

Conscientiousness and Grit associated with Depressive Symptoms:
Phenotypic and Heritability Analyses of a Twin Sample

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ABSTRACT

Current theories of the relationship between personality and depression largely ignore conscientiousness and grit, leaving little conceptual framework for investigation. Among the handful of studies having investigated such relations, few have identified personality-depression explanatory models for conscientiousness and grit. Thus, this thesis investigates the relationships from the theoretical perspective of motivation-related attribution theory using classical theories of achievement motivation and learned helplessness (reformulated). To gain insight into the types of personality-depression explanatory models (e.g. common cause, vulnerability, etc) with which grit and conscientiousness are most consistent, this thesis investigates phenotypic correlations with depressive symptoms and shared genetic influences at both domain and facet-levels of analyses. The study examined a sample of 248 individuals, which included 106 complete twin pairs (MZ = 56; DZ = 50). Findings reveal previously unexplored facet-level relations between grit and depressive symptoms, while uncovering a previously unreported association between the conscientiousness facet, Deliberation, with depressive symptoms. Novel findings include shared genetic variance with depressive symptoms for Perseverance of Effort facet of grit, and Competence facet of conscientiousness, implicating the common cause model. Further, comparing relative contributions of Grit and Conscientiousness with depressive symptoms uncovered unique shared genetic influences with depressive symptoms, suggesting differential effects not apparent in phenotypic analyses. Limitations and future directions are discussed.

CHAPTER 1

BACKGROUND

The hypothesis that personality is linked to depression has historical roots. The ancient Greeks, Hippocrates and Galen, believed that particular “humors” were responsible for specific personality types and forms of mental illness. In particular, they posited that four personality types (sanguine, phlegmatic, choleric, and melancholic) determine vulnerability to psychopathology. Psychology has continued to expand on this view through the work of Freud (1905), who theorized that psychosexual development linked personality types to mental illness. Pavlov (1927) further advocated for Hippocrates’ four-temperament theory, which he reframed in terms of neuronal responses rather than humors. Interest in personality-psychopathology associations continue to this day (Krueger & Tackett, 2006; Watson & Clark, 1994), with psychologists examining the linkages between the Big Five personality traits and depression (see meta-analyses by Kotov et al., 2010 and Malouff et al., 2005). Several authors argue that investigating depressive symptom and personality relationships have promising clinical implications. For instance, evidence of common genetic variance with depression (Kendler et al., 2010) suggests the presence of shared etiological factors. Thus, personality traits could represent potentially attractive markers for identifying individuals at risk for depression and informing case conceptualization and treatment (Naragon-Gainey & Watson, 2014; Kotov et al., 2010).

This thesis will address 5 limitations in the literature linking conscientiousness and grit with depression. First, conscientiousness and grit relations with depression are understudied compared to other traits such as neuroticism and extraversion, therefore requiring deeper investigation. Second, theories of personality and depression largely ignore conscientiousness (and grit), leaving little conceptual framework for investigation (Kotov et al., 2010). Thus, this thesis

seeks to examine and explain the relationship from the theoretical framework of motivation-related attribution theory. Third, lower order traits for grit and conscientiousness have been studied less consistently than the broader dimensions, requiring greater examination at the facet level regarding depressive symptoms. Facet-level analysis is especially important for determining whether a more specific level of analysis will yield more powerful effects and increase the specificity of associations between personality constructs and psychopathology such as depression (Klein et al., 2011). Only one previous study has investigated the association between grit and depressive symptoms, leaving facet-level associations unexamined (Regan et al., 2013, poster presentation). Fourth, the relative contributions of grit and conscientiousness have not been previously studied. Grit and conscientiousness are highly correlated (Duckworth et al., 2007; Duckworth & Quinn, 2009) and parsing apart unique contributions regarding depressive symptoms is necessary for understanding any differential effects of the two traits. Fifth and finally, current investigations of personality-depression relationships lack causal models for explaining associations with conscientiousness (and grit) (Klein et al., 2011). Given the lack of longitudinal studies predicting onset of depression from baseline levels of these traits, behavior genetic methods are a useful tool for determining the causal mechanisms (genetic and environmental) underlying the relationship between these traits and depression. Analyses with twin datasets may help to clarify the type of personality-depression explanatory models (e.g common cause, vulnerability, concomitant, etc) with which grit and conscientiousness are most consistent (Klein et al., 2011), with shared genetic influences providing evidence for the common cause model.

The first goal of this study is to examine the association of grit and conscientiousness with depressive symptoms by investigating correlations and shared genetic influences at both domain and facet-levels of analyses. The second goal is to examine the relative contributions of grit and

conscientiousness with depressive symptoms in both phenotypic correlations and genetic analyses in order to parse apart effects unique to each trait.

In the first chapter, I review the literature on Big Five personality traits and depression. Second, given the limited conceptual framework for linking grit and conscientiousness with depression, I propose to investigate the relationship from the theoretical perspective of motivation-related attribution theory using classical theories of achievement motivation (Weiner, 1972) and reformulated learned helplessness (Abramson et al., 1978). Third, I examine grit in further detail and discuss its validity as a relatively new construct. Fourth, given that the current literature lacks causal models of personality and depression regarding conscientiousness and grit, I propose to use behavior genetic methods to provide insight into the type of personality-depression explanatory models (e.g. common cause, vulnerability, concomitant, etc) with which grit and conscientiousness are consistent. The chapter concludes with an introduction to the present study.

Conscientiousness and grit in relation to depression.

The current literature on Big Five personality trait associations with depression shows that neuroticism has the strongest and most consistent relationship with depression in both cross-sectional (Kotov et al., 2010; Malouff et al., 2005) and longitudinal studies that predict first onset of major depression from premorbid personality traits (e.g. Kendler et al., 2006; Ormel et al., 2004). Low extraversion has been found to have moderate associations with depression but results have been mixed across studies, with some showing a significant effect (e.g Brown et al., 1998; Watson et al., 1988; Watson et al., 2005) but not others (Kotov et al., 2010). Low conscientiousness has also been shown to have correlations with depression (Kotov et al., 2010; Malouff et al., 2005). Longitudinally, only one study has predicted onset of depression from

baseline levels of conscientiousness and its facets (Naragon-Gainey & Watson, 2014). Since most of the literature on personality and depression has focused on the broad traits of neuroticism and extraversion, further work on conscientiousness and its facets are necessary (Klein et al., 2011). Facet-level examination is especially important for determining whether a more specific level of analysis will yield more powerful effects and increase the specificity of associations between personality constructs and particular forms of psychopathology (Klein et al., 2011).

Although not conceptualized as one of the Big Five, grit also warrants further investigation with depressive symptoms, especially at the facet level. Grit is a construct closely related to Big Five Conscientiousness both conceptually and empirically (Duckworth et al., 2007). Like conscientiousness, it has received comparatively less attention than other traits regarding associations with depression. Only one previous study has examined grit in relation to depressive symptoms (Regan et al., 2013, poster presentation). This study used self-report measures to assess depressive symptoms on the Depression, Anxiety and Stress Scale (DASS) in a sample of undergraduate women, and overlooked facet-level examinations. Given the lack of research examining grit and depression associations, no study to date has compared the relative contributions of both grit and conscientiousness in relation to depression or depressive symptoms.

Although relations to depression have been previously reported with domain-level conscientiousness (e.g Anderson & Mclean, 1997; Kotov et al., 2010; Malouff et al., 2005; Chioqueta & Stiles, 2005), associations at the facet level have been relatively inconsistent. Some studies have reported negative associations with the conscientiousness facet of self-discipline, while others found no facet-level associations, or associations with other facets. In a large community sample ($n = 731$), Bienvenu et al., (2004) compared the personality traits in subjects with any lifetime history of major depressive disorder (MDD) to those subjects with no lifetime

history of interest (simple phobia, social phobia, agoraphobia, panic disorder, obsessive-compulsive disorder, generalized anxiety disorder, MDD, and dysthymia). They found that the conscientiousness facet that was most frequently low in MDD was self-discipline. Costa et al. (2005) tested whether depression changes the assessment of personality traits, they administered the NEO-PI-R scales to acutely depressed patients at baseline and up to 26 weeks after treatment with antidepressant medication. The responder group (n=48) was defined as no longer meeting DSM-IV criteria for MDD at end of treatment. For these individuals, there were significant changes in the mean scores at baseline and end of treatment in domain-level conscientiousness, and facet levels competence, achievement striving, and self-discipline. That is, individuals were more likely to rate themselves lower on these facets and the domain level of conscientiousness during an acute depressive episode compared to end of treatment recovery. Gainey & Watson (2014) examined facet-level personality traits in a large community sample as predictors of subsequent depression symptoms 5 years later, accounting for baseline and trait depression. They used multiple omnibus personality inventories based on distinct structural models of personality (including Big Three, Big Five, and Six-Factor models) in order to provide coverage of potential facets within each domain. They then conducted exploratory analyses of the scales that yielded a comprehensive facet-level structure that was then used to predict depressive symptoms. For conscientiousness, four facets emerged: order, achievement, deliberation, and conventionality. Conventionality was the only facet of conscientiousness that was a significant prospective predictor of depression (inversely) based on hierarchical regression analyses. Finally, in an undergraduate sample (n = 219), Chioqueta & Stiles (2005) found an association between domain-level conscientiousness as measured by the NEO-PI-R and depressive symptoms, but no significant associations at the facet level based on multiple regression analyses.

Costa et al. (2005) assessed the methodological validity of examining correlations between depression and personality traits (self-reported). They aimed to assess the psychometric adequacy and construct validity of personality scores based on self-reports of acutely depressed patients, and the effects of treatment response on personality scores. They found that psychometric properties of all NEO-PI-R scales were preserved at baseline when patients were acutely depressed (high internal consistency, replicated normal factor structure). They also found that retest correlations averaged .69 across all traits in the responder group, suggesting that individual differences in most traits were preserved. Moreover, the maintenance of individual differences was considered further evidence for the accuracy of personality self-reports during an acute depressive episode. The authors contend that depression-caused changes in assessed personality trait levels as an accurate reflection of the current condition of the individual. Rather than regard these changes as distortions, the authors argue that personality traits have biological bases, and when they are changed (by disease or therapeutic interventions), trait levels can be expected to change. It should be noted that an awareness of how depression might influence the assessment of personality traits by self-report is important for interpreting cross-sectional analyses of depression and personality traits. Strong test-retest reliability during depressed and non-depressed periods reported in Costa et al. (2005) provides evidence of stability in personality self-reports during abnormal conditions of depression. Further, preservation of the scales' psychometric properties during acute depression provides some justification of their cross-sectional use in examining associations with depression.

Although phenotypic research has established non-trivial cross-sectional associations between conscientiousness and depressive symptoms, theories of depressive disorders largely ignore conscientiousness (and grit), leaving little conceptual framework for examining and interpreting relationships with depression (Kotov et al., 2010). One approach for a conceptual

framework is to investigate the relationship from the theoretical framework of motivation-related attribution theory.

Attribution theory of achievement motivation.

Attribution theory has long interested psychologists (e.g., Heider, 1958; E. E. Jones & Davis, 1965; Bem, 1972; Kelley, 1967) and is based on the underlying assumption that humans are motivated to attain a causal understanding of the world; that is, “why” an event has occurred. Attribution is the process by which individuals explain the causes of behavior and events related to themselves or others. People do not generate causal explanations or attributions for every observed event; instead, they are most likely to engage in attributional processes in response to events that are concrete, important, unusual, or surprising (Anderson, 1983a; Pyszczynski & Greenberg, 1981; Wong & Weiner, 1981). Attribution theory is foundational both in models of achievement motivation (e.g. Weiner, 1972) and learned helplessness in depression (e.g. Abramson et al, 1978), both of which are posited to share similar attribution processes based on expectancy-value models of motivation (Atkinson, 1964). Both theoretical models are conceptually related due to similar causal dimensions along which attributions are thought to be classified (stability and locus).

