

Testing Construct Redundancy: Resilience, Grit, Hardiness, and Mental Toughness

By

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Dedication

Death is not often a part of a graduate student's thesis experience. But in the last few weeks of writing this thesis, I lost not only a gentle, caring, knowledgeable thesis advisor, but also an amazing, funny, caring and stoic classmate and friend. I would, therefore, like to dedicate this work to them as they are both part of my success story.

To my thesis advisor, Dr. Vic Catano, who inspired the topic for this thesis and whose knowledge, continued support, mentorship and patience allowed me to weather all the ups and downs that goes along with it. Thank you for helping me be resilient, gritty, hardy and mentally tough throughout the entire process.

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Abstract

Testing Construct Redundancy: Resilience, Grit, Hardiness, and Mental Toughness

By Jennifer P.B. Price

Given the possible conceptual and content overlap between resilience, grit, hardiness, and mental toughness, it is important to investigate whether or not they are redundant constructs. As such, the primary purpose of my research, was to empirically determine whether resilience, grit, hardiness, and mental toughness represent construct redundancy. I assessed the content, construct and criterion validity of resilience, grit, hardiness, and mental toughness. The main findings of the three validity analyses indicated that there seems to be a strong argument which suggests that the four constructs are largely redundant (even though there is some evidence of their unique contributions). It showed that a common General Resiliency Factor exists across all four constructs of interest. While the group factors and the dimensions provided unique variances, this may be as a result of each construct author describing the larger construct of “Resilience” from different points of view.

July 15, 2019

Testing Construct Redundancy: Resilience, Grit, Hardiness, and Mental Toughness

It is often difficult to tell whether the constructs of resilience, grit, hardiness and mental toughness¹ are distinct from each other and measure different traits as some authors use these terms interchangeably in their studies (Stoffel & Cain, 2018). Other authors also use these terms to define one of the other three terms or use one of the constructs as part of the name of a scale they have developed for one of the other constructs. Take for example, the Connor-Davidson Resilience Scale (CD-RISC), which is a measure of resilience --- during the factor validation of the scale, Connor and Davidson (2003) named one of the factors '*hardiness*.' Another example is the long-form title of the DRS-15, a measure of hardiness, which is called the *Dispositional Resilience Scale 15* (Bartone, 2007). Several authors have also noted in their studies that hardiness is a construct related to resilience, as well as to other constructs also ascribed to being resilient such as good health, performance under stressful conditions, and adaptation (Maddi & Kobasa, 1984; Bartone, Richard, & Maddi, 1999; Ramanaiah, Sharp, & Byravan, 1999; Lang, Goulet & Amsel, 2003; Bartone, 2007). Stoffel and Cain (2018) reviewed literature pertaining to grit and resilience in health profession education and they found that, "Literature pertaining to grit and resilience reveals that the terms are nuanced, complex, and difficult to measure and understand" (p.125). Meanwhile, mental toughness, a concept that originated in the realm of sports (Clough et al., 2002) seem to have some communalities not only with hardiness, but with grit as well. Martin, Byrd, Watts and Dent., (2015) found that grit was related to sport engagement and that athletes who were assessed as high in grit were also more engaged in their

¹ The constructs of resilience, grit, hardiness and mental toughness as a group of constructs will also be referred to as "the four constructs of interest" in this paper.

sport. Unfortunately, there are currently no studies that have considered all four constructs simultaneously. Given the possible conceptual and content overlap between the four constructs of interest, it is important to investigate their similarities and their differences and to contribute to construct parsimony in scientific literature.

This was the purpose of my research. Specifically, I assessed the content, construct, and criterion-related validity of established measures of resilience, hardiness, grit, and mental toughness. I was particularly concerned with whether or not the constructs assessed by these instruments were redundant.

Construct Redundancy

A construct is a human attribute that is believed to be associated or reflected in a related test performance (Cronbach & Meehl, 1980). Construct redundancy occurs when numerous constructs – for example, resilience, grit, hardiness and mental toughness --- appear in literature and seem to be theoretically and empirically similar (Le et al., 2010). More specifically, construct redundancy occurs when the theoretical construct definitions are similar and their correlations are substantial (Le et al., 2010). According to Morrow (1983), construct redundancy would be demonstrated by a, “high, positive intercorrelations among the relevant measures” (p. 496) in between the ranges of .6 to .8 due to common variance shared by the measures. It can also occur when new constructs are being proposed which are similar to already existing ones. Often these new constructs lack discriminant validity, meaning that they may be redundant with constructs already in existence and therefore becomes an example of construct proliferation (Le et al., 2010).

“The lack of knowledge about concept redundancy is not a new problem in organizational research. It characterizes other areas (e.g., organizational climate and job

satisfaction; leadership) and stems from researchers' lack of fascination with construct validation studies” (Schwab, 1980 in Morrow, 1983, p. 496). Le et al. (2010) noted in their paper that construct redundancy and construct proliferation still poses major problems 30 years on, not only in industrial/organizational psychology, but in other social science domains as well. Several researchers (Cole, Walter, Bedeian, & O’Boyle, 2012; Hershcovis, 2011; Le et al., 2010; Morrow, 1983; Rousseau, 2007; Schmidt, 2010; Schwab, 1980) have found this problem as a cause for major concern --- one which they consider as a major failure to apply the canon of parsimony in science. Construct redundancy can prevent science from advancing and accumulating its knowledge base (Blalock, 1968; Le et al., 2010; Singh, 1991; Tesser & Krauss, 1976). Simply stated, construct redundancy can result in the creation of separate lines of research that do not align with each other, and give the false impression of complexity when simpler principles exist at a deeper level (Highhouse et al., 2017). Despite this fact, the number of new constructs in literature highlights the fact that this problem continues to exist in research, which suggests that this is becoming a “...fundamental problem in organizational research” and one that is not easy to deal with (Le et al., 2010, p. 112).

According to Singh (1991) in order for constructs to be considered distinct, they must meet two requirements: conceptual and empirical distinctiveness. Highhouse et al. (2017) later added a third test to construct redundancy, which is the ability to demonstrate that constructs are related to some meaningful outcome or criteria, which is not only useful but also offer different information than any another construct. As it is possible for constructs to be found theoretically distinct and yet still be empirically redundant (Le et al, 2010; Schwab, 1980), it is, therefore, important that all three requirements are explored in order to ascertain if resilience, grit, hardiness and mental toughness are distinct constructs. As such, the primary purpose of my

research was to empirically determine whether resilience, grit, hardiness, and mental toughness represent distinct constructs by assessing the content, construct and criterion validity of resilience, grit, hardiness, and mental toughness.

