level, which leads to performance. Thus, passion and self-regulatory mode are antecedents of grit. The authors stress passion as an antecedent for grit because some entrepreneurs (passionate ones) can overcome struggles (by being gritty; Mueller et al., 2017).

Relatedness.

Another antecedent of grit found in the literature review is relatedness, which is described as the extent to which a person feels accepted by others around him or her (Furrer & Skinner, 2003). Relatedness has been described as a motivational resource that can be used when people are faced with a challenge, according to Furrer and Skinner (2003), suggests that it could be a precursor to grit. Relatedness is considered a significant self-system that may catalyze engagement and motivational type processes, which would naturally fit within a grit relationship. Having a sense of relatedness was shown in one study to be linked to higher perseverance, consistency of interest, and overall grit (Datu, 2017). Additionally, Datu found that having relatedness to particular, distinct social partners was linked to higher passion and perseverance, showing how relatedness could be a precursor to being gritty.

Attachment style.

Because personality is predominantly formed in the years of attachment, attachment style has been logically related to grit (Levy & Steele, 2011). Childhood attachment styles may have some overlap or relationship with grit, as both relate to an individual's personality. However, attachment style is seen more as an antecedent to grit, as it influences one's personality. Grit is partially accounted for by attachment style (Levy & Steele, 2011). For example, lower avoidance and lower anxiety in current adult relationships yield higher care experiences in past relationships with parents. In this study, that was exhibited by proper parenting attachment indicating higher grit scores.

The list of constructs relating to grit in some way continues to grow as more researchers publish, but no theoretical framework seems to exist to link them together in

a logical manner. As such, a new way of considering grit as it relates to some known framework would be especially helpful. Another way to understand the nature of grit is to look toward how it relates to outcomes of interest.

Outcomes

Among the significant outcomes of interest for grit, retention and achievement seem to be two of the most studied. Therefore, they will be reviewed below to determine how grit is related to these outcomes, as finding favorable outcomes because of grit helps identify utility in studying the construct and helps to determine where more research is needed in future grit studies to know even more about it.

Retention.

Retention in an organization can be necessary because of the high cost to replace and invest in another employee (Hinkin & Tracey, 2000). According to one study, losing employees significantly negatively impacted overall organizational performance significantly (Hancock, Allen, Bosco, McDaniel, & Pierce, 2013). Retention may be an appropriate means of evaluating the utility of grit, as researchers argue that grit improves retention in a variety of contexts (e.g., Duckworth et al., 2007; Eskreis-Winkler et al., 2014). The existing literature was evaluating how grit's relationship to retention is predominantly organized into military and academic contexts.

***Military retention*.** Grit was first examined in a group of six seminal studies. One of these studies mentioned earlier evaluated the US Military Academy at West Point to study grit as a predictor of retention in the first-year training program for recruits (Duckworth et al., 2007). The researchers compared grit scores to what is referred to as a Whole Candidate Score at West Point to evaluate retention. The Whole Candidate Score

is a composite score of performance that includes scores for high school rank, SAT score, leadership potential, physical aptitude, self-control, academic GPA, and military performance. However, in using this score, the staff at West Point was unable to determine why a certain percentage of candidates dropped out each year. Therefore, they measured grit to find that it was a better and stronger predictor of retention than any other factor (Duckworth et al., 2007). Kelly et al. found additional support for retention at West Point by comparing grit, hardiness, and attrition over four years (2014). Only grit predicted attrition across the four-year graduation rate (Kelly et al., 2014).

In one other military setting, retention was predicted using grit scores. Army Special Operations Forces (ARSOF) members were evaluated on intelligence, education, physical fitness, and grit to define the best determinant of retention (Eskreis-Winkler et al., 2014). They were put through a rigorous program, intended to retain the grittiest qualified members. Gritty individuals were found to be more likely to complete the course, even when controlling for intelligence and physical fitness (Eskreis-Winkler et al., 2014).

Additionally, researchers analyzed the predictability of retention and grit compared to the predictability of the whole candidate score and the Big Five (Duckworth et al., 2007; John & Srivastava, 1999). Cadets completed the grit scale and the conscientiousness subscale of the Big Five, which would be analyzed with retention rates throughout the first summer at West Point. After the summer ended, the study's results indicated that grit and conscientiousness were related; however, grit was the stronger of the two when it came to predicting retention (Duckworth et al., 2007). Later, those researchers found that cadets were 99% more likely to finish the summer training if they

scored at least one standard deviation above the mean on the grit scale (Grit-S; Duckworth & Quinn, 2009).

Academic retention. Another instance where grit predicted retention was in the 2005 Scripps National Spelling Bee. Duckworth et al. measured grit for 175 finalists (2007). The results suggested that grittier students studied longer than their peers, worked harder than their peers, and were retained in the spelling bee longer as a result. In another study, high schoolers were tested for their grit level in addition to gender, race, socioeconomic status, school safety, and social support. Grit correlated to retention, as grittier individuals were less likely to drop out of life commitments.

As these studies demonstrate, grit has been related to retention many times over. Being able to draw that relationship holds value for employers in organizations, as the cost of hiring new employees remains high. If gritty employees stay longer at their jobs, then hiring gritty employees might help mitigate the turnover rate in many organizations.

Achievement and performance.

Grit has been shown to aid persistence in effort with a goal of interest and be a mechanism that contributes to fully completing that goal. Although completion is essential, grit can also be related to success and achievement, which will be described, justifying the present study to evaluate achievement in an organizational context.

Academic success. Research on grit has not been exclusive to military retention and success but has also been a means of predicting academic success. In one study, elementary, junior high, high school, and college students who scored higher on the grit scale were all shown to have a greater likelihood of graduating and having higher grades (Duckworth & Quinn, 2009; Eskreis-Winkler et al., 2014). Additionally, adults over the

age of 24 tended to have higher degrees and scored higher on grit scales by one standard deviation over their peers (Duckworth & Quinn, 2009). Overall, people with higher grit scores of all ages had higher educational achievement, and people with more grit worked harder toward their achievements than individuals with low grit scores (Duckworth & Quinn).

Sports success. Sporting events with equally talented individuals reveal differences accounted for by other factors, such as effort. In one study, performance was evaluated from a sports perspective, which is a logical outcome for athletic studies, as it measures success in the given sport (Larkin et al., 2016). In this example, grittier players practiced more hours than those who scored lower on the grit scale. The group that scored higher on grit also performed better on perceptual-cognitive activities (e.g., decision making, situational probability, pattern recognition; Larkin et al., 2016). Interestingly, perceptual-cognitive activities have been shown previously in research to discriminate between skilled and less-skilled performers (Farrow, McCrae, Gross, & Abernethy, 2010). Though there are minimal studies conducted on sports success because of the newness of the grit construct, more research has been done in the workplace domain.

Workplace success. Within the workplace, performance among employees is another way to evaluate the utility of the grit construct and its relationship to outcomes. In the educational realm, teachers are generally evaluated on their performance in maintaining high educational standards. In one study, novice teachers were evaluated specifically, as researchers assumed that they had no prior work experience and might be more likely evaluated without the interference of years of previous teaching skill (Duckworth et al., 2009). The researchers looked for positive predictors of teacher

effectiveness by testing grit, life satisfaction, optimistic explanatory style (attribution), and found that grit and life satisfaction are both contributors to teacher effectiveness. Additionally, because those teachers were novice and lacked experience before the study, the effect of grit on their performance was likely due to their effort (a component of grit) as opposed to prior development of teaching skill, further supporting the idea that grit can positively influence performance in the workplace (Duckworth et al., 2009).

In another instance, researchers evaluated why some entrepreneurs were more successful in their business ventures than others (Mueller et al., 2017). They found that grit is related to their venture success, which suggests that some entrepreneurs can persist in the face of difficulties and setbacks better than others. In channeling passion into continual goal pursuit, entrepreneurs were able to increase their performance at their respective businesses (Mueller et al., 2017). In sum, workplace outcomes such as retention and performance are essential; grit may be an additional puzzle piece that helps researchers and practitioners better-understand how to influence and maximize performance.

The nomological network that has been created thus far in grit's short history has been reviewed extensively above. Now that grit has been conceptualized and related to other constructs, the outcome of interest, job performance, will be explained in detail. Job performance will be defined, described, and given descriptions in a context relevant to selection.

Job Performance

Definition of job performance.

Job performance has traditionally been defined as observable behaviors that people exhibit that are significant to achieving organizational goals (Campbell, McHenry, & Wise, 1990). Later, performance became more about individual behaviors that lead to results rather than the results themselves, as the behaviors could be measured and evaluated to influence the outcomes (Campbell, McCloy, Oppler, & Sager, 1993). To understand job performance, one must require an understanding of an organization's goals and understand how employees should contribute to those goals. Performance consists of goal-related actions that are controlled by the individual and can be measured by an individual's proficiency or level of contribution to the goal (Campbell et al., 1993).

Performance management systems are used to measure employee performance. Performance management systems usually include measures of two things: behaviors (what an employee does) and results (the outcomes of the behavior; Campbell et al., 1993). The definition of performance does not include the results of the behaviors but the behaviors themselves, which is more important to measure than the outcomes or products themselves, when it comes to performance management.

Performance taxonomies. There are additional characteristics of the behaviors that are labeled as performance (Motowidlo, Borman, & Schmit, 1997). First, behaviors can be evaluative, which means that they can be judged as negative, neutral, or positive at the individual and organizational levels. Second, performance is multidimensional (Murphy & Shiarella, 1997). This means that there are many kinds of behaviors that can advance or hinder organizational goals.

Although there are many taxonomies and conceptualizations within the organizational literature, a significant one is Campbell's eight-dimension taxonomy of major performance. Its components are job-specific task proficiency, non-job-task-specific proficiency, written and oral communication task proficiency, demonstrating effort, maintaining personal discipline, facilitating peer and team performance, supervision and leadership, and management and administration (Campbell et al., 1993). Another popular taxonomy is from Borman and Motowidlo (1997), who described performance as relating to a task (related to the job description) or contextual (outside the job description) performance. Sinclair and Tucker (2006) included all four dimensions of task, citizenship, counterproductive, and adaptive performance in their taxonomy. The number of taxonomies seeking to understand performance are plentiful, but those are some of the more recognized taxonomies for performance.

Criteria.

Understanding the dimensions and taxonomies of performance helps to determine the important predictors of job performance. Using individuals' knowledge, skills, abilities, and other characteristics (KSAOs) combined to create a set of competencies that I-O psychologists use to predict performance (see Campion et al., 2011, for a review). Potential performance can only be determined before hiring an employee by using assessments and methods to identify benchmarks prospective employees should employ for optimal performance. Over the years, I-O psychologists and researchers have debated different methods for selecting employees based on approximations of how employees perform. Some of the most popular methods are by using interviews, biodata, personality tests, intelligence tests, integrity tests, and references (Breaugh, 2009; Ispas, Ilie, Iliescu,

Johnson, & Harris, 2010; Ones, Viswesvaran, & Schmidt, 1993; Schmidt & Hunter, 1998). Choosing employees based on their test scores has been one of the oldest methods in organizational research (Cascio & Staiger, 2012). Using test scores as an indicator of an outcome occurs when scientists and practitioners create tests that adequately measure the constructs that they are interested in measuring.

Measurement and the criterion problem. The importance of measuring the appropriate criteria originated in 1917 with Scott, while more recently, the focus is on the "necessary, conceptual, taxonomic, and methodological prerequisites for…understanding criteria" (Austin & Villanova, 1992, p. 836). As such, there is a significant need for well-developed criteria to measure performance appropriately. Performance criteria can represent the aspects of performance that stakeholders find to be critical to the job, meaning that the criteria are subjective to whatever conceptual schema is valued (Nagle, 1953).

However, there is what is famously known as 'the criterion problem' (Austin & Villanova, 1992) in measuring performance, which is associated with developing and measuring the multidimensional nature of performance criteria given certain situational factors and limitations (Flanagan, 1956; Smith, 1976). This problem is exhibited, although complications in data analysis such as errors with halo bias, distributional errors, among other errors that prevent criteria from being accurately measured (Borman, 1991).

Performance management systems. Although for over a century, substantial research regarding performance management has been conducted; some researchers note the insufficient amounts of useful performance management recommendations from

academic studies (see DeNisi & Pritchard, 2006, for a review). The fidelity of performance management systems depends upon the closeness of the operational situation (what we believe is occurring) to the actual situation or, more clearly, the reflection of the performance management system to the actual environment (Hays & Singer, 1989). One issue to examine relating to fidelity is the relationship between and differences of typical and maximal performance. Maximal performance is the highest level of performance possible that a person can achieve under ideal conditions, while typical performance is the average daily performance (Mangos & Arnold, 2008). There can be some differences between employees who are appraised under their maximal performance, while others may have had a typical performance.

Individual performance.

Now that criteria have been examined, other aspects of performance will be discussed as to how they affect individual (as opposed to organizational) performance. Some types of individual performance include organizational citizenship behaviors, contextual performance, adaptive performance, and counterproductive work behaviors. Understanding these wide ranges of behaviors clarifies the measurement of performance as it relates to grit.

Job performance behaviors. As mentioned earlier, Campbell identified eight job performance behaviors in his factor analytic research. The first factor is job-specific task proficiency, which explains the tasks that are the core requirement of employee jobs. Next, he identified non-job-task-specific proficiency, which are tasks that are not part of that specific job the person is doing. The third job behavior is written and oral communication task proficiency, which describes how adept an employee is at

communicating information at work. Fourth, he identified demonstrating effort, which describes the degree to which a person commits to the job tasks. The fifth factor is maintaining personal discipline, which alludes to how well the person can follow the rules and laws. Sixth, facilitating peer and team performance describes how willing an employee is to help other colleagues. Seventh, supervision and leadership describe how much a person might be willing to take informal leader roles while having reward/punishment type agreements with others. Finally, management and administration related to how well a person can set organizational goals and perform at a higher organizational level for the job (Campbell et al., 1990).

Organizational citizenship behaviors. Performance is also based on organizational citizenship behaviors (OCBs), which delineate from the task versus contextual performance discrimination mentioned earlier (Borman, Penner, Allen, & Motowidlo, 2001). In that case, contextual performance is where OCBs are organized, as they are not technically part of the job description, but contribute to individual job performance. According to Borman, contextual performance and OCBs can even be the same entity (2004). Another researcher believes that there are seven types of citizenship behavior: helping behaviors (helping others with work-related problems), sportsmanship (having positive attitudes), organizational loyalty (endorsing and defending the organization), organizational compliance (accepting the rules and procedures), individual initiative (doing more than the minimal requirements), civic virtue (having a high-level commitment to the organization, and having self-development (having behaviors that improve the overall performance).

Contextual performance. Similar to citizenship behavior, contextual performance is also an unofficially recognized part of work performance that is not a formal part of job responsibilities. Despite not being a formalized work task, contextual performance contributes to effectiveness; it can contribute to effectiveness by impacting psychological, social, and organizational contexts. According to Borman and Motowidlo, the uniqueness of contextual performance is that it encompasses both OCBs and prosocial work behaviors, which are voluntary behaviors intended to benefit another at work (1997; Motowidlo, 2003).

Adaptive performance. Although adaptive performance is not defined in Campbell et al.'s (1993) list of dimensions, it is mentioned in other models of individual performance. According to Pulakos, Arad, Donovan, and Plamondon, adaptive performance assesses how well individuals can adjust to or adapt to new conditions or unexpected job requirements (2000). This type of performance could perhaps be related to the outcomes of gritty individuals who have been faced with new or difficult tasks to overcome.

Counterproductive work behavior. One final type of individual performance to be discussed is counterproductive work behavior (CWB). Unlike the other types of performance, CWBs are detrimental to a person's performance ratings, as opposed to adding to their overall performance. CWBs have been defined as unfavorable, dysfunctional behaviors that are intentional and usually contrary to the interests of the organization (Sackett, 2002).

Measuring performance.

Since many different types of performance are conceptualized differently, there are many ways to measure performance. The way that performance is measured is essential because it will determine whether multiple criteria or a single composite criterion can be used (Wildman, Bedwell, Salas, & Smith-Jentsch, 2011) The most common reason for performance management are to do research, for feedback and development of employees, and evaluation of performance (Wildman et al., 2011). A few ways to do so will be mentioned below.

***Performance appraisals*.** One of the most commonly used methods of measuring performance in organizations is by using performance appraisals (Wildman et al., 2011). Performance appraisals are usually feared by many employees, as they are commonly known as the annual review, where an employer sits down with each employee to review his or her performance over the past year (Fletcher, 2001). This type of performance measurement has been widely criticized for being ineffective because it focuses on the wrong work behaviors and consequentially is tied to salary decisions (Rynes, Gerhart, & Parks, 2005).

***Multiple-source ratings*.** Multiple-source ratings are also known as 360-degree feedback, as a review of an employee comes from more than one person, and ideally from multiple levels of coworkers (i.e., subordinates, coworkers, leaders; Wildman et al., 2011). The additional utility of this type of performance management is that less bias exists because a more holistic view of a person is reviewed while it allows monitoring and seeing a variety of work behaviors.