If attribution theory is a common denominator for explaining achievement motivation and psychological risk for depression, can it also inform whether *personality traits* considered beneficial to achievement are related to risk for depression? Attribution theory has not previously motivated the study of whether achievement-related personality traits impact the likelihood for depression through specific attribution tendencies, which might characterize these traits. Thus, motivation-related attribution theory may be a relevant perspective for examining the extent to

which grit and conscientiousness, personality traits commonly considered beneficial to achievement, are related to depressive symptoms.

Some attribution researchers, such as Bernard Weiner, are concerned with the effects of attributions on success expectancies, motivation, and performance. Weiner developed an attribution theory of achievement motivation (Weiner, 1985b; Weiner, 1992) in order to explain the motivational differences in high and low achievers when facing success or failure. According to Weiner, when an achievement-related event occurs, (e.g. a student fails an examination), especially if the outcome was unexpected, the learners undertake an attributional search in an attempt to understand what happened. For example, suppose a group of students perform poorly on an examination because of poor instruction. These individuals who attribute their failure to poor teaching will have a different level of motivation in subsequent examinations than those who attribute their failure to their own lack of innate ability. When attributions lead to positive affect and high expectancy of future success, these attributions result in greater effort and willingness to approach similar achievement tasks in the future than attributions that produce negative affect and low expectancy of future success. Eventually, such affective and cognitive assessment influences future behavior when individuals encounter similar situations.

According to Weiner, the specific attribution being made in failing the examination (ability, effort, task difficulty, and luck) is less important than the characteristics of the attribution, which are classified along three causal dimensions. These three dimensions influence an individuals' subsequent motivation toward a task or activity: Stability (whether the cause is stable or unstable across time and situations); locus (location of the perceived cause as internal versus external); and controllability (whether the cause of the event is perceived as being under the control of the individual). For example, if a student believes he failed a science exam because he

did not get enough practice before the event, the cause is controllable because he could have decided to spend more time practicing; in contrast, if he believes he failed the exam because he simply lacks innate science abilities, then the cause is uncontrollable. By definition, only internal attributions can be considered controllable. Stability is closely related to expectations and goals. For example, when people attribute their failures to stable factors such as lack of ability, especially if perceived as a permanent quality, they will expect to fail in that task in the future. In contrast, attributions to stable causes in times of success lead to positive expectations for success in the future. Finally, the locus dimension is thought to be linked to self-perceptions of ability; for example, if the locus is internal, feelings of self-esteem and self-efficacy will be enhanced by success and diminished by failure. If a learner believes she failed an exam because she lacks ability, she is assigning an internal cause because ability is internal to the learner. If she believes she failed an exam because the teacher is incompetent, she is assigning an external cause because teacher incompetence is external to the student.

Further according to Weiner, attributions for performance outcomes can influence a person's success expectancies; these expectancies in turn can influence a person's motivation level. Motivation level can then influence task performance and outcome, which can then influence further attributions, completing the cycle. Specifically, it has been shown that attributing failure to lack of ability can lead to lower success expectancies and reduced motivation than attributing the same failure to lack of effort (see Weiner, 1972, 1974, 1979, 1992 for reviews of this literature). Included in the motivation construct may be variables such as persistence, commitment, and attitude or approach to the task (Anderson & Arnoult, 1985).

The attributional theory of motivation is supported by several studies examining the effects of altering attributions on performance (Graham, 1984; Anderson, 1983; Anderson & Jennings,

1980; Weiner & Sierad, 1975; Meyer 1970). In a key study, Anderson (1983) illustrated the effects of individual differences in attributional tendencies as well as situational manipulations on motivation. Specifically, Anderson (1983) manipulated causal explanations following failure of college students preselected for explanatory style using his Attributional Style Assessment Test (ASAT). Participants were asked to persuade others to donate blood to the Red Cross and explanations for failure were experimentally varied and included an ability/trait condition, as well as a strategy/effort condition. That is, before solicitation, attributions were manipulated by communicating that success was primarily due to stable factors of traits and abilities (“Some people just have persuasive abilities”) or was due to unstable causes, such as proper strategy and effort. Subjects then made a practice call, which reached a confederate who refused to donate. Following this failure, subjects indicated their expectancy of success on future calls. For the next week, motivational indexes were collected: participants kept a record of their calls and success rates, indicated their expectancy of future success, along with willingness to continue as a volunteer. Those who offered internal, unstable and specific explanations for failure, whether by pre-selection or manipulation, reported greater expectations of success, displayed higher motivation, and performed more successfully following failure than subjects who explained failure in internal, stable, and global terms.

Other studies have also found that attributions influence performance motivation. Meyer (1970) was one of the first researchers to implicate the effects of causal attributions on performance. He found that individual differences in need for achievement related to causal ascriptions for failure (experimentally induced failure trials on a digit-symbol task). In turn, such causal ascriptions were linked with expectancy for success, with attributions to stable factors (ability and task difficulty) lowering subsequent expectation of future success. These causal

ascriptions (and therefore expectancies) were associated with decreased motivation on subsequent trials (as assessed by speed of performance on the digit-symbol substitution task). Graham (1984) also found that attributions influence performance motivation by experimentally inducing causal attributions for prior failure. In this study, children were given an unsolvable puzzle. There were four failure trials in which causal attributions were manipulated by means of experimenter feedback after each trial. In the final trial, subjects were permitted to work for as long as they liked; persistence of behavior in the face of failure provided an index of motivation. Results showed that ascribing failure to low ability correlated with lower expectancy, perceived competence, and task persistence, providing support that attributions are related to performance motivation. Finally, Covington and Omelich (1984) demonstrated a link between attributions and motivation by examining negative affect. In their study, students who considered their midterm exam a failure were given the opportunity to retake an exam at a later time. After the initial exam feedback, students were asked to make attributions for their subjectively unsatisfactory performance to low ability and lack of effort; they also reported feelings of humiliation, shame, and guilt, with ratings on expectancy of success on the next exam. The index of motivation was the retake exam performance. Results showed that both effort and ability attributions were related to all of the negative affective states, with low effort highly related to guilt, while lack of ability was highly related to shame and humiliation. Guilt was positively associated with performance motivation on the next exam, while humiliation had a negative association.

Although the attribution theory of motivation was originally developed for achievement, Weiner and colleagues applied it to problems of depression (Weiner & Litman-Adizes, 1980). They proposed that the locus and stability dimensions are linked to depression through their impact on motivation. The stability of attributions influences motivation through success expectancies. On

the other hand, the locus of attributions influences motivation by influencing the value of the consequences (affective reactions) of various outcomes. Weiner makes these predictions based on an expectancy-value model of motivation (Atkinson, 1964; Weiner, 1972, 1974) in which the intensity of motivation is determined by success expectancies and value of the goal object. Studies have shown that in people at risk or suffering from depression, motivational deficits are common (e.g Layne et al., 1982; Layne, 1980). Weiner's model predicts that differences in attributional tendencies on locus and stability dimensions will correlate with depression based on the shared link with motivation (Weiner, 1986).

Attribution Theory and Self-efficacy.

A construct relevant to the locus dimension of attribution theory is self-efficacy. Self-efficacy refers to belief in one's ability to execute behaviors necessary to produce certain performance attainments in a given situation (Bandura, 1997). Bandura's definition of self-efficacy is a situation-specific competence belief. It is an important contributor to performance accomplishments, independent of the actual underlying skills. Bandura (1997) provides a description of individuals with a high level of self-efficacy:

People with strong beliefs in their capabilities approach difficult tasks as challenges to be mastered rather than threats to be avoided. Such an affirmative orientation fosters interest and engrossing involvement in activities. They set themselves challenging goals and maintain strong commitments to them. They invest a high level of effort in what they do and heighten their effort in the face of failures or setbacks. [...] They attribute failure to insufficient effort, which supports a success orientation. [...] Such an efficacious outlook enhances performance accomplishments (p.39).

The link between the locus dimension of attribution theory and self-efficacy has been demonstrated in a meta-analysis by Judge et al. (2002) who found that locus of control and general self-efficacy load on the same factor, are highly correlated, show substantial convergent validity, and thus may be markers of the same higher-order concept. Further, numerous studies in the achievement context have demonstrated a relationship between locus of control and achievement-related self-efficacy. Silver et al. (1995) suggested that levels of self-efficacy beliefs lead to corresponding performance attributions, which in turn affect one's perceptions of self-efficacy, creating a cycle. Specifically, when success is attributed to internal factors, self-efficacy increases, but when failure is attributed to internal and stable causes, self-efficacy beliefs decrease. Hsieh & Kang (2010) found that ninth grade English learners in Korea with different levels of self-efficacy ratings endorsed attributions differently for successful and unsuccessful outcomes. Learners with higher levels of self-efficacy attributed their test results to more internal control factors than those who reported lower self-efficacy levels. For unsuccessful learners, those with higher self-efficacy made stronger personal control attributions than learners with lower levels of self-efficacy. Further, Graham (2006) found that British students with low self-efficacy tended to believe they had no control over the learning outcome, while students with high self-efficacy believed that failure was due to insufficient effort.

Various forms of self-efficacy have been shown to be inversely related to vulnerability to depression (Bandura 1997). For example, low self-efficacy for achieving desired goals in the face of obstacles is associated with greater vulnerability for depression (Bandura, 1997). Adverse life events in the form of failures, hardships, and loss of emotional relationships can instill a sense of worthlessness and despondency over one's life (Krantz, 1985; Lloyd, 1980; Bandura, 1997). The emotional effects of adverse life events largely depend on how they are construed (Bandura, 1997).

Believing that one is powerless to overcome them can lead to feelings of sadness and despondency.

Further, perceived inefficacy of coping with stress is another example in which domain-specific self-efficacy increases vulnerability to depression (Bandura 1997). Social cognitive theory views stress reactions in terms of a low sense of efficacy to exert control over aversive threats and taxing environmental demands. For instance, if individuals believe they can deal effectively with environmental stressors, they are less likely to be perturbed by them. But if they believe they cannot control aversive circumstances, they may distress themselves and impair their level of functioning (Bandura 1997). Most of the salient stressors with which humans have to cope pertain to psychological threats (Lazarus & Folkman, 1984). These stress reactions are governed largely by beliefs of coping efficacy rather than being directly triggered by objective threats and environmental demands (Bandura, 1988). That is, the perception of events as overwhelming one's coping capabilities becomes the stressful reality, ultimately increasing vulnerability to becoming depressed (Bandura 1997).

In recent years, a derivative of the self-efficacy concept called general self-efficacy (GSE) has been developed. GSE refers to "individuals' perception of their ability to perform across a variety of different situations" (Judge et al., 1998). Thus, GSE is a situation-independent competence belief. It has been conceptualized as a relatively stable generalized belief that an individual can consolidate resources needed to deal with the challenges that he or she experiences (Scherbaum et al., 2006). That is, GSE is a trait-like belief in one's competence (Scherbaum et al., 2006). In contrast, Bandura's (1977) original formulations of self-efficacy were described as a state-like belief in one's competence. Thus, general self-efficacy can be conceived as a relatively stable attribution with relevance to the locus dimension of attribution theory.