Definitions of Resilience, Grit, Hardiness and Mental Toughness

Resilience

The concept of resilience has been applied in practice and in research in almost every area of both life and academia (Garcia-Dia, DiNapoli, Garcia-Ona, Jakubowski, & O’Flaherty, 2013). Resilience is described as an individual’s ability to cope and recover from adverse emotional experiences and to adapt to stressful situations (Arthur, Fitzwater, Beattie, & Bell, 2015). The word “resilience” hails from the Latin word “resiliens,” which translates to “to rebound, recoil” (Garcia-Dia et al., 2013, p. 264). The theoretical definition of resilience is, “...one’s ability to bounce back or recover from adversity” (Garcia-Dia et al., 2013, p. 267). According to Smith et al. (2008) “While resilience has been defined as resistance to illness, adaptation, and thriving, the ability to bounce back or recover from stress is closest to its original meaning” (p. 194).

There are currently two points of view on resilience. The first is that resilience is a trait which is fixed and stable referring to a personality trait that may be used to manage, negotiate and adapt to stress or trauma (Lee et al., 2013). In this view, resilience is considered a positive personality characteristic that focuses on human strengths that enhance an individual’s mental wellness and optimal functioning as well as adaptation (Kotze & Kleyhans, 2013; Oshio, Taku, Hirano, & Saeed, 2018). Individuals who are considered to be resilient can overcome stressful situations and avoid burnout and other factors affecting psychological well-being (Kotze & Kleyhans, 2013). Simply put, resilience protects one against adversity (Lee et al., 2013).

Defining resilience as a personality trait, however, fails to account for the idea that resilience is a dynamic process, malleable over time, and is formed by the interactions of various factors surrounding the individual (Dyer & McGuiness, 1996). Lee et al.'s (2013) meta-analysis study of resilience found it to be the latter. Their findings support Tusaie and Dyer's (2004) concept of resilience as a dynamic process that not only protects an individual during adverse conditions, but also enhances therapeutic results against risk factors. Specifically, Lee, Nam, Kim, Kim, Lee, and Lee's (2013) meta-analytic study of resilience found that "in general, the largest effect on resilience was found to come from the protective factors (e.g. life satisfaction, optimism, self-efficacy), the medium effect came from risk factors (e.g. anxiety, depression, perceived stress), and the smallest effect was allied to demographic factors (e.g. age, gender)" (p.273). According to Lee et al. (2013), the strong correlations among these variables with resilience indicate that the resilience construct are comprised primarily of these variables. Among the protective factors, self-efficacy, positive affect and self-esteem had the strongest correlation with resilience as compared to any other factors studied which indicates that the resilience construct is mainly comprised of these factors (e.g. life satisfaction and optimism) (Lee et al., 2013). Among the risk factors, depression had the strongest correlation to resilience as compared to other factors normally investigated (e.g., PTSD and negative affect) (Lee et al., 2013). In comparison to protective factors and psychological risk factors, the effect size for demographic factors were not significant (Lee et al., 2013).

Grit

Duckworth, Peterson, Matthews and Kelly (2007) defined grit as a sustained and passionate pursuit of a given goal or interest (Duckworth et al., 2007). It emphasizes the idea of long-term stamina in maintaining effort and interest over a long period of time (i.e. years) despite

problems, distractions, lack of feedback, lack of progress, setbacks, and failures (Duckworth et al., 2007). Grit is operationalized as a multidimensional construct with two facets: perseverance of effort (henceforth referred to as “perseverance”) and consistency of interest (henceforth referred to as “consistency”) (Credé, Tynan, & Harms, 2017). Both are considered to contribute to success as perseverance is necessary to master any endeavor particularly when it initially involves failures that the individual must overcome, and consistency which refers to the many hours of deliberate practice that is necessary to master any endeavor (Credé, et al., 2017; Ericsson, Krampe, & Tesch-Römer, 1993). Duckworth et al. (2007) found that grit demonstrated incremental predictive validity over and above IQ and conscientiousness as a predictor of success in an academic setting where a sustained focus of the application of talent is required.

Hardiness

The hardiness construct was introduced in 1979 as a way to explain how some individuals are able to better manage stressful situations in a way that turns them from a debilitating experience to a developmental one (Maddi & Khoshaba, 1994). Kobasa (1979a) primarily looked at the relationship of stress and illness, basically stating that hardy individuals (in the case of her study, hardy executives) were able to manage their stress better and are able to stay healthy (Kobasa, 1979a). According to Kobasa (1979a), hardiness is comprised of three interrelated concepts; commitment, control, and challenge. Commitment refers to a person’s sense of purpose and their ability to persevere under pressure. Control refers to one’s strong belief in having personal control over life events and their outcomes. Challenge refers to a person’s ability to respond to change and see it as a potential for growth (Kobasa, 1979a; Ramanaih, et al., 1999). According to Maddi & Khoshaba (1994), the concepts together constitute, “...positivity and resilience in facing life’s tasks” (p. 267). Individuals who are high on hardiness exhibit a strong

sense of commitment to their work and are actively engaged in their environment, believe that they are able to control their own situation, and enjoy new challenges (Bartone, Roland, Picano & Williams, 2008; Gerber, Kajak, Lemola, Clough, Perry, Puhse & Elliot, 2013; Catano, 2015).

Mental Toughness

While there is not one defining model for the construct of mental toughness, there is a general consensus that the mental toughness is a multifaceted construct that enables a person to effectively manage stress and rebound after a setback (Crust, 2008; Gucciardi & Mallett, 2010). Mental toughness has been described as an individual's capacity to consistently produce high levels of performance despite the daily challenges, stressors and significant adversities (Zeiger & Zeiger, 2018; Gucciardi, Hanton, Gordon, & Temby, 2015). Primary definitions of the construct have always included aspects of coping effectively (better than others, e.g. opponents) with stress, multiple demands, and significant adversities (Jones, Hanton, & Connaught, 2002; Thelwell, Weston, & Greenlees, 2005; Coulter, Mallett, & Gucciardi, 2010; Middleton, Martin & Marsh, 2011; Clough & Strycharczyk, 2012; Hardy, Bell, & Beattie, 2014), perseverance (Gucciardi & Hunton, 2016; Middleton et al., 2011; Hardy et al., 2014), consistency in performing and producing at a high level (Gucciardi et al., 2015), and goal orientation (Gucciardi, Gordon, & Dimmock, 2008; Coulter et al., 2010; Hardy et al., 2014).