***Objective measures*.** Objective measures include data that do not have any subjective ratings attached to it. They usually include data such as the number of absences a person might have, numbers in sales (where applicable), or any disciplinary action that has happened at work (Borman, 1991).

***Job knowledge and work sample tests*.** Job knowledge tests may be given at any job where recallable information may be relevant to the work. Work sample tests will test more of the deductive skills to achieve some goal (by showing how to work through a problem). These two types of tests are useful for jobs that are selecting people who may need to have lots of declarative and procedural knowledge (job knowledge) or for those who must know how to solve particular problems (work sample tests; Wildman et al., 2011).

Although there are other forms of measuring performance, these are a few of the most common ways. Performance is important because of how it applies to the selection and how it might impact the type of employees that are affecting the overall organizational output. Given this review of performance, it is clear that performance is a valuable piece of information for researchers in I-O psychology to use as a benchmark for success. Knowing this, relating grit to performance is a clear next step to identify whether grit can predict performance and will justify the utility in measuring grit in employees.

Predicting Performance in a Selection Context

Because there is no literature tying grit directly to employee performance from a selection perspective, exploring research connecting employee performance to the grit domain could reveal more about how grit relates to other outcomes. Researchers identified that intelligence is responsible for predicting job success (Furnham, 2008;

Schmidt & Hunter, 1998). However, cognitive ability was only found to be a portion of the variance, leaving more individual differences to be explored for influence on job success (Chernyshenko et al., 2011). Specifically, I-O psychology could benefit significantly from researching the performance of employees with varying levels of grit, as grit has been found to predict other positive outcomes for individuals (e.g., De Vera et al., 2015; Duckworth et al., 2007; Eskreis-Winkler et al., 2014). Because conscientiousness is such a positive predictor for performance in the realm of I-O psychology, it may also help further to examine the relationship between grit and conscientiousness for clarity. Perhaps using a measure that is more closely related to conscientiousness would help explain that relationship.

Personality in selection.

Meta-analyses in the 1990s, evaluating the personality-job performance relationship increased the popularity of measuring personality for use in selection (Barrick & Mount, 1991). Recently, personality testing has been increasingly employed as using personality tests is becoming a standard method of scoring applicants for its ease and abundance of predictive and descriptive information (Carter et al., 2014). Executives at companies such as Xerox are spending upwards of $3.8 billion per year to use talent management software that includes personality testing (see Walker, 2012). Given that personality testing has become so prominent, the implications of using it in the selection must be entirely understood.

The relationship between personality and performance has been debated for decades, as results have been inconclusive on whether a relationship exists (see Morgeson et al., 2007). Other researchers have found that personality becomes more

relevant to task performance when the trait is directly related to the situation or job demands (Barrick & Mount, 1991; Hogan & Holland, 2003). These results are suggestive of evaluating how grit relates to performance; appraising long-term goals and dedication to completing them measure a trait and relate it to a particular aspect of performance. Despite the inconsistencies in research relating to performance and personality, decisions are made based on the results. Perhaps researchers are too narrowly focused on the linear relationships between personality and performance, and instead, researchers should investigate whether a curvilinear relationship exists (Ones, Dilchert, Viswesvaran, & Judge, 2007).

Grit-performance relationship.

Grit has been linked to many successful outcomes, but only a couple of studies have evaluated it as it relates to a performance outcome. In one study, researchers evaluated what non-cognitive predictors of performance influenced military cadets and their performance at West Point. They found that grit effort not only helped forecast academic performance but also it also contributed to a unique predicting variance in physical performance (Kelly et al., 2014). The authors noted that grit was a significant contributing factor to predicting both performance and retention and suggested that grit be used in addition to other indicators to measure performance (Kelly et al., 2014).

In another study, novice teachers were evaluated to determine if grit effort would influence their performance (Duckworth et al., 2009). The researchers found that grit was a contributor to teacher effectiveness. As mentioned previously, because the teachers were novice and lacked experience before the study, the effect of grit on their performance was likely due to their effort - a component of grit – differing from other

predictors such as teaching skill, determining that grit can influence performance in the workplace (Duckworth et al., 2009).

The relationship between grit and performance may be impacted similarly as conscientiousness or other personality dimensions (Credé et al., 2017). The relationship may not be linear, as many researchers have suggested that there may be such a thing as having too much grit (e.g., Credé et al., 2017; Lucas, Gratch, Cheng, & Marsella, 2015). In Lucas et al.'s research, grittier participants were found to be less willing to give up when failing even though they might incur a cost for their performance (2015). Additionally, they found that individuals scoring higher in grit invested more effort and persistence into tasks that were not going well. The grittier participants would also commit longer to tasks, even when given feedback that they were failing (Lucas et al., 2015). There may be contexts where grit begets lower achievement. In some cases, grit could influence counterproductive performance among employees, which is why the grit level should be explored further (Duckworth & Eskreis-Winkler, 2013).

Grit level.

The meta-analysis of Credé et al. discussed that the level of grit itself might vary based on the level of the relationship between grit and performance (2017). The study concluded that very high levels of grit might hinder performance, especially if they reduce the likelihood of help-seeking behaviors that have been linked to performance. Additionally, if a person increases the amount of commitment to a goal (become 'too' gritty) to solve a particularly tricky problem, then he or she may miss out on choosing a more attainable alternative (Credé et al., 2017). In sum, Credé et al. believe that grit interventions might not always be the best solution for performance problems, as having

too much grit may be as detrimental as having too little. However, more evaluation of grit level is needed to understand the relationship between grit and performance outcomes truly.

Measuring predictors of performance.

Lower performance ratings sometimes occur for employees who rank exceptionally high on conscientiousness because their attention to detail inhibits them from completing tasks promptly (Carter et al., 2014). Similar to studies in conscientiousness, a methodology should be employed to evaluate whether there is a threshold of acceptable grit, as well as whether there is a threshold beyond which performance is inhibited. Additionally, Carter et al. (2014) charged other researchers to evaluate how personality relates to performance so that measurement models could better-specify the relationships used. Because grit is considered a facet of conscientiousness, measuring grit as it relates to performance would satisfy that call from the researchers (Carter et al., 2014).

Hypotheses

Given the current review of the literature, a set of hypotheses for the present study is described below. One issue in the grit literature has been the measurement model for the construct. Duckworth et al. (2007) and Duckworth and Quinn (2009) have reported evidence of a two-factor model in which passion for long-term goals and perseverance are each measured by six items (Grit-O) and four items (Grit-S), respectively (see Appendices A and B). That said, Duckworth and Quinn (2009) described grit as a higher-order construct in which these two factors operate at level one and combine into a second-order construct, overall grit. However, some of the fit statistics they reported for

the model were not considered acceptable, especially for the Grit-O scale (see the review of their studies in the Instruments section; Hu & Bentler, 1999).

Additionally, evidence reported by Credé et al. (2017) indicated that grit might not be a higher-order construct. Credé and colleagues reported that combining the scores from the two factors decreased the relationship with performance. They suggested revisiting the validity of the grit measurement model (Credé et al., 2017).

Hypothesis 1a

> *Hypothesis 1a: Once models with good fit have been identified, the model fit will be better for a second-order measurement model consisting of two first-order factors (passion and perseverance) and a single, second-order factor (overall grit), as measured by indicators from the Grit-S instrument, than the alternative model consisting of two first-order factors (i.e., Model 2 will have a better fit than the model in Model 1).*

The first hypothesis (1a) is consistent with the conclusion by Duckworth and Quinn (2009) that the appropriate measurement model for grit consists of a second-order model with two first-order factors and one overall second-order grit factor. This model of grit has been the predominant model since the publication of Duckworth and Quinn in 2009 (Credé et al., 2017). In prior research, models for the Grit-S scale have demonstrated better fit than models of the Grit-O (Duckworth & Quinn, 2009). As a result, the current investigation will compare the first- and second-order factor structures using the Grit-S scale (Duckworth et al., 2007; Duckworth & Quinn, 2009).

The two measurement models to be tested in Hypothesis 1a are depicted in Figures 1 and 2. Both models reflect existing models from Duckworth and Quinn (2009).

Model 1 is an eight-item, first-order model of the Grit-S with passion and perseverance as the two first-order factors. Model 2 is an eight-item, second-order model of the Grit-S with grit as an overall second-order factor consisting of passion and perseverance as first-order factors of grit. Each model will be tested for appropriate absolute fit (e.g., X^2, RMSEA) using the criteria and cutoff scores mentioned in detail in the analytical procedure section. Models that meet appropriate standards of fit can then be compared using their AIC values, such that the lower AIC model is used as general models with the lowest AIC values are judged to fit the data better as compared to other solutions (Ray & Brown, 2015). Based on the previous literature by Duckworth and Quinn (2009), the second-order model with two first-order factors and one second-order overall grit factor, in Figure 2, is expected to be the better-fitting model of the two.

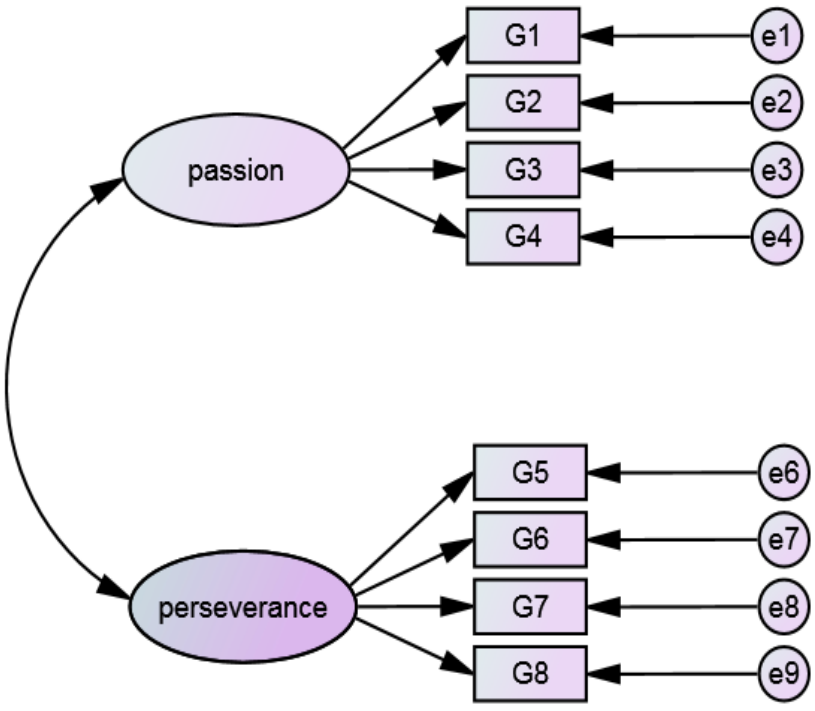

Figure 1. Model 1: First-order, two-factor Grit-S proposed model

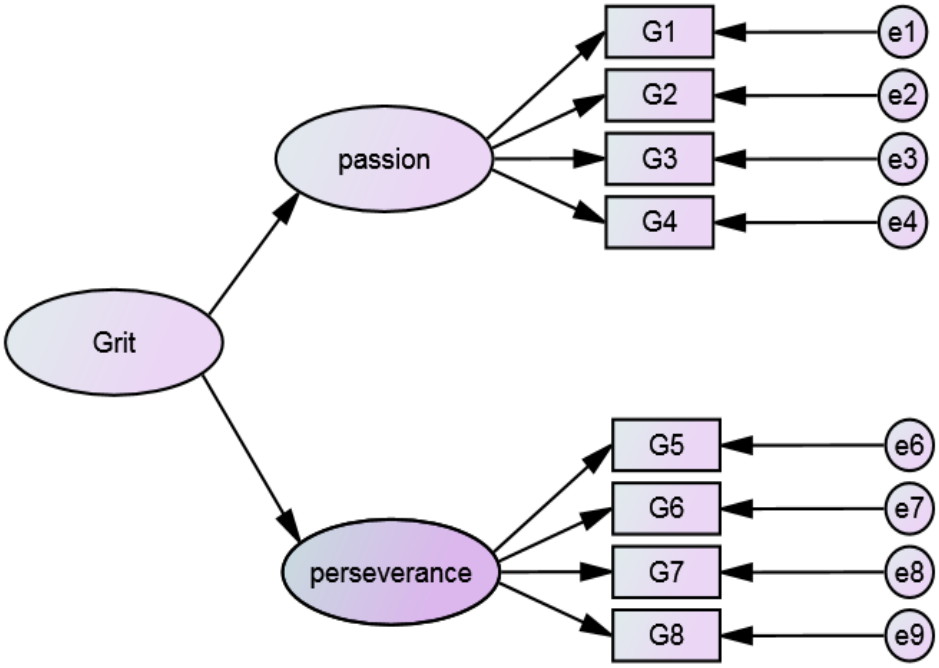

Figure 2. Model 2: Second-order model with two first-order factors and one second-order overall grit factor, Grit-S proposed model

The best model identified in Hypothesis 1a will be used in a subsequent comparison of the best model from Hypothesis 1b. If only one of the models tested has an acceptable fit, then that model will be the one used in later analyses. If both models have acceptable fit, then the model with the lowest AIC value will be accepted as the best model for this group, as it aids in comparing and ranking models (Akaike, 1987; Burnham & Anderson, 2004).

Hypothesis 1b

Based on prior research and recommendations from critics of grit, an alternative group of models will be explored for model fit (Credé et al., 2017; Johnson, 2000). As mentioned previously, a valid and commonly-used assessment of facet-level personality will be explored as an alternative means of conceptualizing grit. SMEs will rate which

facets and corresponding facet-level items might closely align with grit. Those facets will be compared in the three models described in more detail in the Method section. As the factor-level personality construct conscientiousness (Carter et al., 2014) has a relationship with grit and self-control (Credé et al., 2017), it may be inferred that some combination of facets will have a relationship with grit as well. However, no published research to date has explored if the personality items at the facet-level have a relationship with grit.

In this study, it is expected that the items and facets chosen by SMEs from factors of the five-factor model would map most successfully onto the following model: the facets from the FFM are first-order factors, and grit is a single second-order factor. An alternate model (based on Duckworth and Quinn, 2009) is not expected to fit as well; the alternate model will consist of the SME-selected FFM facets as first-order factors and two second-order factors (passion and perseverance). For this model, SMEs will be given the theory and definitions of the structure used for Duckworth and Quinn's (2009) grit framework, as seen in Model 2. Using the model as well as the definitions for grit, passion, and perseverance, SMEs will be instructed to make choices based on relevance (relevant, not relevant) to determine which FFM factors (facets) map best onto the passion and which map best onto perseverance. Results from the CFA will determine the fit of the model in which IPIP-NEO facets are mapped onto the grit factors.

> *Hypothesis 1b: Model fit will be better for a second-order measurement model with several first-order factors consisting of facets and indicators from the IPIP-NEO chosen by the SME and one second-order factor (Model 3) than either a) a second-order model consisting of first-order factors consisting of facets and indicators from the IPIP-NEO chosen by the SME panel and two second-order*

factors (passion and perseverance; Model 4) or b) a third-order model consisting first-order factors consisting of facets and indicators from the IPIP-NEO chosen by the SME panel, two second-order factors (perseverance and passion), and a single third-order grit factor (Model 5).

This hypothesis is supported by work by Credé et al. (2017) in which they concluded that the practice of combining perseverance scores and passion scores into an overall grit score appears to result in a significant loss in the ability to predict performance. The inference being that a model in which grit is depicted as a single second-order factor may be superior to one in which grit consists of two separate second-order factors (passion and perseverance) when the first-order factors in both models are IPIP facets.

The three measurement models to be tested for Hypothesis 1b and the corresponding figure are summarized in Table 2. For simplicity, five facets from the IPIP have been used in Figures 3-5 as placeholders.