Despite this difference, GSE and Bandura's self-efficacy are intuitively related, with evidence showing that GSE and task-specific self-efficacy are positively correlated (e.g., Sherer et al., 1982). Some authors argue that GSE moderates the impact of the environment (e.g., negative feedback) on individuals' task-specific self-efficacy, while others such as Eden (1988, 2001) have argued that GSE is a determinant of task-specific self-efficacy. Given this linkage between GSE and self-efficacy, and existing data on self-efficacy and depression, it can thus be inferred that GSE is likely correlated with depressive symptoms. Indeed, a limited number of studies have shown that GSE is significantly associated with depressive symptoms among undergraduate students (Mukhtar & Hashim, 2010) and in diverse populations across multiple countries (Luszczynska et al., 2005)

Attribution theory in depression.

The reformulated learned helplessness model of depression relies on attribution theory and draws heavily on Weiner's work. The theory argues that helplessness as a consequence of perceptions of noncontingency between one's responses and desired outcomes (Abramson et al., 1978). Specifically, if the probability of a desired outcome is conceived as not increased by one's actions, then helplessness results. A high expectation of noncontingency (helplessness), in turn is postulated to result in cognitive, motivational, and behavioral deficits, which are the components of a general syndrome labeled "depression". According to Abramson et al., (1978), the attribution for a response-outcome noncontingency can be classified on three dimensions of causality: locus (internal-external), stability (stable-unstable) and globality (global-specific). A key concept for the reformulated model, which differentiates it from the original learned helplessness model (Seligman, 1975), is its emphasis on explanatory style (Abramson et al., 1978; Peterson &

Seligman, 1984). Also known as attributional style, this is described as the tendency to explain events in a patterned way (Peterson & Seligman, 1984). Specifically, the model focuses on a depressive explanatory style, which can be considered a risk factor for depression (Seligman, 1975; Peterson & Seligman, 1984). Proponents of the model argue that individuals susceptible to depression are believed to consistently interpret negative outcomes in internal, stable, and global terms (“it’s me; it’s going to last forever; and it’s going to undermine everything I do”).

Various longitudinal studies have supported this theory, showing both that a preexisting depressive explanatory style among depressed individuals predicts future depression, and that preexisting depressive explanatory style followed by bad events increases the likelihood of depression even after controlling for earlier baseline depression (Nolen-Hoeksema et al., 1986; Golin et al., 1981; Metalsky et al., 1982; Metalsky et al., 1987; Bukstel & Kilmann, 1980). For example, in a sample of 168 children, Nolen-Hoeksema (1983) found that those who were nondepressed in January and had a nondepressive explanatory style remained nondepressed three months later. In contrast, children who were non-depressed in January but had a depressive explanatory style were more likely to be depressed at the later time point. In a sample of 170 adult women, O’Hara et al. (1982) administered the ASQ (Attributional Style Questionnaire) to those in their second trimester of pregnancy. They found that the strongest predictor of level of depression, 3 months postpartum, was explanatory style for bad events, which significantly correlated with Beck Depression Inventory (BDI) scores even after controlling for prepartum levels of depression. Peterson et al. (1982) studied prison inmates ($n = 245$) who completed the ASQ upon imprisonment. They found that a depressive explanatory style for bad events was positively correlated with depressive symptoms. Finally, Metalsky et al., (1982) found that students who explain bad events in terms of internal, stable, and global factors were more likely to feel

depressed on learning that they received a low grade than students who tend to explain bad events in terms of external, unstable, and specific factors. Thus, these studies indicate that attributional style is a predisposing cause of depression.

Laboratory experiments further support the reformulated learned helplessness theory by showing that imposing uncontrollable bad events on subjects and inducing causal explanations can lead to helplessness effects. In Pasahow (1980), the global-specific dimension of causal explanations was induced by telling one group of subjects that performance on the concept-identification task they were given correlated highly with how people perform on all psychology experiment tasks (global). Another group of subjects were told that performance on the task had little relation with other tasks used in psychology experiments. All subjects were then given an unsolvable concept-identification problem followed by anagram tasks. Subjects induced to make global explanations for their failure performed worse on anagrams than those encouraged to give specific explanations. This suggests that the manipulation of causal explanations for negative events along the global-specific dimension predicts poorer performance when bad events are imposed on subjects, suggesting a helplessness effect. In another laboratory experiment with depressed inpatients, Miller & Norman (1981) told subjects, who were either acutely depressed or recently improved and made “helpless” by inescapable noise, that they had done well on task measuring social intelligence. Subjects were induced to explain their success along internal-external and global-specific dimensions. Both depressed participants and subjects made “helpless” by inescapable noise reported less depressed mood when induced to explain their success internally, and performed better at a subsequent anagram task when induced to explain their success globally.

Seligman & Schulman (1986) later described explanatory style characterized by internal, stable, and global explanations for bad events as a “pessimistic explanatory style”, while that which is characterized by external, unstable, and specific explanations for bad events was described as “optimistic explanatory style” (Buchanan & Seligman, 1995). The effects of an optimistic explanatory style (sometimes referred to as “nondepressive” attributional style) on reducing depression are also notable. Firth and Brewin (1982) reported a study that examined the course of depression among patients undergoing antidepressive medication therapy. They found that those who explained recent negative life events as more unstable and controllable became less depressed over the next six weeks. In a longitudinal study, Cutrona (1983) found that the women characterized as having a “nondepressive” attributional style predicted higher speed of recovery from post-partum depressive symptoms. Based on such findings, Brewin (1985) has argued for a recovery model that champions the power of explanatory style in recovering from negative events, asserting that prediction of nondepression, given an optimistic explanatory style, is more uniformly confirmed than prediction of depression given a pessimistic style.

Attribution styles may have trait-like characteristics.

Evidence of consistent attribution patterns or various explanatory styles demonstrate that attributions can be conceived as having stable, trait-like characteristics. Indeed, the general conception of attributional styles is based on the assumption that there exist relatively stable, individual differences in the kinds of causal attributions people are predisposed to make in accounting for various outcomes that they and others experience (Cutrona et al., 1985; Metalsky & Abramson, 1981). In fact, early attribution researchers of achievement were interested in the effects of individual differences, specifically a predisposition for need for achievement, on biases

in causal ascriptions for success and failure (Meyer, 1970; Weiner & Sierad, 1975). Later, a shift to examining individual differences from the vantage point of attributional style treated attributional style as a personality characteristic (Weiner, 1986). This motivated the measurement of attributional style as a trait-like tendency (see Peterson et al., 1982 in the initial validation of the ASQ).

Further evidence that attribution styles may have trait-like characteristics can be found in the work of Michael Scheier and Charles Carver, who for many years have investigated a personality characteristic they call dispositional optimism. This refers to one's general expectation that the future holds good outcomes (Scheier & Carver, 1993; Scheier & Carver, 1992). The work of Scheier and Carver has been thought to closely resemble the optimistic explanatory style described by Seligman and colleagues (Peterson et al., 1993). Indeed, Scheier et al. (2001) suggest that one approach to assessing dispositional optimism is by examining attributional style. Specifically, Scheier et al. (2001) articulates that explaining negative events in terms of causes that are more time-limited, narrow in their effects, and external to the self can be thought to reflect a more optimistic orientation. The relationship between dispositional optimism, as measured by the Life Orientation Test (LOT), and explanatory style, as measured by the ASQ has been strong, with the highest correlations reported at .77 (Hjelle et al., 1996; Kamen, 1989; Scheier & Carver, 1992; Gillham et al., 1998). The link between personality traits dispositional optimism and attributional styles suggests that personality traits and attributional styles may share similar characteristics.

Personality traits can be conceived as having attribution tendencies

While attributional styles have been previously conceived as having trait-like characteristics, personality traits have not been traditionally considered as having attributional characteristics. However, it can be argued that certain personality traits have features that at least imply self-oriented attributional processes; that is, the tendency to explain the causes of behavior and events in relation to oneself. For example, Judge et al. (2002) argued that the personality trait neuroticism may be a marker of the same high order construct as locus of control, one of the dimensions of Weiner's attribution theory. Their study found that a single factor appeared to explain the relationships among measures of these traits. Neuroticism had relatively poor discriminant validity from locus of control and generalized self-efficacy, and accounted for little incremental variance in predicting external criteria such as stress and strain and subjective well-being. They concluded that the traits of generalized self-efficacy and locus of control represent a general neuroticism factor, although broader than usually conceptualized. Similarly, Hojat (1982) also found that locus of control and neuroticism had their highest loadings on a common factor. Although the facets of neuroticism were not examined in these studies, one might infer that the vulnerability facet may partially explain the neuroticism and locus of control relationship. In particular, vulnerability implies a tendency to attribute the ability to handle stressors to an external locus of control: "I often feel helpless and want someone else to solve my problems"; I feel I am capable of coping with most of my problems (Reversed keyed)". Another likely candidate for the neuroticism and locus of control relationships is the anxiety facet of neuroticism, with several studies having demonstrated that anxiety is inversely related to locus of control (e.g Joe, 1971; Ray & Katahn, 1968), and Archer (1976) arguing that locus of control and anxiety are "potentially

interactive and multi-determined phenomena” (p. 619). Items such as “I often worry about things that might go wrong” may suggest an external locus of control when dealing with stressors.

In summary, there is evidence for a close relationship between one personality trait, neuroticism, and one dimension of attributional style, locus of control, with the contention from Judge et al (2002) that locus of control may represent a central component of a more general neuroticism factor. Given such findings, it is conceivable that there exist other personality traits for which attributional style is a component. Personality traits might even be considered stable dispositions characterized by attribution tendencies. For example, a consistent explanatory style that attributes adversity or negative life outcomes to external, specific, and unstable causes might be an element of personality traits characterized by the long-term ability to overcome setbacks. Further, other traits characterized by a general, situation-independent belief in one’s capacity to attain goals (similar to GSE), may reflect a tendency towards a consistent optimistic explanatory style, relatively stable across situations and time, including conditions of adversity.

Optimistic explanatory style in grit and conscientiousness.

One relevant personality trait that might be characterized by an optimistic explanatory style is grit. This trait is characterized by the tendency to work strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and stalls in progress (Duckworth et al., 2007). Thus, people scoring high on grit are described as setting extremely long-term objectives, pursued over many years, and not swerving from them even in the absence of positive feedback (Duckworth et al., 2007). Grit has also been considered beneficial for high achievement, accounting for an average of 4% variance in a variety of performance outcomes (Duckworth et al., 2007), and contributing to success in highly demanding contexts. In order to

sustain such high levels of motivation and persistence in the face of repeated setbacks typically encountered in the pursuit of long-term goals, one might argue that such individuals are likely to endorse an attributional style that explains negative outcomes as external, specific, unstable, and positive outcomes as internal, global, and stable. Such an attributional style might be necessary for individuals to believe that despite setbacks, successful outcomes are nonetheless attainable, and thus worthwhile for long-term pursuit.