Gucciardi (2017) later added to the definition stating that mental toughness is “a state-like positive psychological resource that is purposeful, flexible, and efficient in nature for the enactment and maintenance of goal directed pursuits” (p. 18). He stated that this distinction is important in that mental toughness endures through different situations and time, and is open to development and change. Individuals high in mental toughness tend to be more competitive, and

are able to maintain a high effort level regardless of the circumstances (Perry, Clough, Crust, Earle & Nicolls, 2012).

The mental toughness construct seems to have evolved from the domain of sports psychology and was identified as being crucial for success in competitive sports and in the development of champions in sports (Sheard et al., 2009). Although originally conceived to better understand athletic performance under stress, the mental toughness construct has been applied to other domains of studies such as managerial performance and age differences (Merchant et al., 2009), personality (Horsburgh, Schermer, Veselka & Vernon, 2009), attitudes to risk-taking (Crust & Keegan, 2010); imagery use (Mattie & Munroe-Chandler, 2012), education (St. Clair-Thompson et al., 2014), dark triad (Onley, Veselka, Schermer & Vernon, 2013), and adolescent stress (Gerber et al., 2013).

Relationships between Resilience, Grit, Hardiness and Mental Toughness

Resilience, grit, hardiness, and mental toughness seem to tap into the same factors, or at least overlap to some degree. As discussed above, they all seem to be associated with positive psychology, and they seem to have an aspect of being able to perform well under stress, the ability to bounce back from a difficult and/or traumatic situation, and the ability to cope. The constructs of grit, hardiness and mental toughness also seem to have some aspect of resilience built in them. In an interview with Perkins-Gough (2013), Angela Duckworth stated that resilience is a part of the definition of the grit construct in that, “part of what it means to be gritty is to be resilient in the face of failure or adversity. But that’s not the only trait you need to be gritty” (p. 14). According to Duckworth, grit is not just about being resilient in the face of failure and adversity, but about being fully committed to a path or endeavor over many years (Perkins-Gough, 2013). However, despite this clarification, Duckworth noted that half of the Grit items

are about responding resiliently to adverse situations and failure, while the other half were related to the idea of consistency of interest over a long period of time --- the latter, she states, has nothing to do with adversity or failure, rather it is about giving up other things in life and choosing to pursue other things in order to succeed (Perkins-Gough, 2013).

Stoffel and Cain (2018) agreed with these findings. In 2018 they conducted a literature review on the constructs of grit and resilience in which they noted that grit and resilience, while being related terms and are often used interchangeably are actually, “completely different constructs” (p.125). They state, however, that “By definition, resilience is an inherent attribute of grit” (Stoffel & Cain, 2018, p. 125). They further state that from a research point of view, “analysis of grit and resilience is complex because the terms themselves are conceptually weak, overlap with other constructs and terms, and are often misapplied in the literature” (Stoffel & Cain, 2018, p. 130). The authors, however, were drawing their conclusions from analyzing the results of different research which did not specifically look at the possible empirical overlap of the two constructs.

Grit and hardiness seem to also be related constructs. More specifically, grit perseverance and hardiness commitment seem to be describing the same factor in that both stress the importance of persevering under pressure (Credé et al., 2017; Kobassa, 1979a). The mental toughness construct seems to suffer from a similar identity crisis as it has been noted that it is often used interchangeably with resilience (Gucciardi, 2010). However, proponents of the construct argue its distinctiveness from the resilience construct in that mental toughness is more confined to psychological resources of people while resilience is a broader term that can apply to different systems (e.g. groups, organizations, and ecosystems) and not just to individuals (Gucciardi, 2010). They also argue the resilience is based on a range of protective factors such as

personal (e.g. biological factors), community (e.g. social support), and societal (e.g. health and social services) while mental toughness is more focused on only one type of protective factor – the individual. Finally, they argue that resilience is mostly a reactive adaptation to stress or adversity, while mental toughness is more appropriate for goal-directed endeavors which requires one to be both proactive (e.g. planning for a competition) and reactive (e.g. recovering from an injury) (Guiccardi, 2010).

In a related finding, Lin, Mutz, Clough and Papegeorgiou (2017) argued that while mental toughness does share similarities with the construct of resilience in that, "...they promote positive adaptation in the face of adversity" (p. 2), mental toughness, however, is distinct from resilience for two important reasons. First, resilience is a broad construct that consists of a range of protective factors and therefore is not directly measured but is instead inferred whereas mental toughness, "...is measurable as a specific set of traits" (Lin et al., 2017, p. 2). However, the existence of several resilience scales that directly measure resilience seems to contradict Lin et al.'s (2017) argument. Second, resilience assumes the existence of risk in the environment but mental toughness does not. Instead, mental toughness is not only associated to a person's reaction to risk, but also includes the concept of seeking out challenges for personal growth (Lin et al., 2017). Other arguments for its distinctiveness have claimed that mental toughness in athletes and coaches is one of the most crucial psychological traits in achieving athletic excellence (Bull, Shambrook, James, & Brooks, 2005; Jones, Hanton, & Connaughton, 2007). Sheard et al. (2009) noted that mentally tough individuals have the, "ability to bounce back from stressful experiences, such as competitive sport, quickly and effectively" (p. 188), which directly links the construct of mental toughness with the construct of resilience. They also stated that

mental toughness is likely facilitated by an athlete possessing enduring characteristics, one of which is hardiness (Sheard et al., 2009), directly linking it to the construct of hardiness.

While mental toughness has traditionally been associated with sports and athletic performance, the hardiness construct has also been used to identify important personality constructs in sports-specific situations, such as an ability to recover more quickly from an injury by high-level sports performers (Sheard & Golby, 2010). This finding is further echoed by Horsburg et al. (2008) noting that Clough et al.'s (2002) definition of mental toughness was based on an already established psychological construct known as hardiness which was first proposed by Kobasa (1979b). In addition, mental toughness has often been thought to involve aspects of resilience such as confidence, commitment, self-belief, concentration, and the ability to cope with pressure, some of which are also associated to the construct of resilience (Delaney et al., 2015). Clough, Earle and Sewell (2002), one of the earlier authors on the subject, noted that resilience was a key aspect of the construct, stating that a mentally hardy athlete is one who does, "...not easily balked in the face of opposition or adversity" (Clough et al., 2002, p. 4). Clough et al. (2002)'s model of the mental toughness construct, also took inspiration from Kobasa's (1979b) study on hardiness, noting that the model they developed, "...pays a healthy respect in theoretical terms to the 'hardiness' approach utilized within health psychology" (Clough et al., 2002, p. 38). They, however, believed that confidence was also an important factor in sports performance, and one that was not considered as a distinct element in previous hardiness models (Clough et al., 2002), a notion supported by Sheard et al. (2009).