Table 2

Description of IPIP Items and Factors

Figure/Model Number	**Items / Indicators**	**First-Order Factors**	**Second-Order Factor(s)**	**Third-Order Factor**
3	Items from the IPIP facets selected by SME panel	Five facets from the IPIP	Grit	None
4	Items from the IPIP facets selected by SME panel	Five facets from the IPIP	Passion Perseverance	None
5	Items from the IPIP facets selected by SME panel	Five facets from the IPIP	Passion Perseverance	Grit

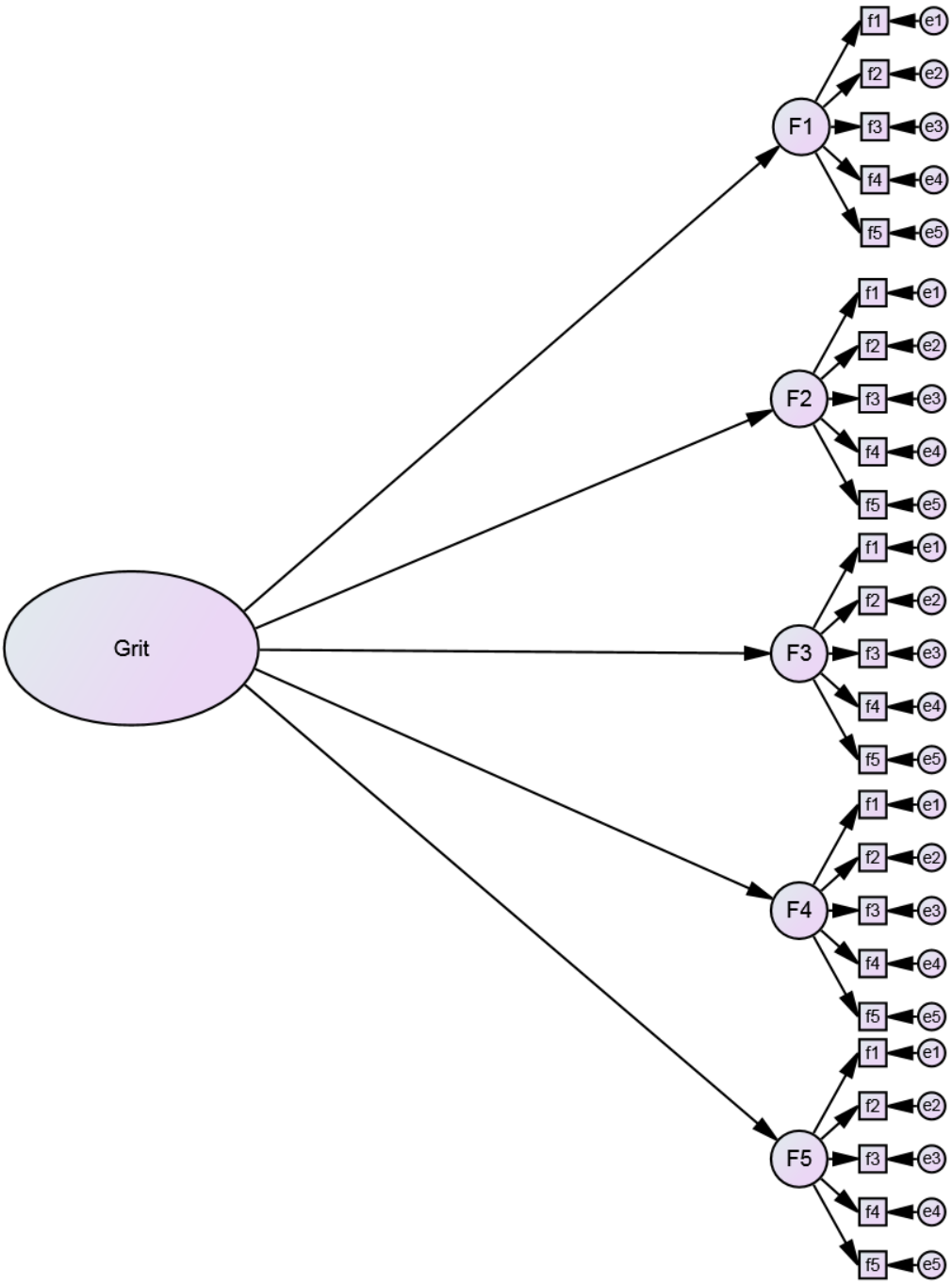

Figure 3. Model 3: Second order model, consisting of one second-order overall grit factor and several first-order factors representing facets and indicators from the IPIP-NEO

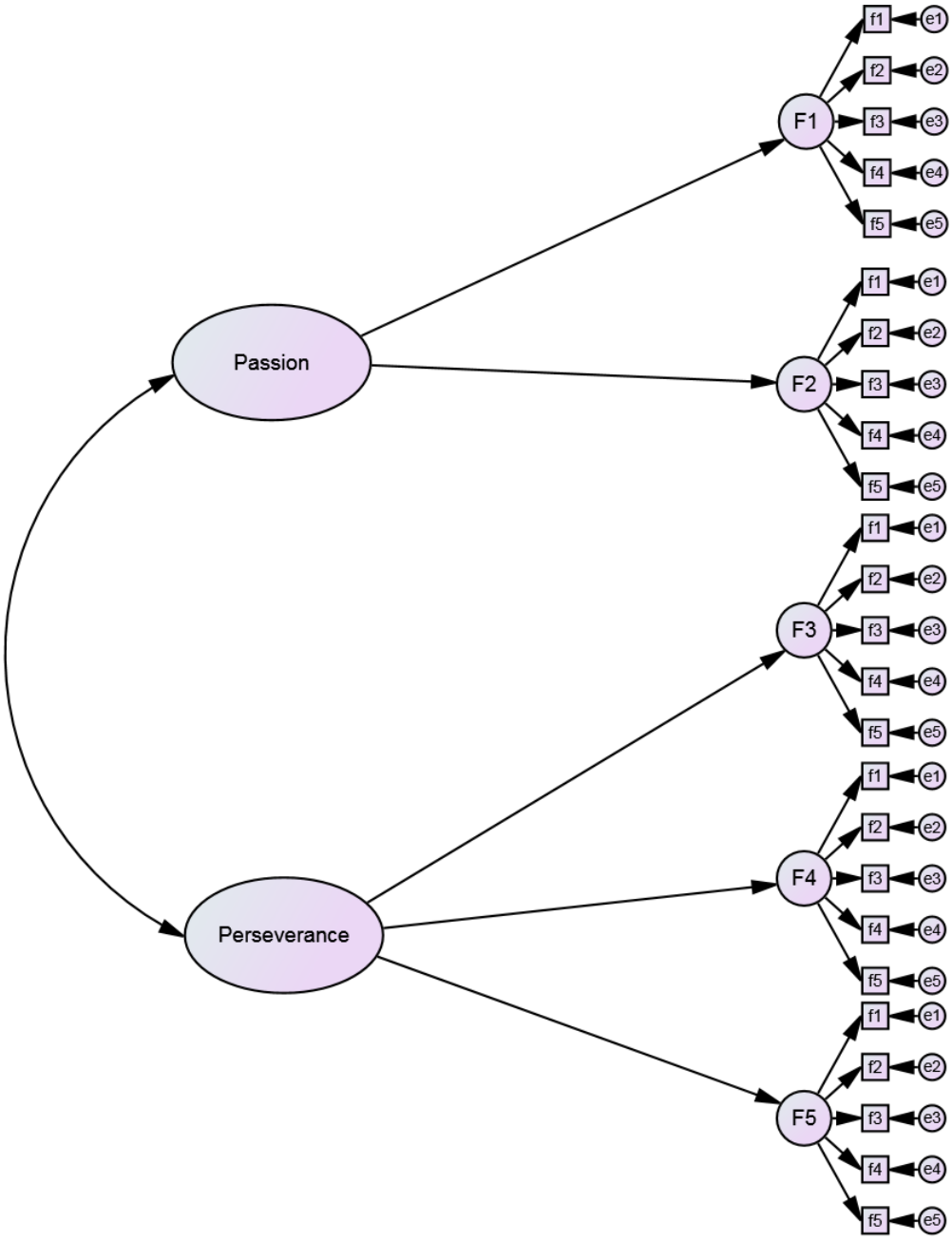

Figure 4. Model 4: Several first-order factors consisting of facets and indicators from the IPIP-NEO chosen by the SMEs and two second-order factors, passion and perseverance

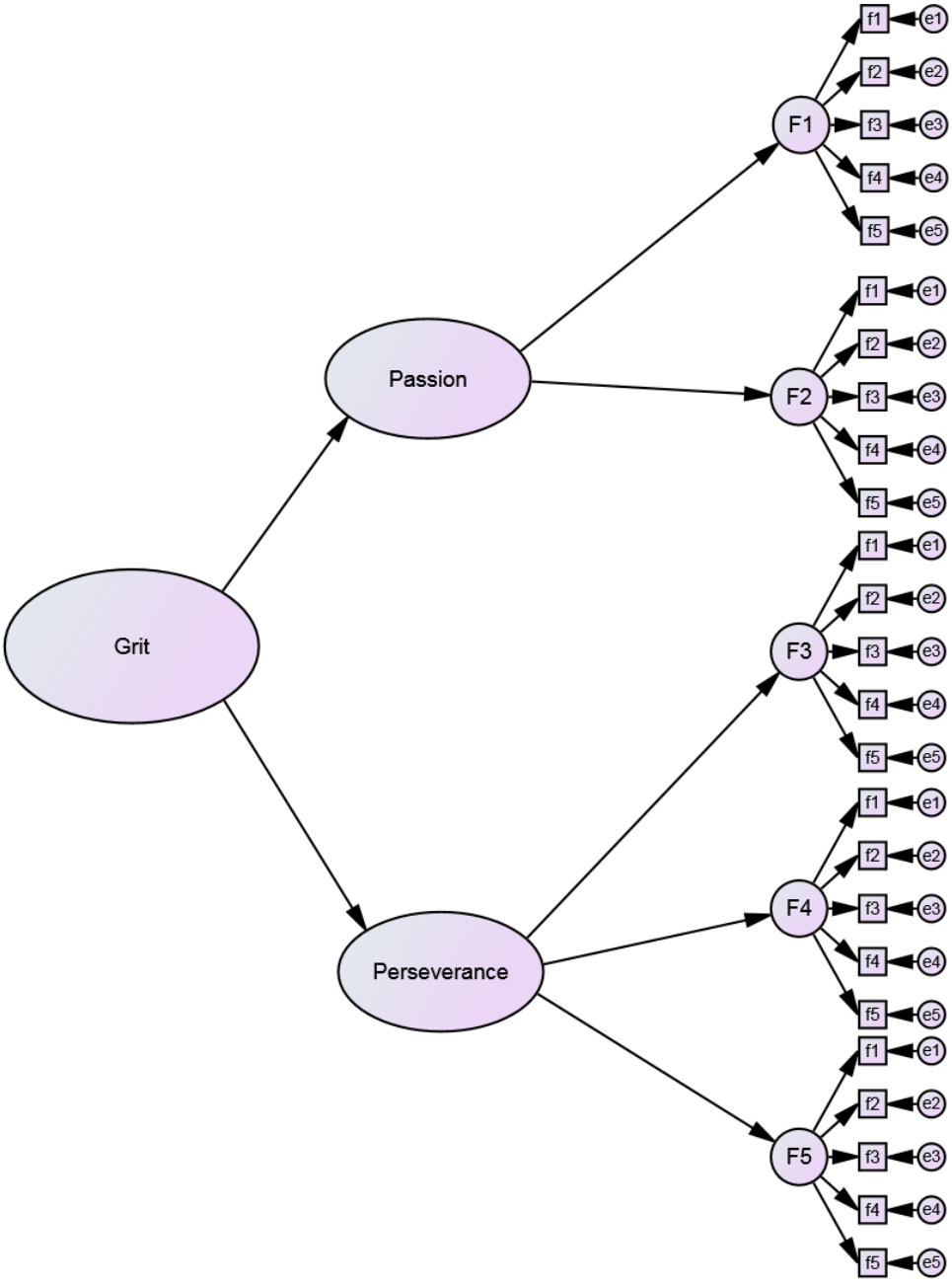

Figure 5. Model 5: Several first-order factors consisting of facets and indicators from the IPIP-NEO chosen by the SMEs, with two second-order factors, passion and perseverance, and one overall third-order grit factor.

Model 3 depicts a model of grit that consists of one second-order factor and facets from the five-factor model IPIP as first-order factors. Model 4 represents a model of grit that consists of two second-order factors (passion and perseverance) and facets from the

five-factor model IPIP as first-order factors. Model 5 depicts a model of grit that consists of one third-order grit factor, two second-order factors (passion and perseverance), and facets from the five-factor model IPIP as first-order factors. In all three models, items from each IPIP facet are indicators of each first-order factor.

Using the IPIP facet-level items proposed by the author and revised based on input from the SME panel followed by three confirmatory factor analyses (CFAs) will be conducted to assess the fit of the three proposed measurement models for how the IPIP facets and items map onto the grit construct. The analyses seek to confirm which model of grit best approximates the latent construct. The exact number of facets were not being determined until the SME results of their feedback on most relevant to the grit construct.

Each of the three models will be tested for appropriate fit (e.g., X^2, RMSEA, CFI) using the criteria mentioned in detail in the analytical procedure section. Models that meet appropriate standards of fit can then be compared using their AIC value, such that the lower AIC value has a better fit. Figure 3 is the model hypothesized to have the best fit, as it is more parsimonious than the other two.

Once the model with the best fit from each step of Hypothesis 1a is determined, the model with the best fit from 1b will be compared to 1a, and the best-fitting model as based on the lower AIC will be used (Steiger, 2007). If none of the models demonstrate adequate fit, the analyses will nonetheless continue. The rationale for proceeding is that the current study is just one piece of evidence concerning the validity of the grit construct and its measurement, and therefore should not negate prior evidence (although mixed) that the Grit-S scale does measure the grit construct (e.g., Credé et al., 2017). Therefore, the measurement model with the best fit will be the one used to test the remaining

hypotheses. If no models achieve an acceptable fit, then Duckworth and Quinn's (2009) model will be used as it has been prevalent in the grit literature with support for its success as a measure in other studies.

Hypothesis 2

Prior research has indicated that grit may be predictive of performance (Duckworth et al., 2009; Kelly et al., 2014). When evaluating grit and work performance, a positive relationship between grit and performance is expected, as it has been seen in previous research. First, the grit and performance relationship will be assessed to determine if a linear relationship exists. This relationship is expected to exist because of prior evidence in the literature (Duckworth et al., 2007; Duckworth & Quinn, 2009; Kelly et al., 2014).

Hypothesis 2: Grit will positively predict performance in a linear fashion.

Hypothesis 3

Researchers have also debated whether the shape of the grit-performance relationship is linear, as reported in early studies of the construct (Credé et al., 2017; Duckworth & Quinn, 2009; Eskreis-Winkler et al., 2014). There has been an emerging trend in organizational research to examine whether the relationships between seemingly desirable traits and performance may be nonlinear, such that extremely high levels of some characteristics are associated with lower, not higher, performance (Pierce & Aguinis, 2013). Research on the relationship between conscientiousness and performance is an excellent example of this line of inquiry (Carter et al., 2014): the authors reported that the functional form of the relationship between conscientiousness and performance was a curvilinear, inverted U-shaped curve, such that trait with positive outcomes did

have a breaking point in which higher levels of conscientiousness no longer predicted performance after a certain point (Carter et al., 2014). A model described by Carter et al. (2014) incorporating a quadratic term accounted for a more significant percentage of the variance than a simple linear model and found that a moderate amount of conscientiousness resulted in the most effective outcomes. As grit was found to be correlated to global conscientiousness and one of the conscientiousness's facets, self-control, the present researcher seeks to determine if this relationship exists for grit and performance as well (Credé et al., 2017). The third hypothesis reflects the call to examine the shape of the relationship between grit and performance.

Hypothesis 3: A curvilinear, inverted u-shaped model (i.e., a model that incorporates a quadratic term) will be a significant predictor of performance.

Hypothesis 4

The proposed curvilinear relationship between grit and performance is such that a moderate level of grit is associated with higher performance than either low or high levels of grit. In this case, a higher percentage of variance will be explained for the curvilinear relationship than the linear relationship.

Hypothesis 4: A curvilinear, inverted u-shaped model (i.e., a model that incorporates a quadratic term) will be a better predictor of performance than a simple linear model.

CHAPTER 2

METHOD

Participants

The regression sample consisted of employees at the headquarters of a sizeable commercial-services organization. Participation in this study was voluntary, and individuals could withdraw at any time without penalty. Participants were screened to include ages 18 and above, and participants who were full-time employees and were asked to respond to approximately 40 questions (descriptions of items are listed in the measures section). Based on a power analysis using G*power 3, a minimum of 138 participants was needed for regression analyses (Faul, Erdfelder, Buchner, & Lang, 2009). This estimate assumes a desired power of 0.95 at $p < 0.05$ and small to moderate effect size, based on benchmark recommendations of Faul et al. (2009).

One recommendation regarding sample size from the structural equation modeling (SEM) literature suggests that decisions be based on existing knowledge of factor loadings (Wolf, Harrington, Clark, & Miller, 2013). Given that factor loadings from the Grit-O obtained via CFA range from 0.44 to 0.77, their procedure results in an anticipated factor loading estimate of 0.65, which would require a minimum of 125 participants. Another recommendation suggests that using power at the 0.05 level; the CFA analyses are robust to a minimum sample size of 100 at that level of power, so approximately 100 participants were needed (MacKinnon, Lockwood, & Williams,

2004). In total, a minimum of 238 participants were needed to achieve appropriate power: 100 participants for the CFA analyses, and 138 participants for the regressions.

A minimum sample of 150 participants from Amazon's Mechanical Turk (AMT) was used to collect responses for the CFA. AMT is a crowdsourcing tool that is defined as "the paid recruitment of an online, independent global workforce for the objective of working on a specifically defined task or set of tasks" (p.801; Behrend, Sharek, Meade, & Wiebe, 2011). To achieve a minimum usable sample, at least 400 respondents were recruited for the CFA and the regression from the large commercial-services organization. Four hundred invitations should yield approximately 240 participants assuming an effective participation rate of approximately 60%, and achieve the desired level of power for familywise error, including the sample needed for the CFA and the sample needed for the regression.