Another personality trait that might be at least partially characterized by an optimistic explanatory style is conscientiousness, which is described as the general propensity to be orderly, responsible, self-controlled, industrious, and perceive oneself as competent. Like grit, conscientiousness has been considered beneficial for achievement, predicting academic and occupational performance across various studies and meta-analyses, accounting for variance in outcomes ranging from 0.81% to 4.8% (Barrick & Mount, 1991; O'Connor & Paunonen, 2007). The NEO-Conscientiousness construct is comprised of 6 different facets: Competence, Order, Dutifulness, Achievement-striving, Self-discipline, and Deliberation (Costa & McCrae, 1991). Particularly relevant to optimistic explanatory style is the competence facet, defined as “belief in one’s own self-efficacy” (Costa & McCrae, 1991). One might argue that perceiving oneself as competent across a variety of situations implies similarities with trait-like generalized self-efficacy (GSE), a construct which, as previously discussed, is shown to be related to attribution processes, and the locus dimension of attribution theory in particular. As mentioned previously, those with high generalized self-efficacy have a strong belief in their capacity to produce successful outcomes despite difficulty. That is, they view adversity or negative outcomes as surmountable challenges (Scherbaum, 2006; Bandura, 1997). Since individuals high on self-efficacy also have a strong sense of personal mastery regarding explanations of positive outcomes (Bandura, 1997), it would

therefore seem that an optimistic explanatory style characterized by the tendency to view negative outcomes as external, specific, unstable, and positive outcomes as internal, global, and stable would be most consistent with high generalized trait-like self-efficacy: “People with strong beliefs in their capabilities approach difficult tasks as challenges to be mastered rather than threats to be avoided. [...] They attribute failure to insufficient effort, which supports a success orientation [...]. Such an efficacious outlook enhances performance accomplishments (Bandura, 1997; pg. 39).” Like most facets of the NEO-PI-R, the competence facet has reasonable test-retest reliability ($\alpha = .70$), suggesting relative stability in this self-reported personality facet across time. Given its relatively stable nature, this facet might be assumed to describe a consistent optimistic explanatory style.

Surprisingly little research has examined the link between optimistic explanatory style and personality traits, grit and conscientiousness. Not only do these two traits seem intuitively related to optimistic explanatory style, they are also commonly considered adaptive for achievement and performance. Indeed, it is possible that these traits are adaptive for achievement and performance *because* of the tendency towards an optimistic explanatory style. That is, an attribution style characterized by external, unstable and specific ascriptions for negative events and internal, stable and global ascriptions for positive events, critically contribute to people’s achievement success, especially in the face of adversity. Such an explanation is plausible since the causal dimensions of Weiner’s attribution theory of achievement are similar to those of optimistic explanatory style, specifically the tendency to view positive events as internal and stable, while negative events are viewed as external and unstable.

According to attribution theory of achievement motivation, attributions have a reciprocal relationship with performance motivation. In particular, the theory asserts that external, unstable

and specific attributions for negative events lead to higher motivation than internal, stable, and global explanations, as supported by studies showing that causal ascriptions of failure to stable factors (ability and task difficulty) lower subsequent expectations of future success (Meyer, 1970; Anderson, 1983), and are associated with perceived competence (Graham, 1984), and decreased performance motivation (Meyer, 1970; Graham, 1984; Anderson, 1983). According to the theory, performance motivations in turn influence future attributions. Therefore, one might assume that personality traits considered adaptive for achievement and performance are characterized by a tendency to be motivated and sustain high levels of motivation in those contexts. Since performance motivation has a reciprocal relationship with attributions, such traits may be characterized by a consistent pattern of attributions (similar to optimistic explanatory style) that has been shown to increase motivation and sustain it at high levels.

Perseverance of Effort in relation to depression

The Perseverance of Effort facet of grit may have a stronger association with depressive symptoms than Consistency of Interests due to a clearer link to an optimistic explanatory style. Items testing perseverance of effort on the Grit Scale (Duckworth et al., 2007) describe an emotionally adaptive response to setbacks: “Setbacks don’t discourage me; I have overcome setbacks to conquer an important challenge”. Thus, the Perseverance of Effort facet might suggest a general capacity to cope with adversity. In contrast, the Consistency of Interests facet provides no comment on responses to setbacks. The Perseverance of Effort facet describes negative outcomes associated with setbacks as surmountable, unstable causes of difficulty. Therefore, an optimistic explanatory style seems most consistent with the personality characteristic of perceiving adversity as challenges to be overcome. Such attributions may confer adaptivity in demanding

achievement and performance contexts. Alternatively, those scoring low on Perseverance of Effort may have low perceived ability to overcome setbacks, endorsing an explanatory style that confers vulnerability to depression.

Validation of the grit construct

The discussion of grit deserves additional attention for two reasons: First, compared to conscientiousness, grit was only recently defined as a formal theoretical construct (Duckworth et al., 2007) and thus its validity and significance deserves further examination. Second, grit is a construct highly related to Big Five Conscientiousness, so further articulation for how it differs empirically and conceptually is required.

At the turn of the 20th century, William James encouraged psychologists to address two broad problems: First, what are the types of human abilities? Second, what diverse means do individuals unleash these abilities, causing certain individuals to “push to their extremes of use” while “others make use of a small part of their resources?” (William James, 1907; p.322-323). The first question has pervaded the psychological study of achievement for the past century in the emphasis on cognitive and IQ assessments. Recent work by Angela Duckworth and colleagues have investigated James’ second question in terms of why some individuals accomplish more than others of equal intelligence.

Duckworth et al. (2007) posit that grit is one intrapersonal quality that allows the few exceptional individuals, as James describes, to push themselves to their limits. Duckworth et al. (2007) defines grit as a personality trait, characterized by individual differences in perseverance and passion for long-term goals. According to Duckworth and colleagues (2007, p.1088), an individual high on grit works strenuously toward challenges, maintaining effort and interest over

years despite failure, adversity, and stalls in progress. The gritty individual views achievement as a marathon and stays the course while less gritty individuals change trajectory and quit due to disappointment or boredom. Thus, gritty people set extremely long-term objectives, pursued over many years, and do not swerve from them even in the absence of positive feedback.

Based on interviews with professionals in investment banking, painting, journalism, academia, medicine, and law, Duckworth et al., (2007) hypothesized that grit is essential to high achievement. Asked what quality distinguished star performers in their respective fields, close synonyms to grit were cited with equal frequency as talent. For instance, many individuals were cited to have not at first seemed as gifted as others, but sustained extraordinary commitment to their goals, eventually achieving prominence. Others were described as highly gifted but did not end up as prominent leaders in their fields.

Research on grit has largely supported the hypothesis that grit is beneficial to high achievement. In cross-sectional studies, grit is associated with undergraduate GPA, to years of educational attainment, and inversely associated with number of life-time career changes (Duckworth & Quinn, 2009). In prospective longitudinal studies, it has been shown to predict high school GPA, hours watching TV in the school year, West Point cadet retention in a grueling summer training camp, and performance at the National Spelling Bee championships (Duckworth & Quinn, 2009).

Further, grit has been thought to contribute to high achievement and has thus been considered a counterpoint to intelligence and cognitive ability (Duckworth et al., 2007). Research has shown that grit is either unrelated or has a weak inverse relationship to intelligence (Duckworth et al., 2007) and explains variance in undergraduate GPA, beyond that which is explained by IQ (Duckworth et al., 2007)

To investigate the role of grit in achievement, Duckworth et al. (2007) developed and validated a self-report questionnaire called the Grit Scale. They aimed to meet four criteria: a precise match with the construct of grit, evidence of psychometric soundness, face validity for adolescents and adults pursuing goals in a variety of domains, and low likelihood of ceiling effects in high-achieving populations.

As described in Duckworth et al. (2007), a pool of items tapping the construct of grit was generated. The goal was to capture the characteristic attitudes and behaviors of high-achieving individuals described in early exploratory interviews. Items were intentionally written to be face valid for both adolescents and adults, and without specifying a particular life domain (e.g., work or school). Items were written to assess the ability to sustain effort in the face of adversity (e.g., “I finish whatever I begin”, “I have overcome setbacks to conquer an important challenge”). Other items aimed to assess the consistency of interests over time (e.g., “My interests change from year to year”, “New ideas and new projects sometimes distract me from previous ones”). This dedication to focused passions is a key component of Duckworth’s conceptualization of grit that distinguishes it from other possible motivations for goal commitment (e.g. compliance with others’ expectations, ignorance of alternative options, fear of change). The items are rated on a 5-point scale from 1 = *not at all like me* to 5 = *very much like me*.

Factor analyses were then conducted on a large sample of adults (N=1,545) aged 25 years and older. Exploratory factor analysis conducted on half of the observations chosen at random (N = 772) yielded a two-factor oblique solution with promax rotation, which satisfied tests for appropriate number of factors (e.g R.B. Catell’s Scree test), had loadings of at least .40, was internally consistent, matched Duckworth’s psychological concept of grit, and best approximated a simple structure. The factor structure reflected two conceptually distinct dimensions: the first

contained 6 items indicating consistency of interests, the second contained 6 items indicating perseverance of effort. Oblique solution was accepted based on the expected positive correlation of interest and effort ($r = .45$).

Further, the integrity of the two-factor solution was confirmed. First, the specificity of each factor was found to be larger than its error variance. Second, confirmatory factor analysis on the other half of the observations ($N = 773$) supported the two-factor solution. The resulting 12-item Grit Scale had high internal consistency ($\alpha = .85$) for the overall scale and for each factor (Consistency of Interests, $\alpha = .84$; Perseverance of Effort, $\alpha = .78$). In subsequent analyses, neither factor was consistently more predictive of outcomes than the other, and in most cases, the two together were more predictive than either alone. Thus, Duckworth et al. (2007) used total scores for the full 12-item scale as a measure of grit.

More recently, brief self-report and informant versions of the Grit Scale were developed and validated (Duckworth & Quinn, 2009). With 4 fewer items (8 items total, 4 per subscale) and improved psychometric properties, the Short Grit Scale (Grit-S) was found to retain the 2-factor structure of the original Grit Scale (Grit-O) (Duckworth et al., 2007) across 4 different samples of children and adults. In confirmatory factor analyses, the two-factor model of Grit-S was a better fit than that of the Grit-O in a community sample of adults aged 25 and older ($N = 1,554$). Grit-S scores were found to significantly correlate with Grit - O scores ($r = .96$), based on the same sample.

The Grit -S has good internal consistency, consensual validity with the informant-report version, test-retest stability, and predictive validity on achievement outcomes. The Grit-S was found to have adequate internal consistency across four different samples, ranging from .73 to .83. The 4-item Consistency of Interest subscale had adequate internal consistency with alphas ranging

from .73 to .79. Alphas for the 4-item Perseverance of Effort subscale were lower, ranging from .60 to .78. Further, the Grit-S self-report version had good consensual validity with the informant version. Correlations between self-report and informant versions completed by family members or peers were medium to large, $r = .45$, $p < .001$ and $r = .47$, $p < .001$, respectively). The Grit-S scale was also found to have good test-retest stability in a year-long prospective longitudinal study of middle and high school students ($N = 279$). There was a significant correlation between scores on the Grit-S at baseline and a year later ($r = .68$). This 1-year test-retest stability of the Grit-S ($r = .68$) compared favorably with Robins et al. (2001) finding that the NEO Five-Factor Inventory (Costa & McCrae, 1992a) Conscientiousness scores correlate across 4 years at $r = .59$). This finding suggests that Grit-S is relatively stable over time, which meets one of the three important assumptions about personality traits.

The grit construct meets a second important criterion for a personality trait; it captures a meaningful individual difference. Various studies indicate that the Grit-S scale has good predictive validity, implying that individuals in a similar situation respond differently based on differences in grit. The Grit-S scale demonstrated good predictive validity in 4 different longitudinal studies. The scale predicted school grades in middle and high school students, and inversely, hours watching television during the school year. Further, Grit-S predicted retention over three months of summer at West Point, over and above the Whole Candidate Score, demonstrating its capacity to predict success in the most challenging environments. Admission to West Point is extremely competitive and depends heavily on a Whole Candidate Score, a weighted average of SAT scores, class rank, demonstrated leadership ability, and physical aptitude. Even with this rigorous admissions process, about 1 in 20 cadets drop out during the first summer of training. Thus, the fact that Grit-S predicts retention at West Point over and above a rigorous standard for admission is an especially strong

indicator of the scale's predictive validity. Finally, Grit-S was found to predict number of rounds achieved at the Scripps National Spelling Bee competition. An oral competition, the Spelling Bee is conducted in rounds until one contestant remains, with immediate elimination if a word is misspelled starting in the third round. Grit-S was a significant predictor of number of rounds attained over and beyond all Big Five traits. Participants who scored 1 SD higher on the Grit-S than same-aged peers were 38% more likely to advance to further rounds ($B = 0.32$, $OR = 1.38$, $p = .04$). Finally these prospective, longitudinal studies using Grit-S to predict various objective outcomes demonstrate that personality measured by Grit-S predicted observed relationships with achievement, rather than the reverse. Further, these objectively measured outcomes rules out the possibility that social desirability bias fully accounts for these relationships.