The above arguments, while offered to argue for the distinctiveness of the mental toughness construct, would seem, at best, to indicate that mental toughness is nested within the definition of resilience. In addition, no empirical analyses have been conducted to substantiate

these arguments. Of the four constructs of interest, mental toughness seems to be the most problematic due to the fact that despite two decades of study in the area of mental toughness, there still remains some confusion and disagreement regarding its meaning, distinctiveness, usefulness, and practice, which has led some authors to challenge its legitimacy as a scientific construct (Gucciardi, 2015). Given several authors' assertions of the mental toughness construct's association with the constructs of resilience and hardiness it would be worthwhile to include this construct in this analysis.

While Meriac, Slifka and LaBat (2015) examined the potential of empirical redundancy of work ethic and grit, to date, there has only been one study that analyzed the possible construct redundancy of three of the four constructs under consideration. Martin, et al. (2015) investigated the empirical construct redundancy of resilience, grit, and hardiness as a secondary focus on their research on resilience, grit, and hardiness as predictors of sports engagement and life satisfaction among wheelchair basketball players. Their study found that grit, hardiness, and resilience were all positively correlated ($r_s=.40, .41, \text{ and } .53$, respectively) (Martin et al, 2015). However, they explained that, "the moderate correlation among grit, hardiness, and resilience suggests that although they share some variance (16-26%), they appear to be measuring unique constructs" (Martin et al., 2015, p. 352). They further assert that given the lack of empirical evidence found in their study, "...it is clear that grit, resiliency, and hardiness are relatively distinct positive-psychological constructs, and the findings do not support the view that the three variables represent construct redundancy" (Martin et al., 2015, p. 355).

While Martin et al.'s (2015) findings seem to empirically establish the distinctiveness of the three constructs, their methodology to reach this conclusion only relied on the results of a correlational analysis and regression results on outcome variables. Since determining construct

redundancy was not Martin et al.'s (2015) primary focus for their study, it is understandable why they did not choose to follow a more stringent analysis to test for it. However, in not doing so, their study leaves some doubt as to the robustness of their results, particularly in light of the fact that the CD-RISC, the scale used to measure resilience in their participants, encompasses Kobasa's (1979b) study on hardiness (Connor & Davidson, 2003). More specifically, Connor and Davidson (2003), in their paper, specifically note that, "items reflecting control, commitment, and change [factors that make up the construct of hardiness by Kobasa (1979b)] viewed as challenge were included" (p. 77) in their measure. The CD-RISC scores were also found to be highly positively correlated with Kobasa's hardiness scale in psychiatric outpatients ($r=0.83$) (Connor & Davidson, 2003). One reason for Martin et al.'s (2015) findings may be due to the fact that they used the shortened version of the CD-RISC (8-items vice the full 25 originally conceived by Connor and Davidson (2003)) which may not be as nuanced as the longer original version. Another limitation of Martin et al.'s (2015) study that they identified in their paper, and which may have had an impact on their empirical results, is the uniqueness of their sample.

Stress, Psychological Well-Being and Personality

Stress and psychological well-being are outcomes commonly associated with resilience, grit, hardiness and mental toughness. In addition, the potential differences of personality traits as antecedents to these four constructs of interest were also explored in order to further ascertain if the four constructs of interest could be differentiated.

Stress

Abeloff et al. (2000) defines perceived stress as "The general concept of maladaptive psychological functioning in the face of stressful life events" (p. 556). Past research on the topic

of resilience and stress have found that individuals with high levels of stress are not as resilient as individuals with lower levels of stress (Bruwer, Emsley, Kidd, Lochner, & Seedat, 2008). Connor and Davidson (2003) found that the CD-RISC, a popular measure of resilience, showed significant negative correlation to stress, which indicates that individuals with higher levels of resilience have less perceived stress. Meriac et al. (2015) found overall grit to be negatively correlated to stress, as well as its factors of perseverance and consistency. A study looking at the relationship between grit, anxiety and stress among emergency physicians found that grit and perceived stress did not correlate significantly (Wong, Anderson, Knorr, Joseph, & Sanchez, 2017). Hardiness, however, has been found to be positively associated with perceived stress levels such that one must be able to clearly recognize stress in order to be able to address it and resolve the problem (Maddi, Harvey, Khoshaba, Fazel, & Resurreccion., 2009). This is supported by Maddi et al.'s (2011) finding of a weak positive correlation between hardiness and stress (Maddi et al, 2011). One study found that the different factors of hardiness may be differentially important in protecting against different types of stressors, for example, the challenge factor may be more important in protecting against stress related to achievement but considerably less important for other types of stressors such as a loss of a loved one (Kardum, Hudek-Knežević, Krapić, 2012).

Gerber et al. (2013) found that mental toughness mitigated the relationship between depressive symptoms and high stress among adolescents aged 18-23 years across two studies. Across two samples, mental toughness was found to be correlated with perceived stress (Gerber et al, 2013). The final analysis across both samples studied was that high levels of mental toughness was associated with lower levels of stress (Gerber et al., 2013). Furthermore, Gerber et al. (2013), claimed that, "...the influence of mental toughness as a resilience resource is of

practical relevance” (p. 168) and based on their findings that when predicting depressive symptoms, the interaction between mental toughness and stress accounted for 10% of the variance among young adults and 2% of the variance in the adolescent sample.

Psychological Well-Being

The concept of psychological well-being is closely linked to the concept of mental health. In practice, there have generally been two approaches to defining this term. One is the notion of positive mental health which refers to, “...behaviours, attitudes and feelings that represent an individual’s level of personal effectiveness, success and satisfaction” (Banks et al., 1980). This definition is not necessarily tied to mental illness in a clinical sense (Banks et al., 1980). The second definition is more directly associated with clinical or medical usage and is defined as the absence of mental illness (Banks, et al., 1980). Many of the studies relating to resilience, grit, hardiness and mental toughness seem to use the latter definition.