Procedure

Permission from the Institutional Review Board (IRB) at Louisiana Tech University was obtained before the start of data collection. Participants were informed of the research opportunity through an email sent by management. The invitation also included a brief description of the study objectives, time commitment involved, information on confidentiality protections (data were de-identified upon reception), description of archival data accessed, and how the information was used. Participants were also informed in the invitation email that they could exit the survey at any time without penalty. The survey link was a single-use link that enabled the primary researcher to connect survey responses to participant performance data. The email described the project, introduced the primary researcher, and gave encouragement to participate while

communicating that participation was not mandatory. The invitation email notified employees that past performance data would be linked with survey results while still preserving confidentiality. A copy of email communications is provided in Appendix F. A second email was then sent from the primary researcher shortly after that included an invitation to participate and a unique survey link. The survey was conducted via Qualtrics, an online survey platform.

By clicking the survey link, participants were directed to the informed-consent page of the survey. The informed consent section described the types of questions that were included in the survey, including items regarding grit, personality (IPIP) items, and demographic characteristics, such as age and gender. The informed consent section assured participants that the information collected via the survey would not be used to make any personnel decisions, the employment opportunities made available to them, or any other circumstances impacting their career. Once consent had been obtained, participants were directed to the primary survey, which was expected to take less than ten minutes to complete.

After data collection, employee survey responses were linked to archival records of their performance by the research team. The email-invitation collector-attribute of Qualtrics was used; a customized email invitation was sent to each participant that tracks who responded. Once the data from both sources (survey and archival records) were linked, all identifying information about participants was removed by the management team within the company, and each participant was assigned a unique respondent identification code for the researcher's use. Only the primary researcher working in collaboration with a business partner at the host organization had access to the keyed

dataset that links each participant's company-identified (individual-linked performance metrics), and de-identified data. Participants who did not consent were able to opt-out of the survey at any time, and their data was not linked or used in any analyses.

Measures

Grit-S

Each participant's level of grit was measured using the Grit-S scale, an eight-item self-report instrument (Duckworth & Quinn, 2009). Responses to each item are on a 5-point Likert-type scale (1 = *not at all like me,* and 5 = *very much like me*). The Grit-S scale yields scores on two subscales: a passion for long-term goals and perseverance of effort (Duckworth et al., 2009). Scores on each of these two subscales were calculated as the average of four items. Items that are reverse scored (four items total) were recoded before conducting the analyses. The full version of the Grit-O and the Grit-S, including instructions, items, and response options, may be found in Appendices A and B. These scales are open to researchers and educators for open-use and do not require permission to use in this instance. The Grit-S has demonstrated evidence of overall internal reliability with a Cronbach's alpha of $\alpha = .82$ with both adult and children samples (Duckworth et al., 2009).

IPIP - NEO 300*i* Facets

First, the primary researcher used prior research associated with grit and other related constructs to determine which factors and facets conceptually overlap with grit based on descriptions and previous results. Of the facets that the primary researcher had identified theoretically-related facets from the IPIP, *self-discipline, striving, immoderation,* and *self-efficacy* as facets most closely relating to the conceptualization of

grit by (Duckworth et al., 2007; Johnson, 2005). As mentioned, the facets were chosen as they relate to the grit construct and its definition of passion and perseverance toward a long-term goal (Duckworth & Gross, 2014). *Self-discipline* is a facet of conscientiousness that describes the confidence in one's ability to accomplish things (Johnson, 2005). This facet has items such as "I complete tasks successfully," which aligns with the overall grit construct. *Striving* is a facet of conscientiousness that is described in individuals as who are driven to be recognized as successful and who use that drive to achieve lofty goals (Johnson, 2005). Striving has items such as "I plunge into tasks with all my heart," which overlaps with the passion facet of the grit construct. *Immoderation* is a facet of neuroticism that overlaps with grit in that it describes individuals who have strong urges that they have difficulty resisting. People who are high in immoderation will have more distractions, which may result in a negative relationship as it may derail from an individual's perseverance. Individuals who score low on immoderation do not experience strong cravings and do not find themselves tempted to indulge and would score on items such as "I easily resist temptations." *Self-efficacy* is a facet of conscientiousness that describes confidence in an individual's ability to accomplish goals. This facet has items such as "I complete tasks successfully," which aligns with the perseverance side of the grit construct. A list of the primary researcher's facets and their items are listed in Appendix C.

Next, a group of three I/O psychologists currently working in applied positions were identified as SMEs rated (separately) via a survey the IPIP facets whose items were used as new approximations of grit based on recommendations from De Vellis (2003). They were provided with a full definition of grit and the conceptualization of the two

factors described by Duckworth et al. (2007). They were allowed to ask questions about the grit construct to maximize their understanding of the grit construct. They were also asked to read through each set of facets for the IPIP found in Appendix D as provided by the primary researcher and rate agreement of each facet's relevance (relevant, not relevant) as recommended by De Vellis (2003). The reading and rating of IPIP facets were done by each SME independently after the initial meeting via a survey. Once they completed the rating task, the SMEs were allowed to reach out and ask any questions before submitting them.

Prior research has recommended using the decision rule of two out of three raters or majority agreement between SMEs to conclude there is consensus (Buster, Roth, & Bobko, 2005). For this research, the decision rule used to conclude the majority consensus was 75% agreement, based on three SMEs and the primary researcher. All personality facets were judged to be an indicator of the grit construct if three of the four raters agreed. There were enough facets rated above 75% not to require any conversations between the team; a consensus was reached separately. There were enough facets with 100% agreement on the grit construct to use as a new cutoff for the use of the facet for the overall grit factor.

Approximately two weeks later (to avoid any recall of their ratings from the overall grit factor ratings), SMEs were asked to repeat the task. However, instead of rating facets corresponding to grit, they were asked to first-rate according to passion, and then to rate again for relevance to perseverance. They were given each facet with a list of the corresponding four items and asked to rate each facet as relevant or not relevant for

each facet. As in the first overall grit rating task, items that reached 100% agreement for relevance (relevant, not relevant) were included in the new model for Hypothesis 1b.

Items representing each facet that the SME panel reached consensus about were included in the survey for participants. For the overall grit factor, the 100% agreement facets and linked four items were used in the CFA for a single factor, second-order model. These facets and corresponding items for the CFA, including an overall grit factor, included: s*elf-efficacy, self-discipline, orderliness, dutifulness, and achievement-striving.* Similarly, the facets identified with 100% agreement for the individual factor of passion were: *self-efficacy, immoderation, activity level, self-discipline, emotionality, adventurousness, achievement-striving,* and *anxiety.* The facets with 100% agreement identified for the individual factor of perseverance were: *self-efficacy, immoderation, activity level, achievement-striving, self-discipline,* and *intellect.* All items from each corresponding facet were identified for use in the proceeding analyses.

The items were drawn from Johnson's (2005) IPIP-NEO instrument covering 30 facets, each measured by four items. Responses to each IPIP item are on a 5-point Likert-type scale that asks participants to rate how well the statements apply to themselves (1 = *very inaccurate* to 5 = *very accurate*). Overall, the IPIP scale has demonstrated evidence of internal reliability with Cronbach's alphas at the facet-level scales being at least 0.71 or higher (Johnson, 2005). The questions, responses, and scoring information for the IPIP may be found in Appendix D.

Demographics

The survey concluded with demographic questions on experience level, age, gender, ethnicity, job category, and education. The demographic questions were used to

assess the representativeness of the sample. Demographic questions were the final set of questions on the survey for two reasons. The first reason is to minimize possible reactance, as previous research indicates that respondents feel psychological risk when given organizational surveys (Rogelberg, Spitzmüeller, Little, & Reeve, 2006). In asking demographic questions after the other questions, participants may be less likely to respond differently to the questions of interest (e.g., personality and grit items) as a response to seeing demographic questions. The second reason relates to the potential for participants to drop out of the study at any point; the more focal survey content (the grit and personality items) will precede the demographic questions as it is the information without which the proposed analyses cannot be completed. These questions can be found in Appendix E.

Performance Measures

Archival performance data were obtained from the host organization. Supervisor ratings of how well an employee satisfied job requirements was the available measure that on all individuals working at the organization's headquarters. Specifically, the overall performance rating was averaged based on a series of questions related to job-specific core competencies. The categories involving each competency included four ratings of role-specific responsibilities, as well as a competency assessment including a rating on manager perceptions of adaptability, client focus, continuous learning, initiative, results management, and teamwork. Ratings were based on a scale from unacceptable (1) to always exceeds expectations (5). All scores were aggregated into an overall rating, which was provided to the primary researcher for analysis. No further

detail in scoring was offered by the host organization, but confirmation was given that performance was identified based on the factors mentioned here.

Permission to access archival performance data was obtained verbally and then in writing from the Vice President and Chief Legal Officer of the host organization at the onset of the study. The primary researcher then requested and obtained IRB approval of the letter, data agreement, and procedure used in the next section. Copies of these documents are included in the Appendices.

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CHAPTER 3

RESULTS

Pre-Analysis Data Screening

Data Quality

The predictor data (both the grit and Conscientiousness scales) were examined to identify cases with missing responses (Baraldi & Enders, 2010) and whether responses were missing due to a technical failure. First, missing data were evaluated to determine how many cases had incomplete data. Per the recommendation of Mertler and Vannatta, cases with responses to less than 50% of the questions were removed first (2013). Then, data were merged with company performance data and immediately de-identified into unique case numbers. Participants who did not have both complete data and performance ratings were then removed for the regression. Next, univariate outliers were evaluated. Univariate outliers included all independent and dependent variables and were identified by standardizing all raw scores to *z*-scores in the distribution (Tabachnick & Fidell, 2013). Roughly 99% of the *z*-scores are within three standard deviations of the mean (-3 to 3), so any score outside of this range was considered to be a univariate outlier (Mertler & Vannatta, 2013). Next, boxplots revealed extreme values, as cases near the median are "boxed in" (25th to 75th percentile is within normal limits, according to Tabachnick & Fidell, 2013). Cases higher than 1.5 box lengths away from the upper and lower edges would have been considered outliers (Mertler & Vannatta, 2013). Three cases were

identified using these methods as potential outliers (i.e., had z scores larger than three standard deviations, were more than 1.5 box lengths away), but once removed, did not affect the analyses, and were therefore included for purposes of increasing sample size for power.

Next, multivariate outliers were evaluated using Mahalanobis distance, which can be interpretable as a chi-squared statistic, using the degrees of freedom equal to the number of variables in the regression. A respondent for whom the Mahalanobis distance value was greater than the critical value of chi-square at $p < 0.001$ were considered a multivariate outlier (Tabachnick & Fidell, 2013). There were no concerning values above the critical value (13.82, $df = 2$), as the maximum value in the sample at 11.17. Another measure for influential cases was conducted by examining the Cook's Distance to determine the influence of a single case on the model as a whole. If the absolute value of the Cook's D is greater than 1, the individual may be considered an influential case (Cook & Weisberg, 1982). The maximum value Cook's D for any case was 0.159, which is less than 1, indicating no presence of influential cases. In the end, any univariate outliers were removed, and since there was no presence of multivariate outliers, the final sample with all complete data for the regression was $n = 167$. The final sample for all CFA analyses was $n = 144$.

Assumptions for Analyses

The data were also examined to determine whether critical assumptions for the planned regression analyses are met. Each of these steps in data screening is described in the paragraphs that follow.

The assumption of linearity was assessed by looking at bivariate scatterplots. (Tabachnick & Fidell, 2013). The assumption of normality was also evaluated using the histogram and standard probability plots. No indication of deviation from the line was found, but there was a bimodal distribution of the performance scores. A possible explanation for this could be a result of a small sample size, the bias in performance ratings, or at minimum, a systematic selection of employees who participated in the survey based on their performance ratings. The distribution of all performance scores was, in fact, more normally distributed before merging with survey responses and deleting missing cases. This may be a direction for future research to explore more, but the analysis continued as it is beyond the scope of the research. Plots can be found in Figures 6 and 7.

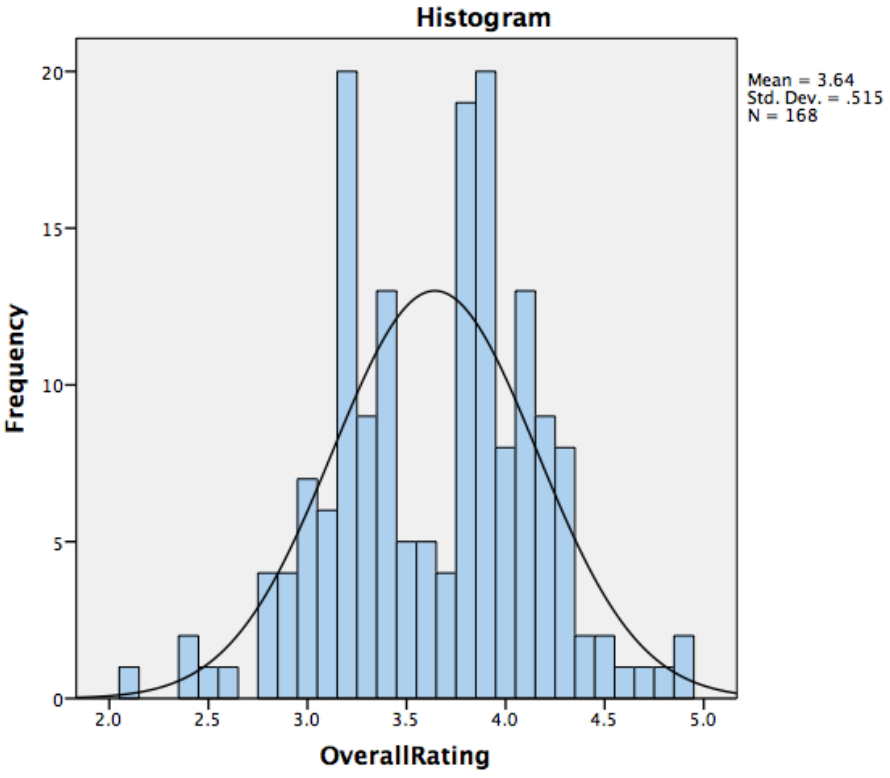

Figure 6. Histogram of final participants' performance ratings for regression analyses with grit scores

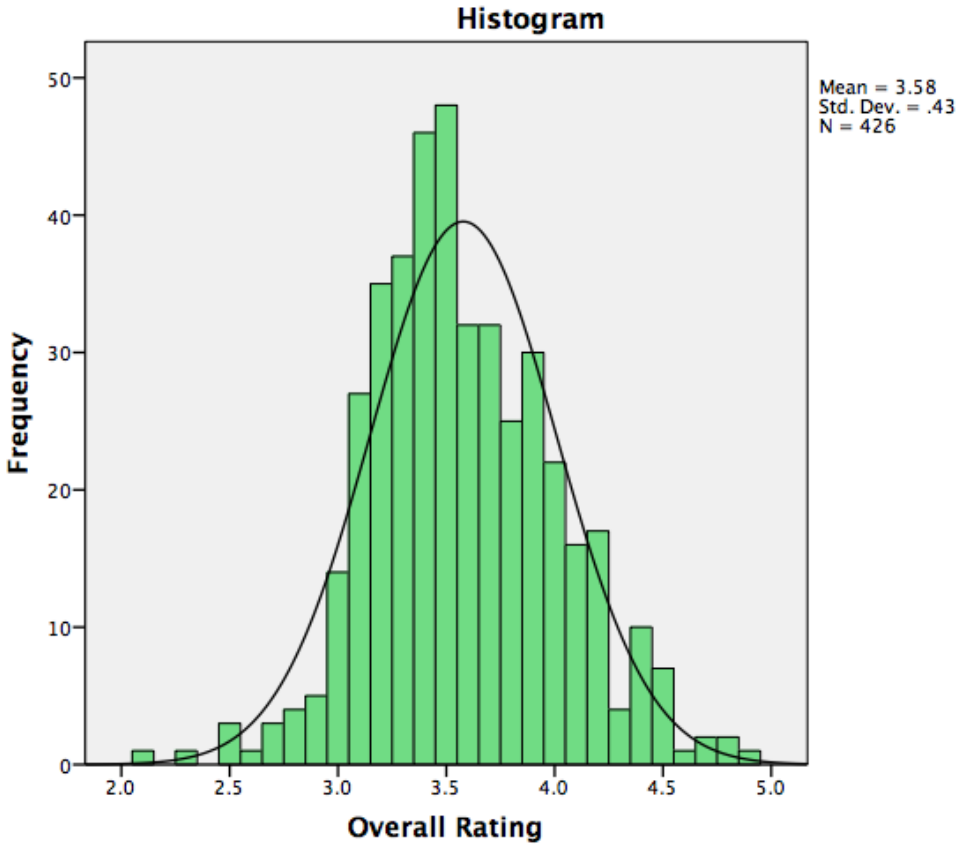

Figure 7. Histogram of all employees' performance ratings at the host organization

The presence of multicollinearity between predictors was evaluated by examining bivariate correlations between predictors to find high correlations (e.g., *r* greater than .90 indicates the presence of multicollinearity) (Tabachnick & Fidell, 2013). Although there were no correlations above 0.90, there were some moderate correlations between predictors (e.g., maximum was $r = 0.60$). Tolerance values and variance inflation factors (VIF) were additional methods to assess multicollinearity (Tabachnick & Fidell, 2013). Tolerance estimates less than 0.2 (Menard, 1995) and/or VIF greater than five to ten (Myers, 1990) indicate the presence of multicollinearity. In this study, tolerance scores were lower than 0.2 (ranged from .010 to .044), and VIF values were lower than ten (lowest VIF was 22.93), indicating the presence of multicollinearity.