The third essential criterion for a personality trait is consistency across situations. Although empirical work has demonstrated that the grit construct as measured by the Grit-S is stable over time and captures a meaningful individual difference, further work must be done to demonstrate that the grit construct is stable across situations. Future studies would need to objectively assess behaviors characteristic of grit in a variety of situations. Furthermore, behavior would need to be measured on several occasions in each situation. As might be expected, such a study presents many challenges. First, a self-report questionnaire administered to individuals in a variety of situations would not likely suffice. The best assessment of stability across situations would be through behavioral observation. Second, such behaviors would need to be measured on multiple occasions within each situation. Given speculation that the consistency of long-term goals and stamina with which one pursues them over many years is less obvious by observation than the amount of energy invested in a particular task at a single moment in time (Duckworth et al., 2007), such a study would be inherently difficult to execute. With such limitations in mind, it is somewhat

unsurprising that no work has yet been done to demonstrate that grit is stable across situations. However, in order to appropriately characterize grit as a personality trait, future work should be done to assess whether it meets this third criteria.

Grit compared to Big Five conscientiousness. Although related to Big Five Conscientiousness ($r = .77$) (Duckworth et al., 2007; Duckworth & Quinn, 2010), it is nonetheless argued to be a distinct personality trait. Proponents of the grit construct believe it is a personality trait not adequately captured by the Big Five facets (Duckworth et al., 2007). The Big 5 is based on factor analyses of the lexicon but is not necessarily comprehensive. Traits for which there are fewer synonyms or antonyms tend to be omitted. However, if such words represent dimensions that are able to account for criterion variance not accounted for by the Big Five personality factors, then such dimensions require separate attention as an important determinant of human behavior (Paunonen & Jackson, 2000). According to Duckworth et al. (2007), achievement is the product of talent and effort, where the latter is a function of the intensity, direction, and duration of one's energies towards a goal. They speculate that differences in the intensity of effort are readily apparent, and thus described by many adjectives in the English language (e.g. energetic, responsible, conscientious, lazy). While the amount of energy invested in a particular task at a single moment in time is salient to oneself and others, the consistency of long-term goals and stamina with which one pursues them over many years may be less obvious. They further speculate that the importance of working harder may be clear, but the importance of working longer without switching directions may be less evident. It is therefore possible that fewer adjectives describe individual differences in the dimensions of duration and direction. The differences in lexical representation might explain its absence as a facet of conscientiousness

despite clear overlap. However, additional empirical studies need to be conducted to demonstrate the extent to which grit is distinct from the other Big Five personality traits.

Studies have shown that grit accounts for unique variance in educational attainment, and number of lifetime career changes, over and above Big Five Conscientiousness (Duckworth et al., 2007; Duckworth & Quinn, 2009). Moreover, in longitudinal studies, grit was found to predict summer attrition at a West Point training camp over and beyond Big Five Conscientiousness (Duckworth et al., 2007) and was a significant predictor of final round attained over and above all Big Five factors (Duckworth & Quinn, 2009).

Although grit is similar to conscientiousness it is argued as a conceptually distinct construct (Duckworth et al., 2007). According to Duckworth et al. 2007, grit is similar to achievement aspects of conscientiousness but differs in its emphasis on long-term stamina rather than short-term intensity. “The gritty individual not only finished tasks at hand but pursues a given aim over years” (Duckworth et al., 2007, p. 1089). According to Duckworth, grit also differs from dependability aspects of conscientiousness, including self-control, in its emphasis on the consistency of goals and interests. Again, Duckworth et al. (2007) contend that the distinction is in timescale. Grit equips individuals to pursue challenging aims over years and decades. In contrast, self-control is believed to operate at a smaller timescale, such as overriding “hourly temptations” (Galton, 1892), as described by Sir Francis Galton, the influential 19th century British psychologist known for his work on individual differences and intelligence. As Duckworth et al. (2007) describes, an individual high in self-control but low on grit may effectively manage his temper, adhere to a diet, resist the urge to surf the Internet – yet switch careers annually.

Grit compared to resilience. Finally, due to limited empirical construct validation of grit, it is also important to note its conceptual distinction from yet another related construct,

psychological resilience. Resilience is broadly described as a dynamic process - an adaptive *response* with respect to significant adversity or stress. It is used to describe individuals who overcome adversity in a life-changing event like a trauma, or difficult life circumstances. For instance, the term has been used to refer to children who thrive despite coming from at-risk environments such as growing up in poverty (Luthar, 1999), having mentally unstable parents (Werner, 1971; Garmezy, 1973; Masten, 1989), or experience of maltreatment (Cicchetti & Rogosch, 1997). Both grit and resilience share the notion of an adaptive response to failure or adversity. However, grit differs in both its conceptualization as a trait and its additional emphasis on consistent interests, or focused passions, over the long-term. The perseverance of effort facet of grit assesses resilient response to failure and adversity, or being a hard worker. The consistency of interests facet is unrelated to failure or adversity and assesses dedication to long-term passions. Thus, grit is not just resilience in the face of adversity, but differs by embodying a deep commitment to interests over the long-term.

The biggest limitation in Duckworth's justification of the grit construct is lack of empirical evidence demonstrating the extent to which it differs from Big Five Conscientiousness. High correlations with conscientiousness ($r > 0.70$) suggest that grit is unlikely to emerge as a separate factor from conscientiousness based on factor analyses. One idea for discerning constructs is to examine the etiology of both traits using behavior genetic analyses that parse apart genetic and environmental contributions. Differences in etiology may imply distinct constructs. Further, future studies may consider studying grit and conscientiousness together in prediction of outcomes in order to parse apart the effects of any unique contributions.

Lack of personality-depression causal models for grit and conscientiousness.

Although phenotypic research has established non-trivial cross-sectional associations between conscientiousness and depressive symptoms, few studies testing causal models of personality and depression have examined conscientiousness (Klein et al., 2011), and none have studied grit. Causal models examining depression with these traits are lacking. Longitudinally, only one study has predicted onset of depression from baseline levels of conscientiousness and its facets (Naragon-Gainey & Watson, 2014). Behavior genetic methods are especially useful for determining the causal mechanisms (genetic and environmental) underlying the relationship between these personality traits and depression. To date, no study has examined shared genetic influences of grit and depression. Only one study has examined the shared genetic influences between domain-level conscientiousness and depression (lifetime diagnosis of MDD), finding moderately negative genetic correlations in a twin sample of 44,112 individuals (Kendler et al., 2010), although facet-level analyses were not examined. Further behavior genetic analyses of grit and facet-level conscientiousness are necessary for providing insight into the type of personality-depression explanatory models with which these traits are most consistent. Shared genetic influences would provide evidence for the common cause model, which argues that these traits and depressive symptomology are influenced by a shared variable (Bienvenu & Stein, 2003; Klein et al., 2011; Ormel et al., 2004), in this case shared genetic factors.

The present study examines how personality traits grit and conscientiousness are related to depressive symptoms in an adult community sample with a dimensional range of psychopathology. First, the relationship will be assessed by phenotypic correlations. Second, shared genetic influences will be analyzed to assess the plausibility of the common-cause model for depression and personality relations. The relative contributions of grit and conscientiousness with depressive

symptoms will be examined in both phenotypic correlations and genetic analyses in order to parse apart effects unique to each trait.

Present Study

The present study aims to advance current knowledge by being the first to examine the following:

1) facet-level correlations of grit in relation to depressive symptoms, and 2) relative contributions of grit and conscientiousness regarding depressive symptoms, 3) shared genetic variance with depressive symptoms using classical twin design 4) shared genetic variance with depressive symptoms compared across both traits.

The following 5 hypotheses guide the current study. (1) Grit will be negatively associated with depressive symptoms. (2) At the facet-level, Perseverance of Effort will be more strongly correlated with depressive symptoms than Consistency of Interests because the former facet in particular suggests a trait-like ability to bounce back and overcome adversity. (3) Conscientiousness will be negatively associated with depressive symptoms, as already shown by previous studies revealing moderate associations with depressive symptoms (4) Grit and Conscientiousness will demonstrate shared genetic variance with depressive symptoms at both domain and facet-level of specificity (5) Given conceptual similarities between grit and conscientiousness, controlling for either trait in genetic analyses will reduce the size of the phenotypic and genetic correlations with depressive symptoms.

CHAPTER 2

METHOD

Participants

The study is based on the Tennessee Twin Study (TTS). Wave 1 of the TTS was selected in 2001 to be representative of all 6-17 year old twins born in Tennessee and living in 28 urban, suburban, and rural counties surrounding Nashville, Memphis, Knoxville, Chattanooga, and Bristol (Lahey et al., 2008). Consistent with the Tennessee population in 2001, 73% of the twins were non-Hispanic white, 26% African American, and 4% Hispanic or other groups. This resulted in 2,023 twin pairs (4,046 youth).

A subset of this original wave was recruited for Wave 2 with oversampling for high risk for psychopathology. From approximately 1800 twins, 200 twin pairs were selected for participation, with replacement pairs for individuals who were unavailable or chose not to participate, and individuals unable to participate due to contraindications for scanning, head injury, neurological diagnoses, or evidence of schizophrenia or choice not to participate. 62.5% of these pairs were selected based on either twin scoring high (top 10%) on Wave 1 internalizing or externalizing psychopathology scores as indexed by the CDISC (Shaffer et al., 2000). The remaining 32.5% twin pairs were randomly selected. Sex and monozygotic versus dizygotic twin status were equally represented in the selected sample. The current sample included all individuals who had completed the Grit scale as of June 2015 and included 248 individuals. There were 106 complete twin pairs, comprised of 56 MZ and 50 DZ pairs. The average age was 25.6 (s.d. = 1.6). Of these, 55% were female, 77% were Caucasian, and 19% were Black. One twin pair was of Hispanic background. Of the remaining, 2% were identified as having mixed ethnicity and 1% did not specify.

Measures

12-item Grit scale. Developed by Duckworth et al. (2007), the Grit Scale was used to assess individual differences to pursue long-term goals with passion and perseverance. The scale reflects two conceptually distinct dimensions (or facets) as determined by factor analysis. The first facet is consistency of interests, and the second indicates perseverance of effort. The 12-item Grit Scale has been shown to have high internal consistency ($\alpha = .85$) for the overall scale and each factor (Consistency of Interests, $\alpha = .84$; Perseverance of Effort, $\alpha = .78$).

NEO-PI-R Conscientiousness subscale. Conscientiousness was assessed using the English-language version of the NEO-PI-R, which measures the “Big Five” dimensions of personality (Costa and McCrae, 1992). The 48 items on the Conscientiousness subscale of the NEO-PI-R were answered using a five-point Likert scale, from strongly disagree to strongly agree. Six facet-level scales: Self-discipline, Order, Deliberation, Dutifulness, Achievement-striving, and Competence comprise the 48-item Conscientiousness factor scale. The Conscientiousness subscale has high internal consistency ($\alpha = .90$) and reliabilities ranging from acceptable ($\alpha = .62$) to good ($\alpha = .75$) for the facets.