A meta-analysis on resilience and mental health found that resilience had a positive moderate correlation to positive indicators of mental health and a weak negative correlation to negative indicators of mental health with adults demonstrating stronger resilience than adolescents and children (Hu, Zhang & Wang, 2015). Grit has not only been linked to performance, cognitive ability and personality traits, but to numerous other traits and constructs including psychological well-being (Credé et al., 2017; MacCann & Roberts, 2010). In a study investigating the relationship between grit and medical resident well-being, Salles, Cohen, and Mueller (2014) found that after measuring grit at the first time point (baseline measurement), that it predicted later psychological health. On average, the study found that residents who possessed more grit as measured at baseline had lower rates of burnout six months later than those who possess less grit at the same time point (Salles, Cohen, & Muller, 2014). The authors also found

that residents who had, on average, higher levels of grit at baseline corresponded with significantly higher levels of psychological well-being six months later than those who had lowered grit levels at the same time point (Salles, Cohen, & Muller, 2014). Several studies (Maddi et al., 1994; Maddi et al., 2006; Maddi et al., 2009; Maddi, Harvey, Resurreccion, Giatras, & Raganold, 2007) have found hardiness to be associated with mental health despite stresses (Maddi et al., 2011). Another study also found hardiness to be negatively correlated with several psychopathological tendencies as measured by the Minnesota Multiphasic Personality Inventory (MMPI) such as depression (weak correlation), anxiety (moderate correlation), and social introversion (weak correlation) (Maddi et al., 1994). A study conducted by Kardum et al. (2012) found that while measures of hardiness overlapped with four of the five Big Five Personality Factors, that the construct hardiness demonstrated incremental variance in predicting mental health outcomes above and beyond personality factors.

Mental toughness has been referred to as a construct that entails the use of positive psychological resources, which are believed to be necessary in the context of achievement, as well as in the domain of mental health (Lin, Mutz, Clough, & Papegeorgiou, 2017). Gerber et al.'s (2013) study found that higher levels of mental toughness was associated with lower levels of depressive symptoms ($r=-.63$ and $-.65$) across two studies of adolescents, and that elevated levels of mental toughness mitigated the relationship between high stress levels and depressive symptoms. In a study of undergraduate students in the UK, Stamp et al. (2015) found that the factors of mental toughness demonstrated moderate to strong predictors of psychological well-being ranging from 35-64% of the variance explained. Overall, the results of the study showed that one or more mental toughness factor explained much of the variance for each of the well-being scale (Stamp et al., 2015).

Personality

The “Big Five” model of personality traits is the most the most often used model to study normal personality in trait psychology (Laverdière, Morin, & St-Hillaire, 2014). According to Costa and McCrae (1992), “the five factors represent the most basic dimensions underlying the traits identified in both natural languages and psychological questionnaires” (p. 14). It consists of five factors namely: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience (henceforth referred to as “Openness”), which was developed and elaborated by Digman (1990) over several decades (Costa & McCrae, 1992).

Extraversion is a personality dimension which consists of elements of sociability, assertiveness, activity, and talkativeness (Costa & McCrae, 1992). Agreeableness is often considered a dimension of interpersonal tendencies with an agreeable person often being seen as someone who is fundamentally altruistic, that is they are sympathetic towards others, are eager to assist, and believes that others will be just as helpful in return (Costa & McCrae, 1992). Conscientiousness is primarily concerned with the control of impulses with a conscientious person often being purposeful, strong-willed, and determined (Costa & McCrae, 1992). It is often associated with academic and occupational achievement (Costa & McCrae, 1992). Neuroticism is the only negative trait among the Big Five Factor, and is contrasted with emotional stability; it often describes a person who may be prone to psychological stress, irrational ideas, to have less control of their impulses, and to cope more poorly to stress than others (Costa & McCrae, 1992). Finally, Openness is a personality dimension often characterized by an active imagination, intellectual curiosity, independence of judgement, a preference for variety, an aesthetic sensitivity, and an attentiveness to inner feelings (Costa & McCrae, 1992). Although other models of personality exist, the Big Five Factor personality trait seemed to be the

popular choice when studying the relationship between personality and resilience, grit, hardiness and mental toughness.

Oshio et al. (2018) conducted a meta-analysis on the relationship between resilience and the Big Five personality traits. They found that, overall, resilience was negatively correlated with Neuroticism and positively correlated with the four other personality traits. Duckworth et al. (2007) found that grit was correlated with conscientiousness in two different samples at $r=.77$ and $r=.64$, however, they proposed that grit is distinct from traditional Big Five facet of Conscientiousness in that the former emphasizes stamina, which is not part of the definition of Conscientiousness. This argument, however, runs contradictory to Morrow's (1983) assertion and that this would actually fit his definition of redundant constructs. Meriac et al. (2015) also found that grit explained incremental variance in outcomes beyond Conscientiousness. Again, this runs against Meyer, Gamst, & Guarino (2017) conclusions which consider variables to be correlated in the middle .7s or higher to be collinear and essentially measuring the same characteristics. Indeed, Credé et al. (2017) found that grit, "...does not appear to be at all that different to conscientiousness" (p. 504).

With regards to hardiness, Ramanaiah et al. (1999) found that there was a significant difference in personality profiles between high hardiness and low hardiness groups such that the high hardiness group scored significantly lower on Neuroticism and significantly higher on Extraversion, Openness and Conscientiousness on the NEO Personality Inventory. Furthermore, the standard discriminant function coefficients were substantial for Openness and Conscientiousness on the NEO Personality Inventory (Ramanaiah et al., 1999). These findings were supported by a study conducted by Kardum et al. (2012) with a Croatian population in which they found that results of the Dispositional Resilience Scale (DRS, a measure of

hardiness) had the highest correlation with neuroticism, extroversion and openness, and had the lowest correlation with agreeableness. With regards to mental toughness, in a study by Delaney et al. (2015) using an undergraduate population, they found that four of the five Big Five Factor Personality traits significantly correlated with mental toughness, namely, Conscientiousness ($r=.41$), Extraversion ($r=.37$), Agreeableness ($r=.32$) and Neuroticism ($r= -.74$). Using the MTQ48 (a measure of mental toughness), another study using both monozygotic and dizygotic twins found moderately strong significantly negative correlations between the mental toughness factors and Neuroticism, ranging from $-.35$ to $-.64$ (Horsburgh, Schermer, Veselka, & Vernon, 2009). They also found significant positive correlations with the three mental toughness factors and Extraversion ($r=.26 - .50$), Openness ($r=.14 - .29$), Agreeableness ($r=.13 - .27$) and Conscientiousness ($r=.18 - .52$) (Horsburgh, Schermer, Veselka, & Vernon, 2009).