Predictor scores were standardized before calculating the polynomial term to account for multicollinearity, following the recommendations of Aiken and West (1991); Dalal and Zickar (2012). However, standardizing the scores did not improve VIF or tolerance values enough to resolve multicollinearity. Next, mean-centering was explored as an option to reduce the effects of multicollinearity. Tabachnick and Fidell describe mean-centering as an option for reducing multicollinearity, especially when interaction terms are introduced, which the polynomial regression would have with the two predictive factors' interaction term, passion*perseverance (2013). They claim that mean-centering can improve statistical stability through reducing multicollinearity, while not changing the underlying model (e.g., the models have the same fit, predicted values, and residuals). Mean-centering was conducted on the predictor variables to determine if multicollinearity could be improved via this method. After mean-centering predictor values and running the regression, VIF and tolerance values were all within the accepted ranges for not having multicollinearity (Menard, 1995; Myers, 1990). The final few assumptions could be tested using the mean-centered scores, and the regression could be run.

The assumption of independence of errors was tested using the Durbin-Watson test (Durbin & Watson, 1951). The test statistic ranges from zero to four, with a value of two interpreted as the values are uncorrelated, and the assumption being met (Durbin & Watson, 1951). Based on prior recommendations, if the value is not lower than one or higher than three, it is within the acceptable range, and the assumption is considered met (Field, 2013). The value for this Durbin-Watson test was 1.75, which falls within the acceptable range for Durbin Watson, but the predictors may only be slightly positively

correlated, which is expected by the primary researcher based on the relatedness of the constructs (Field, 2013).

Once the assumption of independence of error terms was met, homoscedasticity was evaluated. Homoscedasticity occurs when the variance of the residual terms is constant for each level of the predictor variable. The standardized scores for the predictor and the residual terms were plotted to check homoscedasticity. The scatterplot indicated whether the assumption of homoscedasticity is met as well. The bivariate scatterplots between two variables show a distinction of data points of approximately the same width at each level of the independent variable, thus meeting the assumption (Tabachnick & Fidell, 2013). As the check of assumptions was completed, the primary hypothesis-testing phase of the analysis begun.

Data Analysis

Once data screening and tests of preliminary assumptions around outliers were completed in the prior step, correlations, means, and standard deviations for all scales are reported in Table 3. For Hypotheses 1a and 1b, a copy of the steps and decision points in the analytical process for choosing a model to use for grit is provided in Appendix G. Hypothesis testing begun with examination and comparison of the Grit-S factor structures, to determine whether the grit scale was appropriately measuring grit as a single-order factor (Duckworth et al., 2009), as opposed to two separate factors with an overall grit factor. The Grit-S was tested using CFA analyses, including fit statistics described in the Hypothesis 1a section below.

Table 3

Descriptive Statistics of Variables Including Means, Standard Deviations, and Correlation Coefficients

Variable	Mean	SD	Passion	Perseverance	G1	G2	G3	G4	G5	G6	G7	G8	Overall Rating
Perseverance	7.08	1.86	0.564**	1.000	0.426**	0.549**	0.493**	0.664**	0.434**	0.463**	0.698**	0.728**	-0.124
Passion	9.76	3.05	1.000	0.564**	0.759**	0.072	0.812**	0.541**	0.820**	0.831**	0.550**	0.447**	-0.209**
G1	2.66	0.90	0.759**	0.426**	1.000	0.116	0.461**	0.360**	0.507**	0.477**	0.391**	0.313**	-0.192*
G2	2.54	0.97	0.072	0.549**	0.116	1.000	0.078	-0.007	0.019	0.019	-0.009	0.104	0.084
G3	2.35	0.96	0.812**	0.493**	0.461**	0.078	1.000	0.468**	0.582**	0.571**	0.459**	0.398**	-0.058
G4	1.38	0.57	0.541**	0.664**	0.360**	-0.007	0.468**	1.000	0.423**	0.487**	0.519**	0.483**	-0.079
G5	2.41	0.84	0.820**	0.434**	0.507**	0.019	0.582**	0.423**	1.000	0.600**	0.468**	0.346**	-0.293**
G6	2.34	1.03	0.831**	0.463**	0.477**	0.019	0.571**	0.487**	0.600**	1.000	0.458**	0.382**	-0.148
G7	1.65	0.70	0.550**	0.698**	0.391**	-0.009	0.459**	0.519**	0.468**	0.458**	1.000	0.488**	-0.203**
G8	1.51	0.64	0.447**	0.728**	0.313**	0.104	0.398**	0.483**	0.346**	0.382**	0.488**	1.000	-0.200**
Overall Rating	3.64	0.52	1.000	0.564**	0.759**	0.072	0.812**	0.541**	0.820**	0.831**	0.550**	0.447**	-0.209**

Note. Significant correlations are denoted by ** at the 0.01 level (2-tailed) and * at the 0.05 level (2-tailed). $N = 167$.

Then, alternative models of grit using IPIP personality factor approximations were to be compared using CFA analyses, including fit statistics in the Hypothesis 1b section below. The process was first to identify which models had an acceptable overall fit (absolute fit) and then identify which of those models had the best comparative fit. The best-fitting model from those with moderate or better fit would be used for the remaining analyses. In the end, the models with an absolute acceptable fit would be compared by using the Akaike Information Criterion (AIC), where lower scores indicate a better fitting model (Akaike, 1987). Using Kline's recommendations (2016), the model with the smallest value in AIC would be chosen as the most likely to replicate. The best-fitting model according to these criteria would then be compared against the best model from Hypothesis 1a, and one with the smallest value in AIC would be used for future analyses (Burnham & Anderson, 2004). Additional analytical details and decision points, including the results, are provided in the discussion of each hypothesis in the paragraphs that follow.

Hypothesis 1a

Two confirmatory factor analyses (CFA) were conducted to assess the construct validity of the measurement model for the Grit-S and Grit-O scales for Hypothesis 1a. The analyses sought to confirm whether the higher-order grit construct was the more appropriate measurement model for grit, using the Grit-S scale, per the suggestion of Credé et al. (2017). Figure 1 (Model 1) represents the structure for a first-order model of the Grit-S consisting of two factors, perseverance, and passion, with four items loading on each factor. Figure 2 (Model 2) represents the structure of a second-order model with an overall grit factor and two lower-order factors, perseverance and passion, with four

Grit-S items loading on each. Because the two models are nested, the first-order model in Figure 1 was evaluated for its fit first, as it is the simplest. Once the first-order model was evaluated, then the model in Figure 2 was tested. This model builds incrementally on the prior model by adding a second-order overall grit factor.

The χ^2 goodness of fit for each model was examined for a non-significant *p*-value, which indicates a good fit. The Root Mean Square Error of Approximation (RMSEA) value equal to or less than 0.07 is an additional indication of a good fit (Steiger, 2007). After absolute fit for each model was established, the relative fit would be assessed using a Comparative Fit Index (CFI) value, where a value of 0.95 or higher was used as an indication of a good fit (Hu & Bentler, 1999). For Model 1, absolute fit was achieved, $\chi^2(19) = 21.740$, $p = 0.297$; RMSEA = 0.032, CFI = 0.993. Factor scores and covariances can be seen in Figure 8.

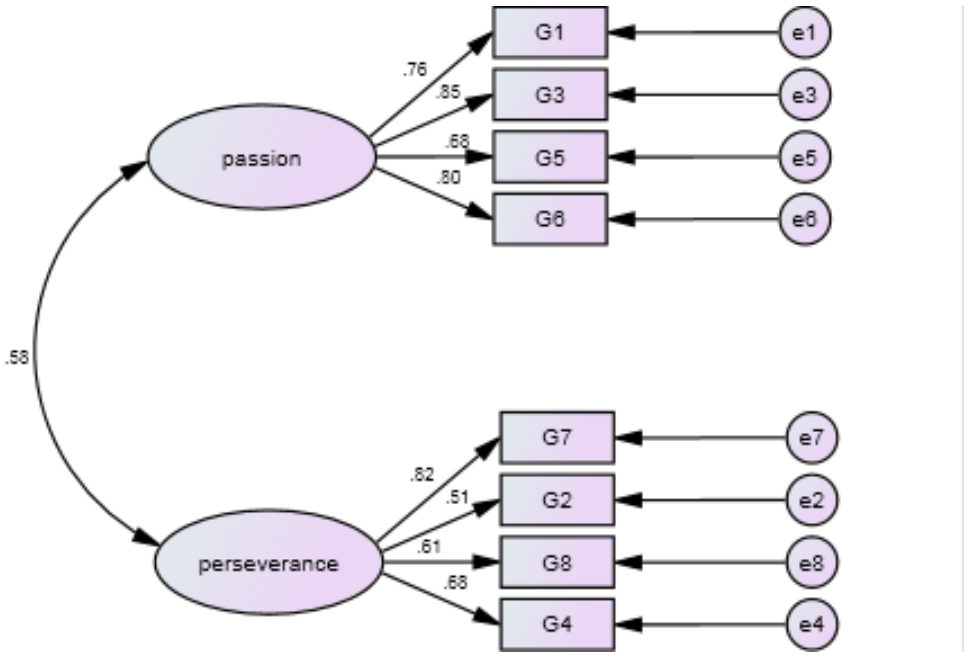

Figure 8: First-order model with two factors, passion and perseverance

After the absolute fit of the model in Figure 1 was completed, the same steps for the model in Figure 2 were used to evaluate fit as a second-order model. Factor scores can be seen in Figure 9. Because there were only two lower-order factors (passion, perseverance) associated with the second-order factor, each path was set to be equal, and an additional variance was added on the overall grit factor for the model to run (Kline, 2016).

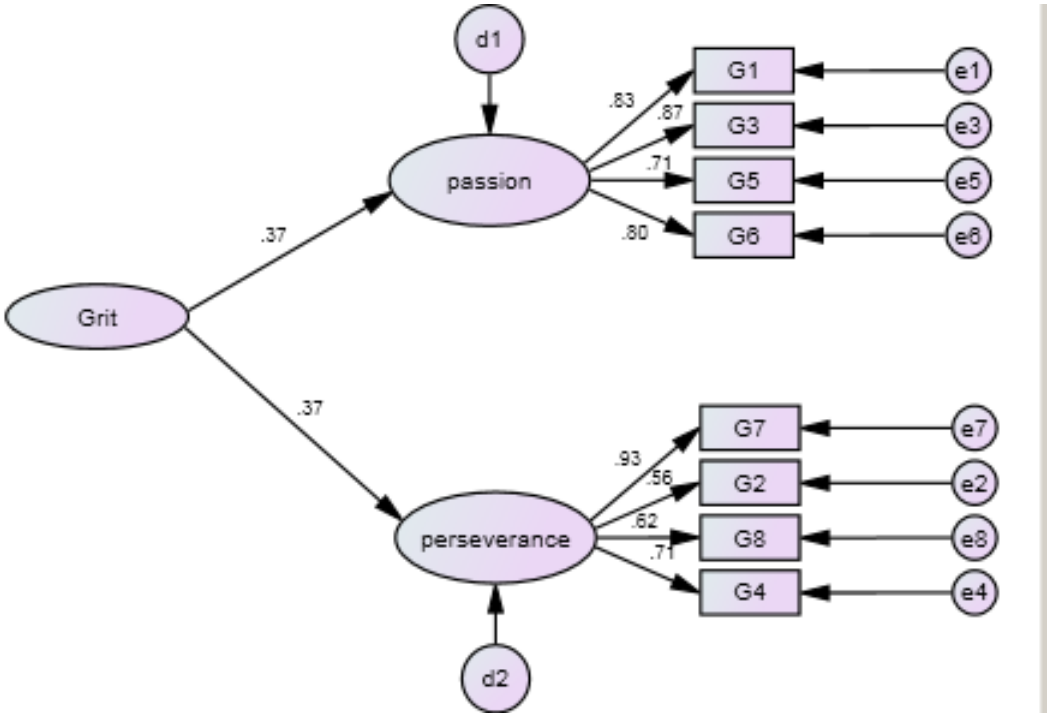

Figure 9. Second-order model with two first-order factors and one second-order overall grit factor, Grit-S proposed model

For Model 2, absolute fit was not achieved, $\chi^2(21) = 64.451$ $p = 0.000$; RMSEA = 0.120, CFI = 0.895. Neither modification, error covariances, nor item deletion improved the fit of the model, so the second-order model was rejected (Hair et al., 2014). Because only Model 1 reached absolute fit following acceptable levels according to researchers mentioned in the prior paragraph, it was the model identified to be used in comparison to

any remaining models that would reach acceptable fit in the remaining steps to test the IPIP models in subsequent tests (Models 3-5 for Hypothesis 1b).

Hypothesis 1b

Before the next set of models were tested, a group of facets from within the 120-item IPIP NEO was identified by the primary researcher and a panel of subject matter experts (SMEs; Johnson, 2005). Based on their expertise and prior research on related constructs, SMEs and the researcher identified which facets they believe most closely map onto the grit construct as if to make a new combination of personality facets that might be uniquely measuring grit. They were instructed to review grit as a construct, including passion and perseverance, and then rate each facet, and its respective items as relevant to the grit construct or not relevant. The identified facets and corresponding items then created a new grit "scale" that would be tested to determine if the models associated with it measure grit acceptably. Next, the same rating task was completed again by SMEs separately for passion, and for perseverance, to understand if some facets may be related to one specific factor within the grit construct. Participants then completed a survey with those items corresponding to the identified items included. Further detail on this process can be found in the method section of this paper.

Credé et al. (2017) suggested that one of the potential reasons why there are inconsistencies in the research conducted by Duckworth et al. (2007) is that the items may not be accurately measuring the grit construct. Using the IPIP facets that the panel selected, three confirmatory factor analyses (CFAs) were hypothesized to assess the construct validity of the measurement model for how the IPIP facets map onto the grit construct using the best-fitting scale: one model for an overall, lower-order grit construct

(Model 3), one model for a lower-order two-factor construct (Model 4), and one with a higher-order grit factor with lower-ordered passion and perseverance values (Model 5). As these three models are nested, they were built in subsequent steps, and the higher-order models could only be run if the lower-ordered models had acceptable fit per the standards laid out in the following paragraph.

The analyses sought to confirm which model of grit best approximates a latent construct. The absolute fit of the CFAs would first be based on three fit statistics. Similar to Hypothesis 1a, three models using facets and indicators from the IPIP-NEO chosen by the SMEs were tested for their absolute and relative fit. The evaluation of models using indicators from the IPIP-NEO would begin with the simplest model, a second-order model with one higher-order grit factor and several lower-order factors based on IPIP facets (Model 3). The number of IPIP factors (facets) in the model would be the number for which there was a majority consensus among SMEs and the primary researcher. The second model using indicators from the IPIP-NEO builds upon the first via the insertion of two factors (passion and perseverance; Model 4) between the overall grit factor and the IPIP factors (facets). This addition would result in a third-order model consisting of first-order factors consisting of facets and indicators from the IPIP-NEO chosen by the SME panel, two second-order factors (perseverance and passion), and a single third-order grit factor (Model 5). Factors from this model that were identified by SMEs for both passion and perseverance were to be evaluated for cross-loadings.

The χ^2 goodness of fit for each model was examined for a non-significant *p*-value, which indicates a good fit. The Root Mean Square Error of Approximation (RMSEA) value equal to or less than 0.07 was an additional indication of a good fit (Steiger, 2007).

After absolute fit for each model was to be established, the relative fit was to be assessed using a Comparative Fit Index (CFI) value, where a value of 0.95 or higher was used as an indication of a good fit (Hu & Bentler, 1999). The pattern of findings for these fit indices was then to be examined to inform an overall judgment of goodness of fit (Hair et al., 2014).

First, Model 3 was tested at a lower-level model with facets as the first-order factor before testing the second-order grit factor per the recommendations of Kline (2016). Five facets of personality identified to be relevant to the grit construct by SMEs (self-efficacy, self-discipline, orderliness, dutifulness, and achievement-striving) were evaluated in the first step of the CFA for Model 3. Interestingly and despite modifications and item deletions, acceptable fit was not found at the first-order model, $\chi^2(170) = 456.507$, $p = 0.000$; RMSEA = 0.115, CFI = 0.778. Because acceptable fit for the lower-level model was not established despite adjustments in error covariances or item deletion, further analyses to identify a second-order model (Model 3 and 4) or a third-order model (Model 5) could not be conducted. Some of the reasons that this could have occurred that will be reviewed in the discussion section. Factor loadings and covariances for Model 3 can be seen in Figure 10. As Models 3, 4, and 5 could not be compared to the best-fitting model from Hypothesis 1a, the single model with acceptable fit (Model 1) would be used for remaining regression analyses.