Young Adult version of the DISC (YA-DISC). Symptoms of major depressive disorder (MDD) were assessed using the YA-DISC, which is a computerized structured diagnostic interview often used in longitudinal studies of children who have become adults (Shaffer et al., 2008). The interview queries all 12-month symptoms of various psychopathologies without skip outs, even when a youth could not meet diagnostic criteria for the disorder. This approach allows for assessment of a dimensional range of MDD symptoms rather than categorical assessment the disorder.

Procedures

The measures used in this study were gathered as part of a larger data collection. All participants completed the questionnaires on RedCap, a web application for managing online surveys. Most individuals filled-out the questionnaires on the day of their laboratory visit, with 44 participants completing the questions at home, following their laboratory visit.

Data Analytic Approach

The current study examines the association of Conscientiousness and Grit with depressive symptoms through phenotypic correlations and heritability analyses of shared genetic influences.

Generalized linear mixed effects modeling (GLME) was used to examine relationships between personality variables (Grit and NEO-Conscientiousness) and depressive symptom counts as measured by the YA-DISC. Analyses were performed using the *lme4* package (Bates et al., 2012) on R (R Core Team, 2012). Each trait was entered separately in the model as sole predictors, and then simultaneously to compare contributions of both personality traits. This mixed effects approach accounts for non-independence between twin pairs by assigning the twin pairs as the random effect and the personality variable as the fixed effect. Further, specification of a negative binomial distribution in GLME accounted for non-normal distribution of depressive symptom count data. Each personality trait at the facet level was also assessed in relation to depressive symptoms using GLME modeling. To assess whether the personality traits contributed significant variance to depressive symptoms, ANOVAs were conducted to determine whether models with each personality trait as the fixed effect was significantly different from a null model without the effects of interest.

To further study how Grit and Conscientiousness are associated with depressive symptoms, bivariate genetic modeling was used to analyze the covariance between the personality traits and depressive symptoms. The covariance between the personality traits and depressive symptoms can be broken into three components: additive genetic (A), shared environmental (C), and nonshared environmental (E) factors. Additive genetic factors assume that all multiple genes independently influence personality or task performance. Shared environmental influences include all nongenetic factors that make twins similar to one another and may include effects of shared rearing experiences, such as parenting style or socio-economic status. Finally, nonshared environmental influences and measurement error are categorized as nongenetic factors that cause members of a twin pair to differ.

Analyses were performed using the *OpenMx* package (Boker et al., 2011) on R (R Core Team, 2012). Sex was treated as a covariate in the linear regression of the means. Likelihood-based confidence intervals in *OpenMx* software were used in order to optimally account for variance in genetically informative studies (Neale & Miller, 1997).

For both univariate and bivariate models, assumptions of homogeneity of means and variances across cotwins and zygosity groups (constrained model) were tested using a maximum likelihood framework. Parameter estimates for the full ACE model were also determined by maximum likelihood. The chi-square test statistic was used to judge goodness of fit by comparing the constrained model with the full ACE model.

CHAPTER 3

RESULTS

Descriptive Statistics

Participants' mean, standard deviations, and ranges on variables of interest are summarized in Table 1. Grit scores were within the range predicted by norms for adults aged 25 and older. (Duckworth et al., 2007). Conscientiousness scores were within the range predicted by the NEO-Conscientiousness norms for college-aged individuals (Costa & McCrae, 1992). The distribution of depressive symptoms is summarized in Figure 1. The mean number of depressive symptoms was 2.65, with a standard deviation of 2.15. Fifteen individuals from our sample of 248 met DSM-V criteria for Major Depressive Disorder (MDD) within the past year.

Phenotypic Associations

ANOVAs were conducted to assess whether models with each personality trait as the fixed effect were significantly different from the null model without the traits (Table 2, 3). Grit had an effect on depressive symptoms ($\chi^2(1) = 8.86, p = 0.003$), as did facet-level Consistency of Interests ($\chi^2(1) = 8.58, p = 0.003$), but not Perseverance of Effort. Domain-level Conscientiousness had an effect on depressive symptoms ($\chi^2(1) = 6.75, p = 0.009$), as did facet-level Deliberation ($\chi^2(1) = 7.41, p = 0.006$), Competence ($\chi^2(1) = 7.72, p = 0.005$), Dutifulness ($\chi^2(1) = 6.58, p = 0.010$), and Self-discipline ($\chi^2(1) = 5.59, p = 0.018$). No significant effects were found for Order and Achievement-Striving.

For personality traits with significant effects, generalized linear mixed effects modeling (GLME) was used to determine the size of associations with depressive symptoms (Tables 4). This method accounted for non-independence between twin pairs by assigning the twin pairs as the

random effect and the personality variable as the fixed effect. Specification of a negative binomial distribution in GLME accounted for non-normal distribution of depressive symptom count data. There were no significant effects of sex on depressive symptom counts ($p=0.201$). Grit significantly accounted for 1.53% of the variance in depressive symptoms. The Consistency of Interests facet was significantly associated with depressive symptoms, accounting for 1.43% of the variance. Conscientiousness significantly accounted for 1.15% variance in depressive symptoms. In terms of facets, Competence, Deliberation, Dutifulness, and Self-discipline were significantly associated with depressive symptoms, accounting for 1.31%, 1.29%, 1.18%, 0.96% of the variance, respectively.

The significant effect of Consistency of Interests might be explained by links to symptoms, with the construct of Consistency of Interests closely overlapping the definition of anhedonia, broadly defined as the absence of interest or pleasure in previously enjoyable activities. Thus, lack of interest in activities may presuppose lack of consistent interests. To determine whether the significant association with depressive symptoms was a result of redundancy between the construct of Consistency of Interests and anhedonia, all individuals endorsing anhedonia in the sample were removed. The effect of Consistency of Interests remained significant, accounting for 1.34% (down from 1.43%) of the variance in depressive symptoms. ANOVA results revealed that a model with Consistency of Interests as the fixed effect was still significantly different from the null model without the trait ($\chi^2(1) = 6.60, p = 0.010$).

To compare the relative contributions of personality traits grit and conscientiousness, the strongest predictors of both traits were entered simultaneously in the model. As sole predictors in the model, overall Grit and the Competence facet of Conscientiousness were significantly associated with depressive symptoms, accounting for 1.53% and 1.31% of the variance,

respectively. When both traits were entered simultaneously in the model, the effects of Grit and Competence were no longer significant, at $p=0.089$ and 0.200 , respectively. This finding indicates that the relationship of each personality trait with depressive symptoms might be better explained by the high covariance between the two personality predictors. The result suggests that Grit and Competence do not contribute enough unique variance for both to independently predict depressive symptoms.

To determine the presence of significant independent effects of Grit and Competence on depressive symptoms, ANOVAs were conducted comparing a model with both traits to a model with only one of the traits. When the model with both traits was compared to a model with only Grit, no significant difference was found ($\chi^2(1) = 1.62, p = 0.203$). Further, no significant difference was found when the model with both traits was compared to a model with only Competence, although there was a non-significant trend level effect ($\chi^2(1) = 2.77, p = 0.096$). This finding indicates that both traits together are not substantially more powerful than either alone for predicting depressive symptoms.

Genetic Analyses

Table 5 provides correlations for MZ and DZ twins. MZ correlation exceeds the DZ correlation on all personality variables, suggesting the presence of genetic influences. Notably, Perseverance of Effort showed small differences in MZ and DZ correlations, suggesting that twin similarity on scores was due to shared environmental variance. The DZ correlations among opposite-sex twins was higher than that of DZ same-sex twins for the personality variables Grit and Conscientiousness, as well as facets Perseverance of Effort, Consistency of Interests,

Competence, and Self-discipline. This indicates that sex differences among DZ pairs did not play a role in inflating heritability for these variables.

Table 6 shows the proportion of variance explained by parameter estimates A, C, and E in univariate analyses after covarying for sex. Notably, sizeable shared environmental were found in Perseverance of Effort ($c^2 = 24\%$). The other grit facet, Consistency of Interests, showed negligible shared environmental effects, suggesting differential specificity in shared environmental effects for grit. Conscientiousness showed negligible shared environmental effects except for the Competence facet. Interestingly, shared environmental influences for Competence increased after covarying for sex ($c^2 = 10$ to 21%), while additive genetic influences decreased ($a^2 = 49$ to 38%). All variables were heritable, with Order having the smallest effects. The heritabilities of Conscientiousness were within the range previously reported (e.g Jang et al., 2002). In univariate analyses, all constrained models of personality variables met assumptions of homogeneity except Deliberation. For all tests of an ACE model except Dutifulness, the chi-square statistic was not significant at $p < 0.05$, indicating good fit.

Table 7 shows genetic correlations from bivariate ACE analyses of personality traits and depressive symptoms. Genetic influences explained a substantial portion of the covariance between depressive symptoms and personality traits Competence and Perseverance of Effort. Common shared environmental effects were not found. Evidence of common non-shared environmental effects were minimal ($e^2 = 1\%$). Since e^2 estimates also include variance due to error, they are not especially informative. Therefore, only analyses of shared genetic variance are reported. Table 7 also reports additional ACE analyses conducted to assess unique shared genetic contributions of Competence and Perseverance of Effort with depressive symptoms. Controlling for either personality trait still revealed significant shared genetic effects with depressive

symptoms, with comparable magnitudes prior to controlling for the other trait. This suggests that Competence and Perseverance of Effort have unique shared genetic influences with depressive symptoms. In bivariate analyses, all constrained models of personality variables met assumptions of homogeneity. For all tests of a bivariate ACE model, the chi-square statistic was not significant at $p < 0.05$, indicating good fit.

CHAPTER 4

DISCUSSION

The goal of this study was to examine the association of grit and conscientiousness with depressive symptoms by investigating correlations and shared genetic influences. We found that Grit and the Consistency of Interests facet are correlated with depressive symptoms, albeit at a modest level of impact. Consistent with results from previous studies, we found that depressive symptoms are correlated with Conscientiousness (e.g. DeNeve & Cooper, 1998; Steel et al., 2008; Malouff et al., 2005) and its various facets (Bienvenu et al., 2004; Costa et al., 2005). We also found substantial shared genetic variance with depressive symptoms for the grit facet Perseverance of Effort and conscientiousness facet Competence.

Domain-level Grit associations were consistent with a previous finding (Regan et al., 2013; poster presentation). Domain-level Conscientiousness associations were consistent with previous reports examining relations with depressive symptoms (Malouff et al., 2005; Chioqueta & Stiles) as well as diagnosed depression (Kotov et al., 2010; Bienvenu et al., 2004; Costa et al., 2005; Hayward et al., 2013; Anderson & McLean, 1997). With the exception of Deliberation, the facet-level associations found are also consistent with previous findings examining personality relations with diagnosed depression (Costa et al., 2005; Bienvenu et al., 2004; Hayward et al., 2013).

Our results at the domain-level of personality were consistent with cognitive-based theories of depression, which argue that distorted cognitions, expectancies, and perceptions of ability interact with life stressors to precipitate onset or exacerbate depressive symptomology (Beck et al., 1979; Abramson et al., 1989; Bandura, 1986). Low conscientiousness has been consistently linked to various performance deficits, which may increase the likelihood of acquiring negative self and outcome expectancies, and subsequently increase vulnerability for depression (Anderson &

Mclean, 1997). Studies show that individuals low in conscientiousness tend to have lower job performance and proficiency (Barrick & Mount, 1991), and lower perceptions of ability (McCrae & Costa, 1987). Although the negative consequences of low grit have not been as comprehensively examined, studies show that individuals scoring low on grit are less likely to keep their jobs, graduate from high school, and stay married (Eskreis-Winkler et al., 2014), compared to those scoring high on the trait. Thus, individuals scoring low on grit and conscientiousness might be susceptible to depressive symptomology by contributing to daily hassles and stressful events, which have been shown to precipitate onset of depressive symptoms (Hammen, 1991).