The Current Research

In order to test the construct redundancy of the four constructs of resilience, grit, hardiness, and mental toughness, I conducted two studies. Study 1 consisted of a sorting exercise to verify the content validity of the four main measures. Study 2 used empirical data to assess both construct and criterion validity.

From the foregoing review it is clear that there is considerable content overlap and conceptual confusion surrounding the four constructs. However, authors and researchers have also argued for the conceptual distinctiveness of their constructs and measures. Therefore, in my first study, I assessed the content validity of the measures by having subject matter experts (SMEs) sort the items. I proposed that:

Hypothesis 1: Items from the four measures will be sorted on to multiple constructs by SMEs.

The four constructs are also empirically related although there remains some debate over whether they are empirically redundant. In my second study, as a preliminary assessment of construct validity, I examined the correlations between measures of the four constructs using Martin et al.'s (1983) threshold for construct redundancy. I hypothesized that:

Hypothesis 2: The four constructs of resilience, hardiness, grit and mental toughness will be strongly correlated with each other (i.e. $r > .60$).

Highhouse (2017) argues that the above analysis is insufficient as it is not possible to estimate the contribution of the shared variances for predicting other external variables based on correlations alone. Accordingly, I also used a bifactor confirmatory factor model to more directly assess construct redundancy. Although bifactor models were introduced over 70 years ago, they have just recently started gaining popularity (Reise, 2012). While their use is somewhat novel in organizational research, this may be due more to a misunderstanding of the approach than its appropriateness (Highhouse et al., 2017). Bifactor modelling is appropriate to test for construct redundancy for several reasons.

First, it is appropriate as it tests for the amount of variance that is attributable to both a general factor that reflects the common variance present in all the measurement items (in the case of the current study, the four different measurements of the constructs of interest) and group² factors which are common among sets of items that are highly correlated (Reise, 2012).

² Highhouse et al. (2017) refers to these factors as “specific factors” while Reise (2012) prefers to refer to them as “group factors” and reserves the term “specific” for an item’s unique reliability variance (variance not shared with other items). This study will use Reies’ naming convention as it is felt that it captures the nature of the variances more aptly, and are therefore more easily understood.

Within a bifactor model, specific item reliability variance, which is the item's unique variance which is not shared with any other item, is also measured, along with variance attributable to random error (Rodriguez, Reise, & Haviland, 2016). The model's ability to measure the amount of the different variances overcomes the limitation of previous Confirmatory Factor Analysis (CFA) approaches when examining construct redundancy (Highhouse et al., 2017). Specifically, a bifactor model can be used to investigate the incremental validity of group factors over the general factor when predicting outcomes (Highhouse, 2017). Second, the use of a bifactor model allows the relationship between the measurement items and the group factors to be explicitly tested, which again allows for the estimation of both the general and the group factor variances (Highhouse et al., 2017). Finally, the bifactor model may be used to evaluate the incremental validity of the group factors above and beyond the general factor (Highhouse, 2016).

Given the use of the same or similar theories across the four constructs of resilience, grit, hardiness and mental toughness, as well as their similar results on stress, psychological well-being, and personality, it seems possible that a common general factor may exist across the four constructs. Furthermore, although conceptualized as multidimensional constructs, the measures of resilience, grit, hardiness and mental toughness also provide unidimensional scores of the respective constructs. I, therefore, hypothesized that:

Hypothesis 3a: Based on the literature review of the four constructs of interest, the best fit will be a bifactor model with a higher order construct, henceforth called General Resiliency Factor, along with the four group factors of resilience, grit and hardiness, and mental toughness.

Figure 1 represents the proposed bifactor model for general resilience and the four group factors representing the constructs of resilience, grit, hardiness, and mental toughness, as well as their respective items.

Hypothesis 3b: The four group factors of resilience, grit, hardiness, and mental toughness would provide incremental validity in predicting stress and psychological well-being over and above that explained by the General Resiliency Factor.

In terms of criterion-related validity, the extant literature suggests that measures of resilience, grit, hardiness, and mental toughness would be related to measures of stress, psychological well-being, and the “Big Five” personality traits. Therefore, I hypothesized that:

Hypothesis 4: The broader constructs of resilience, grit, hardiness, and mental toughness will each make a unique contribution to the prediction of stress.

Hypothesis 5: The broader constructs of resilience, grit, hardiness, and mental toughness will each make a unique contribution to the prediction of psychological well-being.

Hypothesis 6: The broader constructs of resilience, grit, hardiness, and mental toughness will be uniquely associated with the Big Five Personality Factors of Conscientiousness, Openness, Extraversion, Agreeableness, and Neuroticism.