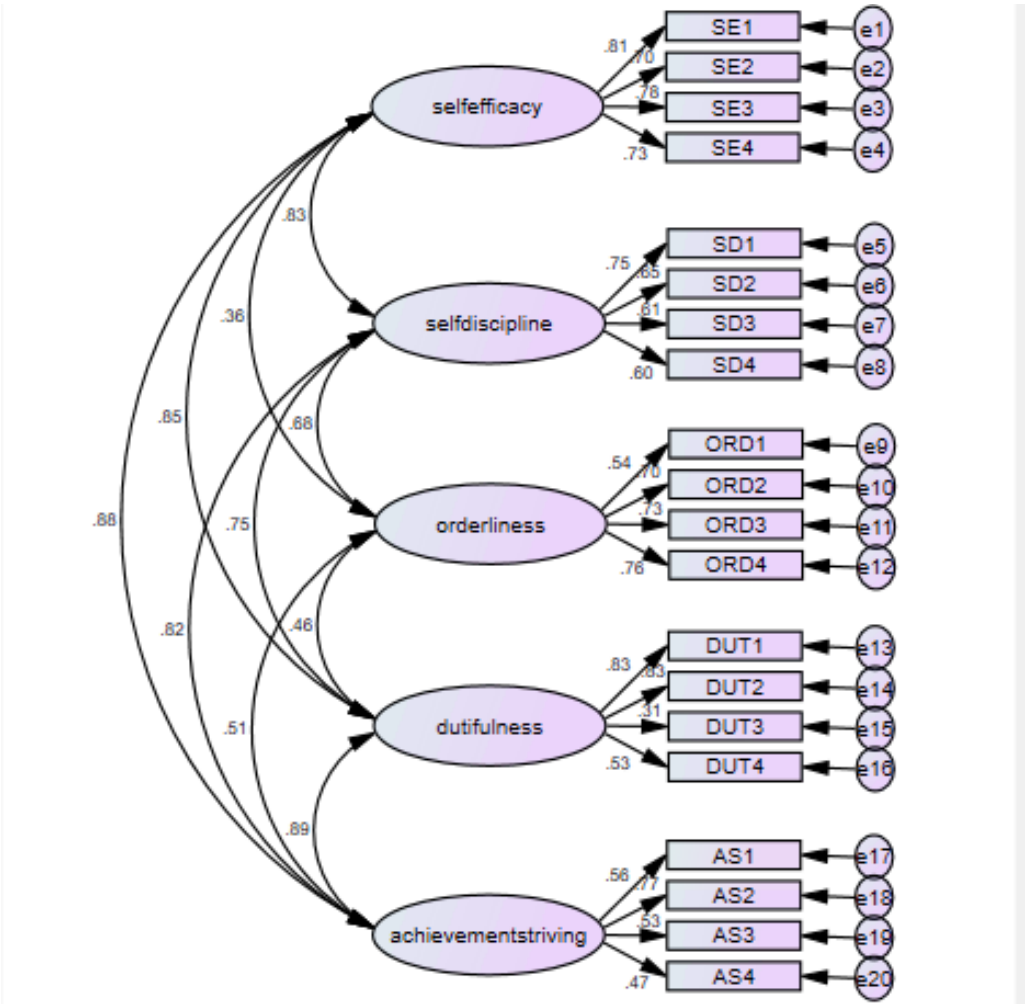

Figure 10: First-order model with five first-order factors of the IPIP facets identified by SMEs

Hypotheses 2 and 3

A hierarchical multiple regression was then to be conducted with a linear, and a quadratic term (for curvilinear evaluation) were entered in the regression in successive steps (Hair et al., 2014; Janssen, 2001). The grit score (or scores in the case of the lower-order model with better fit) was originally hypothesized to be entered into the first step per Duckworth and Quinn's (2009) supported model with one overall grit factor. However, the supported model in this study was a first-order two-factor model with

passion and perseverance as separate factors predicting performance. As such, passion and perseverance were entered simultaneously in step one of the linear regression. The regression was significant, F (164) = 3.867; p = 0.023, R^2 = 0.045. The F values from this first step indicate that a linear relationship exists between passion, perseverance, and performance (Hypothesis 2). In the second step, quadratic terms created by squaring the passion and perseverance scores were entered. The F test of significance values for the model containing the quadratic term indicated that a quadratic model does not have a relationship between passion, perseverance, and performance, F(163) = 2.576; p = 0.056, ΔR^2 = 0.00 (Hypothesis 3). Further explanation will be provided in the discussion section as to these results.

Hypothesis 4

Following the approach described to test Hypotheses 2 and 3, a linear and a quadratic term (for curvilinear evaluation) were entered into the regression in successive steps (Hair et al., 2014; Janssen, 2001). The ΔF test of significance and incremental predictive power from the ΔR^2 values were not evaluated, as the quadratic equation was found to be non-significant in Hypothesis 3. The linear relationship between passion, perseverance, and performance was statistically significant. The examination of the regression coefficient table indicated that passion was significantly related to performance. Specifically, passion was negatively related to performance scores over and above the linear relationship (b = -0.035, β = -0.206, p = 0.029). A further conversation will occur in the final discussion section regarding these results.

CHAPTER 4

DISCUSSION

It appears that grit will remain contentious and in need of further exploration beyond this study. While the present evidence suggests confirmation of the construct, other results suggest more questions than answers. From a measurement perspective, there was some confirmation of a model for grit; however, it was conflicting to Duckworth and Quinn's (2009) model because the higher-order model was rejected, while the lower-order model was accepted. Additionally, it seems that recently published literature indicates inconsistencies in the measurement of the grit (see Vazsonyi et al., 2019, for a review). Some research indicates that the grit scale's factor structure only achieved acceptable fit through allowing cross-loading, while others include adding the personality facet self-control (which were included by SMEs in the rating task) as a third factor in addition to facets of conscientiousness and neuroticism (Abuhassàn & Bates, 2015; Credé et al., 2017). Research conducted initially by Duckworth and Quinn (2009) to develop and modify the scale even argued conceptually for the overall grit factor as a means of parsimony and predictive power, but never psychometrically demonstrated that grit should be a second-order factor for the Grit-S scale. With this, further research of the measurement properties is needed to learn about and understand this phenomenon.

In addition to uncertainties in measurement, grit may have only incremental predictive power over and above what conscientiousness is already predicting for performance. Theoretical and statistical relationships have been identified in this study, as well as in Credé et al. (2017), but are limited, and could benefit from further investigation into how grit is related to performance, as this study did not find support for a non-linear relationship between grit (passion and perseverance) and performance. Some of the implications of practice will be described in the next section.

Practical Implications

Despite the publicity and financial support Duckworth and team have experienced in recent years, implications for Ted talks and buzz on grit in corporate conferences such as increased use of an inappropriately-validated scale may pose less than ideal (or at least predictable) results. If the authors are advertising this construct as a buttoned-up theory with large amounts of support from the literature, they may have more challenges ahead. Although advertising the grit construct may not be harmful in practice, it could be a waste of resources and investment in assessing, training, debriefing, and even possibly intervening in employees until the construct is better-understood. There could potentially be more critical implications if the scale were used to predict or determine selection or promotion decisions, primarily if not well understood or measured as of currently.

Inconsistencies in psychometric properties also offer more practical opportunities to study the construct in an applied setting to understand the working population as well as various groups of demographic samples, such as age, job type, etc. to define if other factors could be impacting grit level. Additionally, understanding the dynamic of passion

and perseverance will aid in determining if one or both factors are predicting more of the performance outcomes, as the present study identified some significant negative predictive ability for passion over and above that of the linear model (see Results for a review).

Limitations

The present study is not without its limitations. Many limiting factors influenced how the study could be conducted and achieved for this dissertation. First, there were several limitations with the available populations for sampling for both the factor analysis and the regression analysis. The population used for the CFA responses were a group of employees funded through the Amazon Mechanical Turk (AMT). This group of working professionals could be limited by the recommended sample size of 150, especially when considering the more significant number of factors that were considered for the IPIP facet scales (Models 3-5). In addition to potentially having lower power, this sample could be range-restricted as they are all working for an online company and may self-select into taking the assessment if they are interested in the topic.

Additionally, there were some limitations regarding the employees used in the sample from the host organization that linked performance scores to grit levels. As the headquartered organization only had approximately 400 invited participants, the primary researcher depended on incentives to obtain the minimum sample size, and after linking scores and removing systematic missing data, was left with only slightly more than the minimum sample size to conduct this research. For example, approximately 45 respondents had results with over 50% of responses missing and therefore had to be

removed from the study, decreasing the sample size by almost 25% and lowering the predictive power of grit factors on employee performance.

Reflecting on statistical power and the acceptable sample size needed, it was confirmed that 138 was an acceptable sample size for this study when running an *a priori* analysis using G*power three (Faul et al., 2009) for a medium effect size at $p = .05$. Using a sample size of 138 when running a *post hoc* power analysis yields a power of 0.95, suggesting that acceptable power was reached for a medium effect size ($f^2 = .15$). Making a Bonferonni-type adjustment for the two sets of statistical tests within the hierarchical multiple regression yields an alpha level of 0.025, for which the minimum sample size is 157, which was still achieved with the final sample size of 168 (Tabachnick & Fidell (2013). Another potential modification that could have been used in the *a priori* power analysis would have been to use a smaller effect size (e.g., 0.09 instead of .15) to require more sample size for the analysis.

However, some research suggests that the traditional way of calculating acceptable power may not account for predators that are not independently and identically normally distributed when used in linear regressions (Jan & Shieh, 2019). In future evaluations of power of multiple linear regressions, *a priori* sample sizes could be evaluated using the exact approach as opposed to the current method, where the distributional features of standard predictors are accounted for instead of only using mean parameters of the predictor variables (Jan & Shieh, 2019).

Moreover, the host organization only provided a sample report for how the overall rating score was derived for employees; otherwise, the primary researcher was simply provided with one averaged overall performance rating score to use in the study. Having

more scores for each of the individual performance indicators could have offered specific and task-related relationships between grit and the performance type, which would have been following a future recommended direction of Credé et al. (2017). Another limiting factor was the distribution of performance ratings, in that the final distribution of ratings for the linked participants displayed a bimodal distribution. And finally, sampling from one specific organization could have resulted in range restrictions based on the cultural or organizational attributes.

As for the SME ratings – other approaches could have been potentially identified to confirm the factor scores of the facets within the IPIP scale, and more variation in relevance ratings could have had better or more discriminant inclusion of facets for grit models.

Research

Future research could look first and foremost into the measurement model and items used to measure grit. Personality facets should not be ignored; this study, for example, could have potentially benefitted from a higher power in confirming those factor structures. Additionally, the interactions and roles of items on each factor mentioned in the Grit-S scale would benefit from many replication studies, as well as other studies evaluating the psychometric properties of the scale. Another implication mentioned by other researchers that could have impacted results includes the stability of grit. Determining if grit is, in fact, stable over time, or whether it can be subject to change via interventions, training, etc. would give more information on the construct and why continual inconsistencies in results are found (Credé et al., 2017).

Future research into types of performance that may be impacted by various job tasks or roles, as well as focus on having more than one overall performance rating provided, could also help understand situations or roles in which having grit may be more beneficial than others. There also seems to be a lot of focus in the other more recent literature around potential facets of grit and specific job roles or functions (Credé et al., 2017). An exploration of this relationship might aid in understanding how constructs such as self-control might be more beneficial in some job functions than others.

Further evaluations of overlap conceptually with other personality facets and how they might interact with one another would also benefit the understanding and delineation between facets such as self-control and conscientiousness facets. And finally, one last area of exploration should be in understanding the passion factor more fully, as it seems to be significantly predictive of performance over and above the original model (albeit negatively related). Perhaps qualitative research could be conducted to encourage more thorough techniques and better ways of identifying the facets or items for the construct. Following any qualitative research, other practices in item development such as using Item Response Theory to refine the Grit-S scale to better-assess which items are evaluating grit at which level (e.g., high grit, moderate grit, low grit), which may indicate more accurate levels of grit (and potentially more variability of scores) within individuals.

Conclusion

In sum, there are still many unanswered questions regarding grit. With these questions comes opportunity within the field of I/O Psychology, as well as the other social sciences, to test and refine this phenomenon to understand better what is occurring

when individuals feel passionate about achieving a goal and persevere to achieve it. This study does support the benefit of further investigation into this construct and its relationships with other constructs and outcomes (e.g., personality and performance). It seems that having a more rigorous scale development process and review might yield better results in subsequent analyses, and defend the construct more definitively rather than intuitively for future studies. Additionally, having the opportunity to review and relate grit to other measures of job-relevant performance could reveal more closely the nature of how grit relates to performance, and whether that non-linear relationship indeed does exist or not.

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APPENDIX A

HUMAN USE APPROVAL LETTERS

LOUISIANA TECH
UNIVERSITY

MEMORANDUM

OFFICE OF SPONSORED PROJECTS

TO: Dr. Mitzi Desselles and Ms. Ellen Lovell

FROM: Dr. Richard Kordal, Director of Intellectual Property & Commercialization (OIPC)
rkordal@latech.edu

SUBJECT: HUMAN USE COMMITTEE REVIEW

DATE: September 3, 2019

In order to facilitate your project, an EXPEDITED REVIEW has been done for your proposed study entitled:

"A Grit, Personality, and Job Performance: Exploring Non-Linear Relationships"

HUC 20-013

The proposed study's revised procedures were found to provide reasonable and adequate safeguards against possible risks involving human subjects. The information to be collected may be personal in nature or implication. Therefore, diligent care needs to be taken to protect the privacy of the participants and to assure that the data are kept confidential. Informed consent is a critical part of the research process. The subjects must be informed that their participation is voluntary. It is important that consent materials be presented in a language understandable to every participant. If you have participants in your study whose first language is not English, be sure that informed consent materials are adequately explained or translated. Since your reviewed project appears to do no damage to the participants, the Human Use Committee grants approval of the involvement of human subjects as outlined.

Projects should be renewed annually. ***This approval was finalized on September 3, 2019 and this project will need to receive a continuation review by the IRB if the project continues beyond September 3, 2020.*** **ANY CHANGES** to your protocol procedures, including minor changes, should be reported immediately to the IRB for approval before implementation. Projects involving NIH funds require annual education training to be documented. For more information regarding this, contact the Office of Sponsored Projects.

You are requested to maintain written records of your procedures, data collected, and subjects involved. These records will need to be available upon request during the conduct of the study and retained by the university for three years after the conclusion of the study. If changes occur in recruiting of subjects, informed consent process or in your research protocol, or if unanticipated problems should arise it is the Researchers responsibility to notify the Office of Sponsored Projects or IRB in writing. The project should be discontinued until modifications can be reviewed and approved.

Please be aware that you are responsible for reporting any adverse events or unanticipated problems.

LOUISIANA TECH
UNIVERSITY

MEMORANDUM

OFFICE OF SPONSORED PROJECTS

TO: Dr. Mitzi Desselles and Ms. Ellen Lovell

FROM: Dr. Richard Kordal, Director of Intellectual Property & Commercialization (OIPC)
rkordal@latech.edu

SUBJECT: HUMAN USE COMMITTEE REVIEW

DATE: October 23, 2019

In order to facilitate your project, an EXPEDITED REVIEW has been done for your proposed study entitled:

"A Grit, Personality, and Job Performance: Exploring Non-Linear Relationships"

HUC 20-013 Amendment
(Collecting additional comparative data)

The proposed study's revised procedures were found to provide reasonable and adequate safeguards against possible risks involving human subjects. The information to be collected may be personal in nature or implication. Therefore, diligent care needs to be taken to protect the privacy of the participants and to assure that the data are kept confidential. Informed consent is a critical part of the research process. The subjects must be informed that their participation is voluntary. It is important that consent materials be presented in a language understandable to every participant. If you have participants in your study whose first language is not English, be sure that informed consent materials are adequately explained or translated. Since your reviewed project appears to do no damage to the participants, the Human Use Committee grants approval of the involvement of human subjects as outlined.

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You are requested to maintain written records of your procedures, data collected, and subjects involved. These records will need to be available upon request during the conduct of the study and retained by the university for three years after the conclusion of the study. If changes occur in recruiting of subjects, informed consent process or in your research protocol, or if unanticipated problems should arise it is the Researchers responsibility to notify the Office of Sponsored Projects or IRB in writing. The project should be discontinued until modifications can be reviewed and approved.

Please be aware that you are responsible for reporting any adverse events or unanticipated problems.

APPENDIX B

ORIGINAL GRIT SCALE

Original Grit Scale: Grit-O

Directions for taking the Grit Scale: Here are several statements that may or may not apply to you. For the most accurate score, when responding, think of how you compare to most people -- not just the people you know well, but most people in the world. There are no right or wrong answers, so just answer honestly!