For conscientiousness, our facet-level associations support the view that low scores on the trait may lead to depressive symptomology. Specifically, individuals that have low belief in one's own self-efficacy (Competence), emphasis on fulfilling moral obligations (Dutifulness), capacity to follow through on tasks (Self-discipline), and tendency to think things through before acting or speaking (Deliberation) may produce inefficient and unreliable performance that leads to affective distress and subsequent development of depressive symptoms. For instance, low sense of mastery or agency are particularly found to increase vulnerability to depression (Bassoff & Glass, 1982; Whiteley, 1985), while low perceived competence has been found to contribute to unfavorable achievement outcomes and depressive symptomology (Blechman, 1981; Bandura, 1977). Further, various authors have found positive associations between task performance and competence, self-discipline and dutifulness (Chamorro-Premuzic & Furnham, 2003; Denis et al., 2010; Piedmont & Weinstein, 1994), suggesting that individuals low on these facets may have a higher likelihood of experiencing performance failures. Over time, the accumulation of ineffective performances may increase daily stressors that may activate depressogenic schemas to precipitate onset of depressive symptoms (Anderson & Mclean, 1997). For instance, such performance failures may contribute to

the formation of negative outcome expectancies and belief about one's abilities. Such beliefs may then reflect a depressive realism that one's performance abilities are substandard or unchangeable, further impeding performance (e.g. through learned helplessness behaviors) and creating a self-perpetuating cycle of depressive symptomology (Metalsky, 1982; Pekrun, 1992).

Contrary to expectations, we also found a previously unreported association between depressive symptoms and Deliberation. To our knowledge, the existing literature on facet-level conscientiousness associations with depression have not reported a specific association with deliberation. As the Deliberation facet is defined as the tendency to think things through before acting or speaking, one explanation for this finding is that individuals low on Deliberation tend to perform inefficiently and unreliably, which causes stressful events that precipitate onset of depressive symptoms. Another explanation is that depressive symptoms may cause problems in concentration and decision-making, causing individuals with depressive symptoms to rate themselves lower on this trait. Further, Deliberation might be absent from the literature due to psychometric factors arising from differences in measuring depression. Reports of conscientiousness-depression relations typically compare personality profiles between diagnostic and control groups, rather than examining associations with depressive symptoms (Hayward et al., 2013, Bienvenu et al., 2004, Costa et al., 2005). Additionally, any reports that do examine depressive symptom associations with conscientiousness rarely investigate facet-level associations (Bagby et al., 1996; Chioqueta et al., 2005). Thus, Deliberation might be concealed due to measurement differences, where relations with depression might be best captured by depressive symptomology rather than binary diagnoses. Perhaps Deliberation associations are most apparent among individuals with milder forms of depression, likely found in samples that exhibit a dimensional range of symptoms and do not necessarily meet diagnostic criteria.

For grit, the facet-level association between Consistency of Interests and depressive symptoms is a novel finding. To determine whether the significant association with depressive symptoms was a result of redundancy between the Consistency of Interests construct and anhedonia (reflecting a lack of interest), all individuals endorsing anhedonia in the sample were removed in a follow-up analysis. The relationship was still significant, implying that the effect is not entirely driven by anhedonia, and might be explained by a characteristic of the personality trait that influences depressive symptom endorsement. One possibility is that individuals with consistent, long-term interests are more likely to have greater engagement and meaning in life, as supported by one study finding an association between consistency of interests and meaning in life, measured by the orientations to happiness scale (Von Culin et al., 2014). Heightened engagement and meaning in life has been found to be positively related to subjective well-being (Schueller & Seligman, 2010), which in turn has been proposed to protect against the development of depression (Cummins, 2013).

Further, we found no significant associations between perseverance of effort and depressive symptoms. Our finding concurs with research showing a weak relationship between perseverance and depressive symptoms using other measures of perseverance. For example, Anestis et al., (2011) found a weak correlation between (lack of) perseverance on the UPPS impulsive behavior scale with depression on the BDI ($r=0.15$). Further, d'Acremont & der Linden (2007) found that lack of perseverance on the UPPS modestly predicted depression ($r = 0.18$) on the Reynolds Adolescent Depression Scale. The results of these two previous studies are consistent with our finding that strictly persevering behavior is not significantly associated with depressive symptoms. Nonetheless, absence of a significant association might be due to the fact that only two out of the six items on the perseverance of effort scale describe an *emotional interpretation* of the

persevering behavior (“Setbacks don’t discourage me”, I have overcome setbacks to conquer an important challenge”, while the remaining four items are solely a *description* of persevering behavior. While an emotional interpretation of persevering behavior that describes an emotionally adaptive response to setbacks might be expected to correlate strongly with depressive symptoms, non-significant associations with the other four items that strictly describe persevering behavior might dilute the effects.

Our phenotypic and behavior genetic analyses also helped to identify personality-depression explanatory models for conscientiousness and grit. Our data is consistent with four personality-depression explanatory models: vulnerability, scar, concomitant, and common cause. First, it is possible that individuals low in conscientiousness and grit are more prone to failures and poor coping with stressors (e.g endorsing learned helplessness behaviors and other depressotypic cognitions), which can contribute to depressive symptoms. This account is consistent with the vulnerability model, which can be viewed as a diathesis-stress model, conceptualizing certain personality traits as the diathesis and stress as a factor that precipitates the onset of depressive symptoms (Klein et al., 2011). Second, depressive symptoms may cause negative self-perceptions and lowered self-esteem, which then leads to lower grit and conscientiousness scores. This account is consistent with the scar and concomitant models. Both models argue that depressive symptoms alter levels of personality traits. The concomitant model argues that assessments of personality are altered by an individual’s mood state, which implies that personality returns to its baseline after recovery from psychopathology (Klein et al., 2011). In contrast, the scar model argues that depressive symptoms have an enduring effect on personality, such that changes persist even after recovery (Klein et al., 2011; Kotov et al., 2010; Krueger & Tackett, 2003; Clark, 2005).

Despite evidence that depressive symptoms may *alter* self-ratings of personality traits, (Costa et al., 2005; Hayward et al., 2013), the likelihood that current depressive symptoms entirely *distort* personality is not high. Previous studies have found that personality in general, and measurement on the NEO PI-R in particular, remain highly stable across the life span (Terraciano et al., 2006; Roberts et al., 2000) and among patients with major depressive disorder (Morey et al., 2010; Costa et al., 2005; Santor et al., 1997). Moreover, clinical trials suggest that changes in depressive symptoms are not necessarily accompanied by changes in personality (Quilty et al., 2008b, Tange et al., 2009). Hence, the influence of depressive symptoms on personality should not be overstated. Further, evidence of accurate self-reported personality during depression is at least consistent with the possibility that the personality assessed simultaneously with depressive symptoms in our cross-sectional study represents an accurate estimate of that which preceded the onset of symptoms and predicted symptom development. At present, longitudinal data are too limited to clarify the precise nature of these relationships; thus future studies examining both domain and facet-level conscientiousness and grit are needed to differentiate between vulnerability versus concomitant and scar effects.

Finally, our bivariate ACE results provide evidence for the common cause model, which argues that personality and depression are influenced by a shared variable (Bienvenu & Stein, 2003; Klein et al., 2011; Ormel et al., 2004), in this case, shared genetic factors. While our phenotypic findings established associations between depressive symptoms and personality traits conscientiousness and depression, evidence of shared genetic effects using behavioral genetics methods suggests a causal mechanism: a genetic etiology. Our findings indicate that genetic factors influencing the Competence facet of conscientiousness and Perseverance of Effort facet of grit have appreciable overlap with those factors impacting manifestation of depressive symptoms.

The sizeable proportion of genes simultaneously influencing these personality traits and depressive symptomology suggest the viability of these traits as intermediate phenotypes for depression.

These results could imply a genetic liability for depressive symptoms through manifestation of these personality traits, which may aid our understanding of the genetic bases for depressive symptoms.

Interestingly, we found sizeable shared genetic influences on Perseverance of Effort, which did not exhibit significant phenotypic correlations. Our results raise the possibility that weak or negligible phenotypic correlations do not necessarily preclude sizeable shared genetic influences. Most behavioral genetic studies require strong phenotypic correlations to justify multivariate ACE analyses, with the argument that phenotypic correlations must be high enough to warrant partitioning of covariances. We caution against adhering too strictly to this approach. The genetic correlation between two traits can be high regardless of whether the correlation between traits is high or low (Bouchard, 2004). Many factors may influence weak phenotypic correlations with depression, but nonetheless warrant behavioral genetic investigation of shared genetic influences. First, a weak phenotypic correlation may result from methodological limitations such as using an index of depression that measures breadth of symptoms rather than severity. Second, genetic components of a phenotype might be under-expressed or muted, resulting in weak phenotypic associations but sizeable shared genetic variance using behavioral genetics methods. Either of these explanations suggest that dismissing behavioral genetic investigation of non-significant or weak phenotypic correlations may overlook substantial shared genetic effects that may inform our understanding of genetic causal factors underlying personality-depression relationships.

It is worth considering why relations between personality traits conscientiousness and grit were not stronger predictors of depressive symptoms. Differences in measuring depression might

explain the small effect sizes. Two large meta-analyses reveal that the size of personality-depression relations can vary based on the measurement of depression. A meta-analysis by Kotov et al. (2010) compared diagnostic and control groups across 175 studies and found that conscientiousness yielded consistently strong effects with MDD, even after adjusting for neuroticism. In contrast, the meta-analysis of 33 studies by Malouff et al. (2005) included studies of clinical symptoms, which consistently reported 47% smaller effect size estimates for conscientiousness (averaged with neuroticism and extraversion) than investigations comparing diagnostic and control groups (Kotov et al., 2011). The weaker effect sizes in studies of symptoms versus diagnoses might be a consequence of greater range in disorder severity using a symptom-based and dimensional measure of depression than threshold criteria for clinical diagnosis. The former may include individuals who endorse symptoms less central to depression, while the latter by definition includes those who meet clinical criteria for deficits germane to the disorder. One limitation of these meta-analyses is that they do not report effect sizes at the facet-level, which might be due to the small number of studies in the literature examining personality facets, such that available data might be insufficient to allow a comprehensive meta-analysis (Kotov et al., 2010).

Our results from comparing relative contributions of grit and conscientiousness to depressive symptoms reveal substantial overlap between the two traits and in their contributions to depressive symptoms. Grit and conscientiousness do not contribute enough unique variance for both to independently predict depressive symptoms. However, despite substantial overlap in their contributions to depressive symptoms, the association of each trait with depressive symptoms may have clinical relevance on its own. To use the facets as an example, one can be high on competence but low on consistency of interests (e.g. perceive oneself as having domain-general

competence, across a variety of situations, without having consistent interests in any particular domain). Therefore, if personality is driving depressive symptoms, individuals high on competence but low on consistency of interests might still benefit from decreased risk for developing depressive symptoms. Alternatively, individuals low on competence but high on consistency of interests might be at risk for developing symptoms. Further, the utility of both traits is supported by our behavioral genetic analyses, which revealed that facets Competence and Perseverance of Effort have unique shared genetic influences with depressive symptoms after controlling for the other trait. In terms of clinical relevance, this might suggest that Grit and conscientiousness are sufficiently different as independent intermediate phenotypes for depressive symptoms.