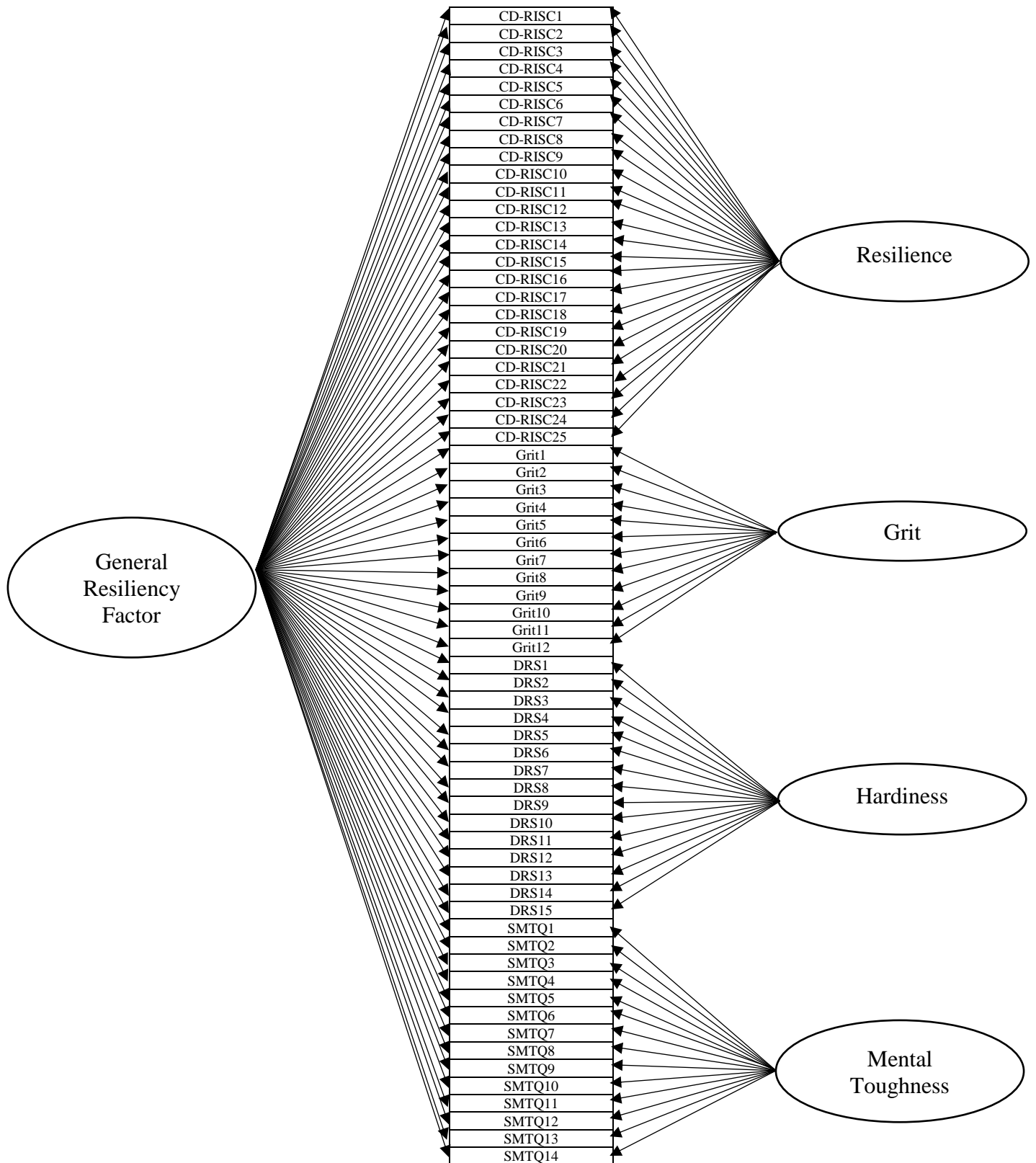


Figure 1: Proposed bifactor model for assessing the structure of Overall Resilience.

Although the group factors were allowed to correlate, all other factor correlations were constrained to zero (i.e. all the group factors were uncorrelated with the General Resiliency Factor). Lines indicating correlations among the variables is not represented in the above model for simplicity.

Study 1 – Content Validity

Method

Sample

Eighteen individuals who were either current Industrial/Organizational Psychology Masters or PhD students or who have already completed a post-graduate degree in the same domain were invited to participate in the item sorting exercise. The 18 were SMEs on content validity and were very familiar with the sorting activity; however, they were not experts on the topic of resilience and were therefore deemed appropriate participants for this task. Twelve SMEs completed the survey for a 67% return rate.

Procedure

Hinkin's (1985 and 1998) steps for assessing content validation with non-expert respondents was used to sort all 66 items into nine categories corresponding to the uni-dimensional resilience construct and the eight subfactors representing the grit, hardiness, and mental toughness constructs. Select participants were sent an email with a link to the online survey on Qualtrics. According to Hinkin (1998), an acceptable agreement index between the SMEs, which is the percentage of the respondents who correctly classify the items, should be a minimum of 75% (or nine out of 12 SMEs). Lawshe (1975), however, sets this index at 56% for 12 respondents (or seven out of 12 SMEs). For the purpose of this study, Lawshe's index was used given the low agreement between the SMEs on the items. The survey listed all 66 items from all four measures of resilience, grit, hardiness and mental toughness. Respondents were provided with the construct subfactor definitions created by the original measurement authors (as shown in Table 1). The mental toughness subfactor name of "control" was changed to "influence," which was part of the subfactor definition, in order for the respondents not to

confuse it with the hardiness subfactor of “control.” The term “influence” was still in keeping with the subfactor definition. The word “competitors” in mental toughness confidence Item 11 (“I have qualities that set me apart from other competitors”) was removed in order to make the item more general and not sport specific. No other changes were made to the items and they were presented in the survey as per their original versions. The respondents were asked to choose to indicate the category that best describes each item (“Please sort each item based on the definition provided below by clicking the appropriate category”). The SME responses were analyzed using SPSS version 24. A frequency count of each response on each item were taken with a potential maximum of 12 points per item.

Table 1 *Construct Subfactor Definitions*

Construct	Subfactor	Definition
Resilience	Resilience	Demonstrates the ability to “bounce back” or cope and recover from adverse emotional experiences and to adapt to stressful situations.
	Grit	
Grit	Perseverance	Demonstrates the ability to maintain effort over a long period (e.g. years) of time that is necessary to master any endeavour particularly when it initially involves failures that the individual must overcome.
	Interest	Demonstrates an interest despite problems, distractions, lack of feedback, lack of progress, setbacks and failures
Hardiness	Commitment	Demonstrates a sense of purpose and ability to persevere under pressure.
	Control	Demonstrates strong belief in having personal control over life events and their outcomes.
	Challenge	Demonstrates the ability to respond to change and see it as a potential for growth.
Mental Toughness	Confidence	Demonstrates one’s belief in their own abilities to achieve goals and be better than others.

Constancy	Demonstrates determination, personal responsibility, an unyielding attitude, and ability to concentrate.
Influence/Control	Demonstrates the ability to perceive that one is personally influential and can bring about desired outcomes with particular reference to controlling emotions

Results

Only three out of 66 items (4.5%) were sorted by all 12 SMEs into one category (resilience item #8, Resilience item # 22, and mental toughness item #5; however, only resilience item #8 was sorted into the correct construct (1.5%). All other items were sorted into multiple constructs and subconstructs. This finding supports Hypothesis 1. Furthermore, only 31 (47%) met Lawshe's (1975) Critical Value Ration (CVR) value (and only 20 (30%) using Hinkin's (1998) 75% agreement index). Of these, only three out of 25 (12%) items in the resilience construct, five out of 12 (42%) items in the Grit construct (only four (33%) in the correct subfactor), three out of 15 items (20%) in the hardiness construct, and three out of 14 (21%) in the mental toughness construct were correctly sorted. Finally, 17 (26%) were incorrectly sorted in a different construct all together. This provides further support to Hypothesis 1 that the items are not well understood by the users, and/or are not well-defined. Table 2 shows a full list and frequency count of all items.