1. I have overcome setbacks to conquer an important challenge.
   - D Very much like me
   - D Mostly like me
   - D Somewhat like me D Not much like me D Not like me at all

2. New ideas and projects sometimes distract me from previous ones.*
   - D Very much like me
   - D Mostly like me
   - D Somewhat like me D Not much like me D Not like me at all

3. My interests change from year to year.*
   - D Very much like me
   - D Mostly like me
   - D Somewhat like me D Not much like me D Not like me at all

4. Setbacks don't discourage me.
   - D Very much like me
   - D Mostly like me
   - D Somewhat like me D Not much like me D Not like me at all

5. I have been obsessed with a certain idea or project for a short time but later lost interest.*
   - D Very much like me
   - D Mostly like me
   - D Somewhat like me
   - D Not much like me
   - D Not like me at all

6. I am a hard worker.
   - D Very much like me
   - D Mostly like me
   - D Somewhat like me D Not much like me D Not like me at all

7. I often set a goal but later choose to pursue a different one.*
   - D Very much like me
   - D Mostly like me
   - D Somewhat like me D Not much like me D Not like me at all

8. I have difficulty maintaining my focus on projects that take more than a few months to complete.*

D Very much like me
D Mostly like me
D Somewhat like me D Not much like me D Not like me at all

9. I finish whatever I begin.

D Very much like me
D Mostly like me
D Somewhat like me D Not much like me D Not like me at all

10. I have achieved a goal that took years of work.

D Very much like me
D Mostly like me
D Somewhat like me D Not much like me D Not like me at all

11. I become interested in new pursuits every few months.*

D Very much like me
D Mostly like me
D Somewhat like me D Not much like me D Not like me at all

12. I am diligent.

D Very much like me
D Mostly like me
D Somewhat like me D Not much like me D Not like me at all

APPENDIX C

SHORT GRIT SCALE

Short Grit Scale (Grit-S)
Directions for taking the Grit Scale: Please respond to the following eight items. Be honest – there are no right or wrong answers!

1. New ideas and projects sometimes distract me from previous ones.*
❑ Very much like me
❑ Mostly like me
❑ Somewhat like me
❑ Not much like me
❑ Not like me at all

2. Setbacks don't discourage me.
❑ Very much like me
❑ Mostly like me
❑ Somewhat like me
❑ Not much like me
❑ Not like me at all

3. I have been obsessed with a certain idea or project for a short time but later lost interest.*
❑ Very much like me
❑ Mostly like me
❑ Somewhat like me
❑ Not much like me
❑ Not like me at all

4. I am a hard worker.
❑Very much like me
❑ Mostly like me
❑ Somewhat like me
❑ Not much like me
❑ Not like me at all

5. I often set a goal but later choose to pursue a different one.*
❑ Very much like me
❑ Mostly like me
❑ Somewhat like me
❑ Not much like me
❑ Not like me at all

6. I have difficulty maintaining my focus on projects that take more than a few months to complete.*

❑ Very much like me

❑ Mostly like me

❑Somewhat like me

❑ Not much like me

❑ Not like me at all

7. I finish whatever I begin.

❑ Very much like me

❑ Mostly like me

❑ Somewhat like me

❑ Not much like me

❑ Not like me at all

8. I am diligent.

❑ Very much like me

❑ Mostly like me

❑ Somewhat like me

❑ Not much like me

❑ Not like me at all

Scoring:
1. For questions 2, 4, 7, and 8 assign the following points:

5 = Very much like me
4 = Mostly like me
3 = Somewhat like me
2 = Not much like me
1 = Not like me at all
2. For questions 1, 3, 5 and 6 assign the following points:

1 = Very much like me
2 = Mostly like me
3 = Somewhat like me
4 = Not much like me
5 = Not like me at all

Add up all the points and divide by 8. The maximum score on this scale is 5 (extremely gritty), and the lowest score on this scale is 1 (not at all gritty).

APPENDIX D

JOHNSON (2005) IPIP DOMAINS

Johnson (2005) IPIP Domains:
Identified Items for Use

Item Scoring	Item Number	Facet	Item
+C5	C5	Self-Discipline	Am always prepared.
+C5	C5	Self-Discipline	Carry out my plans.
-C5	C5	Self-Discipline	Waste my time.
-C5	C5	Self-Discipline	Have difficulty starting tasks.
+C5	C5	Self-Discipline	Get chores done right away.
+C5	C5	Self-Discipline	Start tasks right away.
+C5	C5	Self-Discipline	Get to work at once.
-C5	C5	Self-Discipline	Find it difficult to get down to work.
-C5	C5	Self-Discipline	Need a push to get started.
-C5	C5	Self-Discipline	Postpone decisions.
+C4	C4	Achievement-Striving	Work hard.
+C4	C4	Achievement-Striving	Do more than what's expected of me.
-C4	C4	Achievement-Striving	Do just enough work to get by.
-C4	C4	Achievement-Striving	Put little time and effort into my work.
+C4	C4	Achievement-Striving	Go straight for the goal.
+C4	C4	Achievement-Striving	Turn plans into actions.
+C4	C4	Achievement-Striving	Plunge into tasks with all my heart.
+C4	C4	Achievement-Striving	Set high standards for myself and others.
+C4	C4	Achievement-Striving	Demand quality.
-C4	C4	Achievement-Striving	Am not highly motivated to succeed.
+E4	E4	Activity Level	Am always busy.
+E4	E4	Activity Level	Am always on the go.
+E4	E4	Activity Level	Do a lot in my spare time.
-E4	E4	Activity Level	Like to take it easy.
+E4	E4	Activity Level	Can manage many things at the same time.
+E4	E4	Activity Level	React quickly.
-E4	E4	Activity Level	Like to take my time.
-E4	E4	Activity Level	Like a leisurely lifestyle.
-E4	E4	Activity Level	Let things proceed at their own pace.
-E4	E4	Activity Level	React slowly.
+N5	N5	Immoderation	Go on binges.
-N5	N5	Immoderation	Rarely overindulge.
-N5	N5	Immoderation	Easily resist temptations.
-N5	N5	Immoderation	Am able to control my cravings.
+N5	N5	Immoderation	Often eat too much.
+N5	N5	Immoderation	Don't know why I do some of the things I do.
+N5	N5	Immoderation	Do things I later regret.
+N5	N5	Immoderation	Love to eat.

-N5	N5	Immoderation	Never spend more than I can afford.
-N5	N5	Immoderation	Never splurge.
+C1	C1	Self-Efficacy	Complete tasks successfully.
+C1	C1	Self-Efficacy	Excel in what I do.
+C1	C1	Self-Efficacy	Handle tasks smoothly.
+C1	C1	Self-Efficacy	Know how to get things done.
+C1	C1	Self-Efficacy	Am sure of my ground.
+C1	C1	Self-Efficacy	Come up with good solutions.
-C1	C1	Self-Efficacy	Misjudge situations.
-C1	C1	Self-Efficacy	Don't understand things.
-C1	C1	Self-Efficacy	Have little to contribute.
-C1	C1	Self-Efficacy	Don't see the consequences of things.

APPENDIX E

JOHNSON (2005) IPIP DOMAINS 300-ITEM SCALE

Johnson (2005) IPIP Domains:
300-item scale (Alpha = .75)

Factor	Facet	Item
Agreeableness1	Trust	Trust others.
Agreeableness1	Trust	Believe that others have good intentions.
Agreeableness1	Trust	Trust what people say.
Agreeableness1	Trust	Distrust people.
Agreeableness1	Trust	Believe that people are basically moral.
Agreeableness1	Trust	Believe in human goodness.
Agreeableness1	Trust	Think that all will be well.
Agreeableness1	Trust	Suspect hidden motives in others.
Agreeableness1	Trust	Am wary of others.
Agreeableness1	Trust	Believe that people are essentially evil.
Agreeableness2	Morality	Use others for my own ends.
Agreeableness2	Morality	Cheat to get ahead.
Agreeableness2	Morality	Take advantage of others.
Agreeableness2	Morality	Obstruct others' plans.
Agreeableness2	Morality	Would never cheat on my taxes.
Agreeableness2	Morality	Stick to the rules.
Agreeableness2	Morality	Use flattery to get ahead.
Agreeableness2	Morality	Know how to get around the rules.
Agreeableness2	Morality	Put people under pressure.
Agreeableness2	Morality	Pretend to be concerned for others.
Agreeableness3	Altruism	Love to help others.
Agreeableness3	Altruism	Am concerned about others.
Agreeableness3	Altruism	Am indifferent to the feelings of others.
Agreeableness3	Altruism	Take no time for others.
Agreeableness3	Altruism	Make people feel welcome.
Agreeableness3	Altruism	Anticipate the needs of others.
Agreeableness3	Altruism	Have a good word for everyone.
Agreeableness3	Altruism	Look down on others.
Agreeableness3	Altruism	Make people feel uncomfortable.
Agreeableness3	Altruism	Turn my back on others.
Agreeableness4	Cooperation	Love a good fight.
Agreeableness4	Cooperation	Yell at people.
Agreeableness4	Cooperation	Insult people.
Agreeableness4	Cooperation	Get back at others.
Agreeableness4	Cooperation	Am easy to satisfy.
Agreeableness4	Cooperation	Can't stand confrontations.
Agreeableness4	Cooperation	Hate to seem pushy.
Agreeableness4	Cooperation	Have a sharp tongue.
Agreeableness4	Cooperation	Contradict others.
Agreeableness4	Cooperation	Hold a grudge.
Agreeableness5	Modesty	Believe that I am better than others.
Agreeableness5	Modesty	Think highly of myself.
Agreeableness5	Modesty	Have a high opinion of myself.
Agreeableness5	Modesty	Boast about my virtues.

Agreeableness5	Modesty	Dislike being the center of attention.
Agreeableness5	Modesty	Dislike talking about myself.
Agreeableness5	Modesty	Consider myself an average person.
Agreeableness5	Modesty	Seldom toot my own horn.
Agreeableness5	Modesty	Know the answers to many questions.
Agreeableness5	Modesty	Make myself the center of attention.
Agreeableness6	Sympathy	Sympathize with the homeless.
Agreeableness6	Sympathy	Feel sympathy for those who are worse off than myself.
Agreeableness6	Sympathy	Am not interested in other people's problems.
Agreeableness6	Sympathy	Try not to think about the needy.
Agreeableness6	Sympathy	Value cooperation over competition.
Agreeableness6	Sympathy	Suffer from others' sorrows.
Agreeableness6	Sympathy	Tend to dislike soft-hearted people.
Agreeableness6	Sympathy	Believe in an eye for an eye.
Agreeableness6	Sympathy	Believe people should fend for themselves.
Agreeableness6	Sympathy	Can't stand weak people.
Conscientiousness1	Self-Efficacy	Complete tasks successfully.
Conscientiousness1	Self-Efficacy	Excel in what I do.
Conscientiousness1	Self-Efficacy	Handle tasks smoothly.
Conscientiousness1	Self-Efficacy	Know how to get things done.
Conscientiousness1	Self-Efficacy	Am sure of my ground.
Conscientiousness1	Self-Efficacy	Come up with good solutions.
Conscientiousness1	Self-Efficacy	Misjudge situations.
Conscientiousness1	Self-Efficacy	Don't understand things.
Conscientiousness1	Self-Efficacy	Have little to contribute.
Conscientiousness1	Self-Efficacy	Don't see the consequences of things.
Conscientiousness2	Orderliness	Like to tidy up.
Conscientiousness2	Orderliness	Often forget to put things back in their proper place.
Conscientiousness2	Orderliness	Leave a mess in my room.
Conscientiousness2	Orderliness	Leave my belongings around.
Conscientiousness2	Orderliness	Like order.
Conscientiousness2	Orderliness	Want everything to be "just right."
Conscientiousness2	Orderliness	Love order and regularity.
Conscientiousness2	Orderliness	Do things according to a plan.
Conscientiousness2	Orderliness	Am not bothered by messy people.
Conscientiousness2	Orderliness	Am not bothered by disorder.
Conscientiousness3	Dutifulness	Keep my promises.
Conscientiousness3	Dutifulness	Tell the truth.
Conscientiousness3	Dutifulness	Break rules.
Conscientiousness3	Dutifulness	Break my promises.
Conscientiousness3	Dutifulness	Try to follow the rules.
Conscientiousness3	Dutifulness	Pay my bills on time.
Conscientiousness3	Dutifulness	Listen to my conscience.
Conscientiousness3	Dutifulness	Get others to do my duties.
Conscientiousness3	Dutifulness	Do the opposite of what is asked.
Conscientiousness3	Dutifulness	Misrepresent the facts.
Conscientiousness4	Achievement-Striving	Work hard.
Conscientiousness4	Achievement-Striving	Do more than what's expected of me.

Conscientiousness4	Achievement-Striving	Do just enough work to get by.
Conscientiousness4	Achievement-Striving	Put little time and effort into my work.
Conscientiousness4	Achievement-Striving	Go straight for the goal.
Conscientiousness4	Achievement-Striving	Turn plans into actions.
Conscientiousness4	Achievement-Striving	Plunge into tasks with all my heart.
Conscientiousness4	Achievement-Striving	Set high standards for myself and others.
Conscientiousness4	Achievement-Striving	Demand quality.
Conscientiousness4	Achievement-Striving	Am not highly motivated to succeed.
Conscientiousness5	Self-Discipline	Am always prepared.
Conscientiousness5	Self-Discipline	Carry out my plans.
Conscientiousness5	Self-Discipline	Waste my time.
Conscientiousness5	Self-Discipline	Have difficulty starting tasks.
Conscientiousness5	Self-Discipline	Get chores done right away.
Conscientiousness5	Self-Discipline	Start tasks right away.
Conscientiousness5	Self-Discipline	Get to work at once.
Conscientiousness5	Self-Discipline	Find it difficult to get down to work.
Conscientiousness5	Self-Discipline	Need a push to get started.
Conscientiousness5	Self-Discipline	Postpone decisions.
Conscientiousness6	Cautiousness	Jump into things without thinking.
Conscientiousness6	Cautiousness	Make rash decisions.
Conscientiousness6	Cautiousness	Rush into things.
Conscientiousness6	Cautiousness	Act without thinking.
Conscientiousness6	Cautiousness	Avoid mistakes.
Conscientiousness6	Cautiousness	Choose my words with care.
Conscientiousness6	Cautiousness	Stick to my chosen path.
Conscientiousness6	Cautiousness	Like to act on a whim.
Conscientiousness6	Cautiousness	Do crazy things.
Conscientiousness6	Cautiousness	Often make last-minute plans.
Extraversion1	Friendliness	Make friends easily.
Extraversion1	Friendliness	Feel comfortable around people.
Extraversion1	Friendliness	Avoid contacts with others.
Extraversion1	Friendliness	Keep others at a distance.
Extraversion1	Friendliness	Warm up quickly to others.
Extraversion1	Friendliness	Act comfortably with others.
Extraversion1	Friendliness	Cheer people up.
Extraversion1	Friendliness	Am hard to get to know.
Extraversion1	Friendliness	Often feel uncomfortable around others.
Extraversion1	Friendliness	Am not really interested in others.
Extraversion2	Gregariousness	Love large parties.
Extraversion2	Gregariousness	Talk to a lot of different people at parties.
Extraversion2	Gregariousness	Prefer to be alone.
Extraversion2	Gregariousness	Avoid crowds.
Extraversion2	Gregariousness	Enjoy being part of a group.
Extraversion2	Gregariousness	Involve others in what I am doing.

Extraversion2	Gregariousness	Love surprise parties.
Extraversion2	Gregariousness	Want to be left alone.
Extraversion2	Gregariousness	Don't like crowded events.
Extraversion2	Gregariousness	Seek quiet.
Extraversion3	Assertiveness	Take charge.
Extraversion3	Assertiveness	Try to lead others.
Extraversion3	Assertiveness	Take control of things.
Extraversion3	Assertiveness	Wait for others to lead the way.
Extraversion3	Assertiveness	Can talk others into doing things.
Extraversion3	Assertiveness	Seek to influence others.
Extraversion3	Assertiveness	Keep in the background.
Extraversion3	Assertiveness	Have little to say.
Extraversion3	Assertiveness	Don't like to draw attention to myself.
Extraversion3	Assertiveness	Hold back my opinions.
Extraversion4	Activity Level	Am always busy.
Extraversion4	Activity Level	Am always on the go.
Extraversion4	Activity Level	Do a lot in my spare time.
Extraversion4	Activity Level	Like to take it easy.
Extraversion4	Activity Level	Can manage many things at the same time.
Extraversion4	Activity Level	React quickly.
Extraversion4	Activity Level	Like to take my time.
Extraversion4	Activity Level	Like a leisurely lifestyle.
Extraversion4	Activity Level	Let things proceed at their own pace.
Extraversion4	Activity Level	React slowly.
Extraversion5	Excitement-Seeking	Love excitement.
Extraversion5	Excitement-Seeking	Seek adventure.
Extraversion5	Excitement-Seeking	Enjoy being reckless.
Extraversion5	Excitement-Seeking	Act wild and crazy.
Extraversion5	Excitement-Seeking	Love action.
Extraversion5	Excitement-Seeking	Enjoy being part of a loud crowd.
Extraversion5	Excitement-Seeking	Willing to try anything once.
Extraversion5	Excitement-Seeking	Seek danger.
Extraversion5	Excitement-Seeking	Would never go hang gliding or bungee jumping.
Extraversion5	Excitement-Seeking	Dislike loud music.
Extraversion6	Cheerfulness	Radiate joy.
Extraversion6	Cheerfulness	Have a lot of fun.
Extraversion6	Cheerfulness	Love life.
Extraversion6	Cheerfulness	Look at the bright side of life.
Extraversion6	Cheerfulness	Express childlike joy.
Extraversion6	Cheerfulness	Laugh my way through life.
Extraversion6	Cheerfulness	Laugh aloud.
Extraversion6	Cheerfulness	Amuse my friends.