Our study has several limitations. First, the cross-sectional design limited inferences about the direction of causality for personality-depression relationships. Second, we used a nonstandard approach for assessing a dimensional range of depression. Using the YADISC, we assessed depressive symptoms, which is arguably a measure of breadth rather than severity of symptoms. By contrast, more commonly used dimensional measures of depression such as the BDI or Hamilton Depression Rating Scale provide an index of both breadth and severity. Although both indices are arguably correlated, our methodology yields results that are harder to directly contrast with those of past studies such as the Regan et al. 2013 study, which found stronger effects with grit using the BDI. Another potential limitation of the cross-sectional study design is risk that the NEO PI-R and Grit scale are no longer valid when assessed in a clinical population with depressive symptoms. This concern is at least partially mitigated by the Costa et al. (2005) study, which found that under conditions of acute depression, NEO PI-R scales show high internal consistency and replicated the normative factor structure, suggesting that psychometric properties of the scale are preserved. Our sample is likely milder in overall depressive severity than that of

Costa et al., (2005), with only a small portion of individuals in our study meeting clinical criteria for MDD ($N = 15$) in an overall sample of 248 individuals. Thus, as in the case of Costa et al., (2005), the psychometric properties of the NEO PI-R scale in our study are likely preserved. Further, good test-retest reliability at baseline depression and recovery show that personality traits are accurately reported under conditions of depression (Costa et al., 2005). Together, these findings are at least consistent with the possibility that the domain and facet-level conscientiousness trait precedes onset of depressive symptoms and may causally influence onset. Unfortunately, the validation of the Grit Scale in a clinical population has not yet been conducted, which leaves open the possibility that the scale may not retain its psychometric properties or meet criteria for validity under non-normative conditions of psychopathology. Another limitation of our investigation is the relatively small sample sizes for a bivariate ACE analysis, resulting in genetic correlation confidence intervals that encompass zero. Although we cannot rule out the possibility that genetic variance is negligible, the DZ correlations among opposite-sex twins were as high or higher than that of DZ same-sex twins for the key personality variables, indicating that sex differences among DZ pairs did not play a role in inflating heritability for these variables.

Overall, our findings reveal previously unexplored facet-level relations between grit and depressive symptoms, while uncovering a previously unreported association between the conscientiousness facet of deliberation with depressive symptoms. We also found previously unreported shared genetic variance with depressive symptoms for Perseverance of Effort facet of grit, and Competence facet of conscientiousness. Further, by examining the relative contributions of grit and conscientiousness with depressive symptoms, we found unique shared genetic influences with depressive symptoms, suggesting differential effects not apparent in phenotypic analyses. Our phenotypic and behavior genetic analyses also helped to identify personality-

depression explanatory models for conscientiousness and grit. Finally, we encourage further longitudinal examination of facet-level grit and conscientiousness associations with depressive symptoms with an emphasis on assessing validity of the Grit Scale in a non-clinical sample.

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Table 1. Means, Standard Deviations, and Ranges for Study Variables

	M	SD	Range
Grit	42.93	6.05	0-60
Perseverance of Effort	23.48	3.88	0-30
Consistency of Interests	19.46	4.35	0-30
NEO-Conscientiousness	126.28	22.16	0-192
Competence	22.22	4.46	0-32
Achievement-Striving	20.78	4.70	0-32
Dutifulness	23.28	4.81	0-32
Deliberation	18.97	5.28	0-32
Self-Discipline	22.30	5.06	0-32
Order	18.72	4.51	0-32

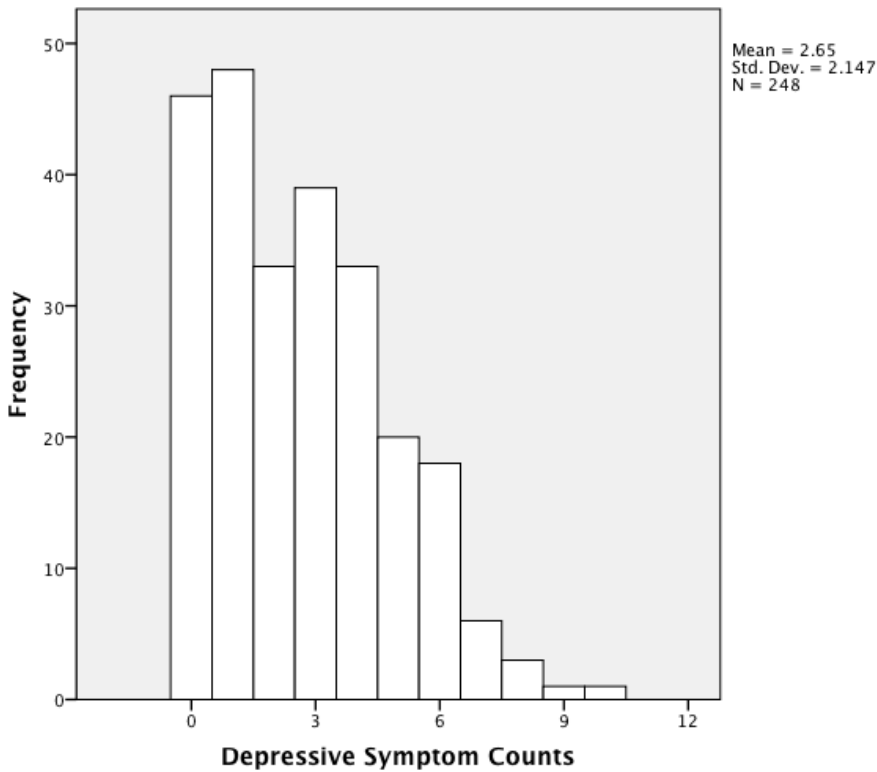


Figure 1: Distribution of depressive symptoms

Table 2: ANOVA Results Comparing Full Model with Grit to Null Intercept Model

Model	Df	AIC	BIC	logLik	Deviance	Chisq	Df	<i>p</i>
Intercept	3	1045.2	1055.7	-519.6	1039.2	--	--	--
Full (Grit)	4	1038.3	1052.4	-515.2	1030.3	8.86	1	0.003
Full (Consistency of Interests)	4	1038.6	1052.7	-515.3	1030.6	8.58	1	0.003
Full (Perseverance of Effort)	4	1045.4	1059.5	-518.7	1037.4	1.80	1	0.182

Table 3: ANOVA Results Comparing Full Model with Conscientiousness to Null Intercept Model

Model	Df	AIC	BIC	logLik	Deviance	Chisq	Df	<i>p</i>
Intercept	3	1045.2	1055.7	-519.6	1039.2	--	--	--
Full (Conscientiousness)	4	1040.5	1054.5	-516.2	1032.5	6.75	1	0.01
Full (Deliberation)	4	1039.8	1053.8	-515.9	1031.8	7.41	1	0.01
Full (Competence)	4	1039.8	1053.8	-515.7	1031.5	7.72	1	0.01
Full (Dutifulness)	4	1040.6	1054.7	-516.31	1032.6	6.58	1	0.01
Full (Self-Discipline)	4	1041.6	1055.7	-516.8	1033.6	5.59	1	0.02
Full (Order)	4	1046.8	1060.9	-519.42	1038.8	0.36	1	0.55
Full (Achievement- Striving)	4	1046.7	1060.8	-519.35	1038.7	0.49	1	0.49

Table 4: Significant Personality Associations with Depressive Symptoms

Parameter	Estimate	Std. Error	% Variance
Grit	-0.024	0.008	1.53
Consistency of Interests	-0.033	0.011	1.43
Conscientiousness	-0.006	0.002	1.15
Competence	-0.031	0.011	1.31
Deliberation	-0.026	0.010	1.29
Dutifulness	-0.027	0.011	1.18
Self-Discipline	-0.023	0.010	0.96

Table 5. Twin Correlations for Personality Variables

Personality Trait	MZ correlation (<i>N</i> =112)	DZ correlation (<i>N</i> =100)		
		Overall	Same Sex (<i>N</i> =54)	Different Sex (<i>N</i> =46)
Grit	0.46	0.21	0.10	0.28
Perseverance of Effort	0.49	0.31	0.21	0.39
Consistency of Interests	0.45	0.09	0.04	0.11
NEO- Conscientiousness	0.63	0.07	-0.02	0.08
Competence	0.61	0.33	0.25	0.39
Achievement- Striving	0.38	-0.05	-0.02	-0.08
Dutifulness	0.58	0.24	0.28	0.20
Deliberation	0.56	-0.05	-0.03	-0.12
Self-Discipline	0.47	0.18	0.05	0.24
Order	0.04	0.02	0.03	-0.07

Table 6. Univariate Genetic Model-Fitting Results of Proportion of Variance after Covarying for Sex

Variables	Parameter Estimates (95% CI)			Model Comparison Tests for Assumptions of Homogeneity		
	a^2	c^2	e^2	χ^2	df	p
Grit	0.40 (0, 0.60)	0.03 (0, 0.48)	0.56 (0.40, 0.78)	0	1	0.99
Perseverance of Effort	0.22 (0, 0.61)	0.24 (0, 0.55)	0.54 (0.38, 0.73)	0.30	1	0.58
Consistency of Interests	0.43 (0, 0.61)	0.00 (0, 0.33)	0.57 (0.39, 0.80)	-0.75	1	1
NEO-Conscientiousness	0.58 (0.16, 0.71)	0.00 (0, 0.36)	0.42 (0.29, 0.60)	1.89	1	0.17
Competence	0.38 (0, 0.72)	0.21 (0, 0.61)	0.40 (0.27, 0.58)	1.92	1	0.17
Achievement-Striving	0.32 (0, 0.50)	0.00 (0, 0.35)	0.68 (0, 0.90)	0.44	1	0.51
Dutifulness	0.43 (0, 0.69)	0.13 (0, 0.57)	0.44 (0.30, 0.63)	4.45	1	0.03
Deliberation	0.12 (0, 0.34)	0.00 (0, 0.19)	0.88 (0.66, 1)	-1.74	1	1
Self-Discipline	0.39 (0, 0.61)	0.06 (0, 0.51)	0.56 (0.39, 0.77)	0.98	1	0.32
Order	0.03 (0, 0.33)	0.04 (0, 0.25)	0.93 (0.67, 1)	1.84	1	0.17
Depressive Symptoms	0.20 (0, 0.50)	0.09 (0, 0.43)	0.71 (0, 0.94)	0.52	2	0.77

Table 7. Bivariate Genetic Correlations of Depressive Symptoms and Personality Traits after Covarying for Sex

Personality Traits	r_a (95% CI)	Model Comparison Tests for Assumptions of Homogeneity		
		χ^2	df	p
NEOC*	-0.21 (-1, 0.96)	3.18	4	0.53
Competence*	0.45 (-0.86,1)	4.69	4	0.32
Deliberation*	-0.07 (-0.97, 1)	8.05	4	0.09
Dutifulness*	-0.14 (-1, 1)	3.79	4	0.44
Self-Discipline*	-0.24 (-1,1)	1.46	4	0.83
Achievement	-0.12 (-1,1)	3.55	4	0.47
Order	-1 (-1,1)	6.67	4	0.15
Grit	0.18 (-1, 1)	2.15	4	0.71
Consistency of Interests	0.11 (-0.94,1)	7.1	4	0.13
Perseverance of Effort	0.37 (-1,1)	5.57	4	0.23
Competence, controlling for Perseverance of Effort	0.47 (-1,1)	2.16	3	0.54
Perseverance of Effort, controlling for Competence	0.41 (-1,1)	0.18	3	0.18

Note. Asterisks indicate traits having significant phenotypic correlations with depressive symptoms.