Extraversion6	Cheerfulness	Am not easily amused.
Extraversion6	Cheerfulness	Seldom joke around.
Neuroticism1	Anxiety	Worry about things.
Neuroticism1	Anxiety	Fear for the worst.
Neuroticism1	Anxiety	Am afraid of many things.
Neuroticism1	Anxiety	Get stressed out easily.
Neuroticism1	Anxiety	Get caught up in my problems.
Neuroticism1	Anxiety	Am not easily bothered by things.
Neuroticism1	Anxiety	Am relaxed most of the time.
Neuroticism1	Anxiety	Am not easily disturbed by events.
Neuroticism1	Anxiety	Don't worry about things that have already happened.
Neuroticism1	Anxiety	Adapt easily to new situations.
Neuroticism2	Anger	Get angry easily.
Neuroticism2	Anger	Get irritated easily.
Neuroticism2	Anger	Lose my temper.
Neuroticism2	Anger	Am not easily annoyed.
Neuroticism2	Anger	Get upset easily.
Neuroticism2	Anger	Am often in a bad mood.
Neuroticism2	Anger	Rarely get irritated.
Neuroticism2	Anger	Seldom get mad.
Neuroticism2	Anger	Keep my cool.
Neuroticism2	Anger	Rarely complain.
Neuroticism3	Depression	Often feel blue.
Neuroticism3	Depression	Dislike myself.
Neuroticism3	Depression	Am often down in the dumps.
Neuroticism3	Depression	Feel comfortable with myself.
Neuroticism3	Depression	Have a low opinion of myself.
Neuroticism3	Depression	Have frequent mood swings.
Neuroticism3	Depression	Feel desperate.
Neuroticism3	Depression	Feel that my life lacks direction.
Neuroticism3	Depression	Seldom feel blue.
Neuroticism3	Depression	Am very pleased with myself.
Neuroticism4	Self-Consciousness	Find it difficult to approach others.
Neuroticism4	Self-Consciousness	Am afraid to draw attention to myself.
Neuroticism4	Self-Consciousness	Only feel comfortable with friends.
Neuroticism4	Self-Consciousness	Am not bothered by difficult social situations.
Neuroticism4	Self-Consciousness	Am easily intimidated.
Neuroticism4	Self-Consciousness	Am afraid that I will do the wrong thing.
Neuroticism4	Self-Consciousness	Stumble over my words.
Neuroticism4	Self-Consciousness	Am not embarrassed easily.
Neuroticism4	Self-Consciousness	Am comfortable in unfamiliar situations.
Neuroticism4	Self-Consciousness	Am able to stand up for myself.

Neuroticism5	Immoderation	Go on binges.
Neuroticism5	Immoderation	Rarely overindulge.
Neuroticism5	Immoderation	Easily resist temptations.
Neuroticism5	Immoderation	Am able to control my cravings.
Neuroticism5	Immoderation	Often eat too much.
Neuroticism5	Immoderation	Don't know why I do some of the things I do.
Neuroticism5	Immoderation	Do things I later regret.
Neuroticism5	Immoderation	Love to eat.
Neuroticism5	Immoderation	Never spend more than I can afford.
Neuroticism5	Immoderation	Never splurge.
Neuroticism6	Vulnerability	Panic easily.
Neuroticism6	Vulnerability	Become overwhelmed by events.
Neuroticism6	Vulnerability	Feel that I'm unable to deal with things.
Neuroticism6	Vulnerability	Remain calm under pressure.
Neuroticism6	Vulnerability	Can't make up my mind.
Neuroticism6	Vulnerability	Get overwhelmed by emotions.
Neuroticism6	Vulnerability	Can handle complex problems.
Neuroticism6	Vulnerability	Know how to cope.
Neuroticism6	Vulnerability	Readily overcome setbacks.
Neuroticism6	Vulnerability	Am calm even in tense situations.
Openness1	Imagination	Have a vivid imagination.
Openness1	Imagination	Enjoy wild flights of fantasy.
Openness1	Imagination	Love to daydream.
Openness1	Imagination	Like to get lost in thought.
Openness1	Imagination	Indulge in my fantasies.
Openness1	Imagination	Spend time reflecting on things.
Openness1	Imagination	Seldom daydream.
Openness1	Imagination	Do not have a good imagination.
Openness1	Imagination	Seldom get lost in thought.
Openness1	Imagination	Have difficulty imagining things.
Openness2	Artistic Interests	Believe in the importance of art.
Openness2	Artistic Interests	See beauty in things that others might not notice.
Openness2	Artistic Interests	Do not like poetry.
Openness2	Artistic Interests	Do not enjoy going to art museums.
Openness2	Artistic Interests	Like music.
Openness2	Artistic Interests	Love flowers.
Openness2	Artistic Interests	Enjoy the beauty of nature.
Openness2	Artistic Interests	Do not like art.
Openness2	Artistic Interests	Do not like concerts.
Openness2	Artistic Interests	Do not enjoy watching dance performances.
Openness3	Emotionality	Experience my emotions intensely.
Openness3	Emotionality	Feel others' emotions.
Openness3	Emotionality	Rarely notice my emotional reactions.
Openness3	Emotionality	Don't understand people who get emotional.
Openness3	Emotionality	Am passionate about causes.
Openness3	Emotionality	Enjoy examining myself and my life.
Openness3	Emotionality	Try to understand myself.
Openness3	Emotionality	Seldom get emotional.
Openness3	Emotionality	Am not easily affected by my emotions.
Openness3	Emotionality	Experience very few emotional highs and lows.

Openness4	Adventurousness	Prefer variety to routine.
Openness4	Adventurousness	Prefer to stick with things that I know.
Openness4	Adventurousness	Dislike changes.
Openness4	Adventurousness	Am attached to conventional ways.
Openness4	Adventurousness	Like to visit new places.
Openness4	Adventurousness	Interested in many things.
Openness4	Adventurousness	Like to begin new things.
Openness4	Adventurousness	Don't like the idea of change.
Openness4	Adventurousness	Am a creature of habit.
Openness4	Adventurousness	Dislike new foods.
Openness5	Intellect	Love to read challenging material.
Openness5	Intellect	Avoid philosophical discussions.
Openness5	Intellect	Have difficulty understanding abstract ideas.
Openness5	Intellect	Am not interested in theoretical discussions.
Openness5	Intellect	Like to solve complex problems.
Openness5	Intellect	Have a rich vocabulary.
Openness5	Intellect	Can handle a lot of information.
Openness5	Intellect	Enjoy thinking about things.
Openness5	Intellect	Am not interested in abstract ideas.
Openness5	Intellect	Avoid difficult reading material.
Openness6	Liberalism	Tend to vote for liberal political candidates.
Openness6	Liberalism	Believe that there is no absolute right or wrong.
Openness6	Liberalism	Tend to vote for conservative political candidates.
Openness6	Liberalism	Believe that we should be tough on crime.
Openness6	Liberalism	Believe that criminals should receive help rather than punishment.
Openness6	Liberalism	Believe in one true religion.
Openness6	Liberalism	Believe that too much tax money goes to support artists.
Openness6	Liberalism	Believe laws should be strictly enforced.
Openness6	Liberalism	Believe that we coddle criminals too much.
Openness6	Liberalism	Like to stand during the national anthem.

Note. *For + keyed items, the response "Very Inaccurate" is assigned a value of 1, "Moderately Inaccurate" a value of 2, "Neither Inaccurate nor Accurate" a 3, "Moderately Accurate" a 4, and "Very Accurate" a value of 5. For - keyed items, the response "Very Inaccurate" is assigned a value of 5, "Moderately Inaccurate" a value of 4, "Neither Inaccurate nor Accurate" a 3, "Moderately Accurate" a 2, and "Very Accurate" a value of 1.

APPENDIX F

DEMOGRAPHIC QUESTIONS

Demographic Questions

1. Age: _____

2. Gender (circle one): Female Male Other Prefer Not to Respond

3. Ethnicity (circle one):
Caucasian or White African-American or Black Hispanic or Latino
Asian Native Hawaiian or Other Pacific-Island American Indian or Alaskan Native Two or More Races Not Specified

4. How many years of work experience do you currently have in your career (not strictly at the company)?
1-5 years
6-10 years
11-15 years
16-20 years
21-25 years
26-30 years
31+ years

5. Which one of the following best describes your job function?
Finance/Accounting
Human Resources
Information Technology/MIS
Administration
Sales
Marketing
Research and/or Development
Manufacturing
Engineering
Other, please specify: _____

APPENDIX G

INVITATIONS TO SERVPRO

Invitation to Servpro Team Members: Win $50!

As a close friend of the Servpro family, I am very fortunate to have the support of senior company management as I work toward my doctorate in industrial/organizational psychology. I am writing to ask for your help to complete my dissertation on the views and preferences of employees at large organizations such as Servpro. Please consider taking 10 minutes out of your day to complete my survey! Your responses to the survey will be completely confidential, and no one from Servpro will know who participates. Your participation is optional but is strongly encouraged and will be much appreciated. In gratitude, I will be giving away a $50 gift card to XX to one lucky person who completes the survey by DATE. To enter the drawing, all you have to do is take the 10-minute survey.
Watch for an email from Servpro with a link to access your survey on XX Date.
If you have any questions, reach out at ellenflovell@gmail.com

Thank you,

Ellen

Follow-Up Invitation to Servpro Team Members: Win $50!

As you may have heard, you have been invited to complete a survey to win a $50 gift card to XX. Complete the survey here (hyperlinked) to be entered. Drawing for a winner will be announced on XX. In case you missed the first note, my name is Ellen Lovell, and I am a close friend of the Servpro family working to complete my dissertation by studying employees at a large organization such as Servpro. Please consider taking time to complete this survey! It will ask you questions about your work style and preferences and is completely confidential. Your participation is optional but is strongly encouraged and will be much appreciated. In gratitude, I will be giving away a $50 gift card to XX to one lucky person who completes the survey by DATE. To enter the drawing, all you have to do is take the 10-minute survey.
Watch for an email from Servpro with a link to access your survey on XX Date.
If you have any questions, reach out at ellenflovell@gmail.com

Thank you,

Ellen

APPENDIX H

ANALYTICAL PROCESS/DECISION POINTS

Analytical Process/Decision Points for Using a Grit Model in CFA

Hypothesis	Step	Action	Note
H1a	1	Evaluate fit model of Model 1 (grit as single-order, consisting of passion and perseverance factors with four items each)	Absolute Fit Indices: X^2, RMSEA Relative Fit: CFI
H1a	2	Make minor re-specifications to Model 1, based on modification indices to improve the model fit while retaining essential elements of Duckworth (Model 1r)	Some error terms allowed to covary, but not dropping items, shifting to other factors, cross-loading on both factors.
H1a	3	Build Model 2 adding a higher-order, overall grit factor to Model 1r (if applicable)	
H1a	4	Evaluate model fit of Model 2, grit as higher-order model with overall grit as second-order factor and 2 lower-order factors (passion and perseverance) with four items each	Absolute Fit Indices: X^2, RMSEA Relative Fit: CFI
H1a	5	Compare incremental fit of Model 1r (if applicable) and Model 2	Comparative Fit Index: delta AIC
H1a	6	Conclude which model is better	
H1b	7	Evaluate fit of Model 3: grit as second-order factor consisting of overall grit factor plus approximately IPIP factors (facets) with approximately five items each	Absolute Fit Indices: X^2, RMSEA Relative Fit: CFI
H1b	8	Make minor re-specifications to Model 3, based on modification indices to improve Model 3 fit)	Still retaining essential elements of IPIP / Johnson (Model 3r) some error terms allowed to covary, no items dropped, shifted to another factor, or cross-loading on two factors
H1b	9	Build Model 4 by using 2 second-order factors (perseverance and passion) and the first-order IPIP factors with approximately five items each	Absolute Fit Indices: X^2, RMSEA Relative Fit: CFI
H1b	10	Make minor re-specifications to Model 4, based on modification indices to improve Model 4 fit)	Still retaining essential elements of IPIP / Johnson (Model 4r) some error terms allowed to covary, no items dropped, shifted to another factor, or cross-loading on two factors
H1b	11	Build Model 5 by using first-order IPIP factors with approximately five items each, second-order factors of passion and perseverance, and an overall third-order grit factor	Absolute Fit Indices: X^2, RMSEA Relative Fit: CFI
H1b	12	Make minor re-specifications to Model 5, based on modification indices to improve Model 5 fit)	Still retaining essential elements of IPIP / Johnson (Model 5r) some error terms allowed to covary, no items dropped, shifted to another factor, or cross-loading on two factors
H1b	13	Conclude which model is better (3, 4, or 5 with minor re-specifications)	Comparative Fit Indices: delta AIC

H1b	14	Identify which models have acceptable fit ("moderate" or better)	Absolute Fit Indices: X^2, RMSEA Relative Fit: CFI
H1b	15	If no models achieve acceptable fit, then use Duckworth's recommended model (Model 2) because of precedent from the literature.	
H1b	16	If several models have acceptable fit, then their fit will be compared	Comparative Fit Index: delta AIC
H2-4	17	Use Best fitting model moving forward	

APPENDIX I

LETTERS OF SUPPORT

[redacted]

November 25, 2019

To: Louisiana Tech University

Attn: Institutional Review Board

Institutional Review Board,

I am subnitting this letter of support and approval of a request by Ms. Ellen Lovell to conduct her dissertation research with employees of [redacted] Ms. Lovell is currently a Ph.D. candidate in the Industrial/Organizational Psychology program at Louisiana Tech University.

Ms. Lovell has my permission to survey our employees about grit and personality and access performance data as needed for this clearly defined educational purpose. Further, I grant permission to Ms. Lovell to publish the results of this analysis with the understanding that the identity of [redacted] and its employees will be protected in all published results.

Ms. Lovell has provided us with a Data Security Plan which assures me that all employee information gathered will be protected, de-identified prior to any publication, and reported only as aggregated, grouped data.

Please contact me in the event you require further information.

Sincerely,

Matthew Preston
VP and Chief Legal Officer, [redacted]

[redacted]

APPENDIX J

DE-IDENTIFICATION CERTIFICATION FORM

Louisiana Tech University
Institutional Review Board
De-identification Certification Form

Principal Investigator: _____Ellen Lovell_____

Project Title: _____Grit, Personality, and Job Performance: Exploring Non-Linear Relationships_____

In order to be exempt under privacy provisions, each of the following (safe harbor) identifiers of the research subjects or of their relatives, employers, or household members must be removed prior to disclosure.

Note: Scrambling of names and social security numbers is not considered de-identifying information.

By completing this form, you are certifying that, as principal investigator of this study, and on behalf of the research team assisting you, neither you nor your research team will disclose the following subject identifiers from any information obtained for use in a research study to which this form applies.

Review and verify that the following data elements will not be used and disclosed by checking each element.

1.	Names	
2.	All geographic subdivisions smaller than a State, including street address, city, county, precinct, zip code.	X
3.	All elements of dates (except year) for dates directly related to an individual, including birth date, admission date, discharge date, date of death; and all ages over 89 and elements of dates (including year) indicative of such age, except that such ages and elements may be aggregated in a single category of 90 or older.	X
4.	Telephone Numbers	X
5.	Fax Numbers	X
6.	Electronic Mail Addresses	X
7.	Social Security Numbers	X
8.	Medical Record Numbers	X
9.	Health Plan Beneficiary Numbers	X
10.	Account Numbers	X
11.	Certificate/license numbers	X
12.	Vehicle Identifiers and Serial Numbers, including license plate numbers	X
13.	Device Identifiers and serial Numbers	X
14.	Web Universal Resource Locators (URLS)	X
15.	Internet Protocol (IP) Address Numbers	X
16.	Biometric Identifiers, Including Finger and Voice Prints	X
17.	Full face Photographic Images and any Comparable Images	X
18.	Any other unique identifying number, characteristic, or code	X
19.	The covered entity does not have actual knowledge that the information could be used alone or in combination with other information to identity an individual who is a subject of the information.	X

Investigator's Assurances

1. Not Applicable

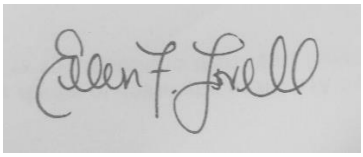
2. If I assign a code or other means of record identification, in order to allow information to be de-identified or re-identified:

    a. The code or other means of record identification is not derived from or related to information about the individual and is not otherwise capable of being translated so as to identify the individual, and
    b. I will not use or disclose the code or other means of record identification for any purpose other than re-identification, and
    c. I will not disclose the mechanism (algorithm or other tool) for re-identification.

3. Not Applicable

4. I have completed and attached a data use agreement entered into with any individual and/or sponsor outside Louisiana Tech University covered entity to which statistically de-identified information will be used and/or disclosed.

5. I understand that the code or other means of record identification must not be disclosed to non-Louisiana Tech entities.



03/27/2018

Principal Investigator/Responsible Investigator (if applicable) Date