Table 2 *SME Sorting of Construct Items*

Construct	Items	Resilience	Grit		Hardiness			Mental Toughness			
			Interest	Perseverance	Commitment	Control	Challenge	Confidence	Constancy	Influence	
Resilience	1	Able to adapt to change	6					6			
	2	Close and secure relationships	2			1	1		2	3	3
	3	Sometimes fate or God can help				1	9*				1
	4	Can deal with whatever comes	4				1	1	3	2	
	5	Past success gives confidence for new challenge						3	9*		
	6	See the humorous side of things	4	2				1	3		2
	7	Coping with stress strengthens**	8*						4		
	8	Tend to bounce back after illness or hardship **	12*								
	9	Things happen for a reason				1	8*	1			2
	10	Best effort no matter what				2		2			2
	11	You can achieve your goals					1	2	1	8*	
	12	When things look hopeless, I don't give up	3			2					1
	13	Know where to turn for help	2	1	1			2	2	2	2
	14	Under pressure, focus and think clearly	3		2	4			2		1
	15	Prefer to take the lead in problem solving						1	2	7*	2
	16	Not easily discouraged by failure	3	1	3	2			1	1	
	17	Think of self as strong person	1					1	9*	1	
	18	Make unpopular or difficult decisions	2		1				2	2	3
	19	Can handle unpleasant feelings**	8*					2		1	1
	20	Have to act on a hunch		3				2	4	2	1
	21	Strong sense of purpose				8*				2	1
	22	In control of your life						12*			
	23	I like challenges		2					10*		
	24	You work to attain your goals			5	4		1			2
	25	Pride in your achievements						1		10*	1

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Grit									
Interest	1	I often set a goal but later choose to pursue a different one. (R)		2	7*	2			1
	2	New ideas and new projects sometimes distract me from previous ones. (R)		4	2	1	1		4
	3	I become interested in new pursuits every few months. (R)		4	4			3	1
	4	My interests change from year to year. (R)**		7*	4			1	
	5	I have been obsessed with a certain idea or project for a short time but later lost interest. (R)		6	4				2
	6	I have difficulty maintaining my focus on projects that take more than a few months to complete. (R)				11*			1
Grit									
Perseverance	7	I have achieved a goal that took years of work.**			9*	2			1
	8	I have overcome setbacks to conquer an important challenge.	9*	1	2				
	9	I finish whatever I begin.**			9*	1			2
	10	Setbacks don't discourage me.	2	4	4	1		1	
	11	I am a hard worker.	1		4			1	3
	12	I am diligent.			6	1			2
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Hardiness ^a									
Commitment	1	Most of my life gets spent doing things that are meaningful.		2		5	2		1
	4	DRS2	1	2		4	1	2	1
	7	DRS3		6		1		1	2
	10	DRS4		10*				1	1
	13	DRS5		9*	1			1	1
Control	2	By working hard you can nearly always achieve your goals.			3	2	2	1	4
	6	DRS7					9*		3
	8	DRS8					6	1	5
	12	DRS9					10*		2
Challenge	15	DRS10					6		6
	3	I don't like to make changes in my regular activities. (R)	1				1	5	5
	5	DRS12		2			1	6	3
	9	DRS13		1		1		9*	1
11	DRS14	1				5	2	4	
<hr/>									

		14	DRS15			4	3			5
Mental Toughness										
Confidence	13	I interpret potential threats as positive opportunities	1	1			10*			
	5	I have an unshakeable confidence in my ability.**							12*	
	11	I have qualities that set me apart from others.**							9*	3
	6	I have what it takes to perform well while under pressure	1		1	4			6	
	14	Under pressure, I am able to make decisions with confidence and commitment	2		1	8*			1	
	1	I can regain my composure if I have momentarily lost it	7*		1					1 3
Constancy	3	I am committed to completing the tasks I have to do	1		1	8*				2
	12	I take responsibility for setting myself challenging targets					4	6		2
	8	I give up in difficult situations	5		5	1				1
	10	I get distracted easily and lose my concentration		4	2					5 1
Control	2	I worry about performing poorly (R)	2	1		1			5	1 2
	4	I am overcome by self-doubt(R)	3						9*	
	9	I get anxious by events I did not expect or cannot control (R)	2		1		7			1 1
	7	I get angry and frustrated when things do not go my way (R)	5	1	2		2	1		1

Note. Grit Perseverance = Perseverance of Effort; Grit Interest = Consistency of Interest; (R)=negatively worded item; DRS=Dispositional Resiliency Scale.

a. Due to proprietary rights, only a sample of the hardiness measure (DRS-15) is listed in this table.

*Signifies the subfactor for which the item met Lawshe's (1975) CVR.

**Signifies that the item met Lawshe's (1975) CVR and was sorted correctly by the SMEs.

Study 2 – Construct and Criterion Validity

Method

Sample

Respondents were recruited through two sources. Data was collected from 411 participants through Mechanical Turk (MTurk), an online data collection system. Sixty-Two respondents were eliminated for failing one or more attention checks in MTurk. Of the 349 remaining participants, the mean age was 37.28 ($SD=10.34$), 61.6% were males, 79.1% were White/Caucasian, 7.4% were Black, 4.3% were Hispanic/Latino, 5.2% were Asian, 1.1% were Native Americans, and 2.9 were “Other.” Most respondents had a university degree or higher (67.6%) or a high school diploma (31.2%). The majority of the respondents were employed full-time (64.8%) or employed in some capacity (30.7%), 4.3% were unemployed. Data was also collected through SONA, an online platform available to Psychology undergraduate university students at Saint Mary’s University. Two hundred and thirty-three participants responded; however, 70 were eliminated for failing one or more attention checks or for failing to complete the survey. Of the 163 remaining participants, the mean age was 21.91 ($SD=5.07$), 16.6% were males, 71.8% were White/Caucasian, 10.4% were Black, 1.8% were Hispanic/Latino, 4.9% were Asian, 4.3% were Middle Eastern, 1.8% were Native Americans, and 4.9 were “Other”. Some respondents already had a university degree or higher (28.8%), the majority had a high school diploma (67.5%) and 3.7% had “Other.” The majority of the respondents were employed part-time (53.4%), 4.3% were employed full-time, 9.8 were employed in some other capacity, 30% were unemployed, and 2.5% reported “Other. “

MTurk participants who complete the survey were paid \$3.00 USD for each completed study. Participants who completed it through SONA received 0.5 credits towards a course of

their choosing. Although the use of MTurk respondents has been controversial, the track record and rejection (HIT approval rating) of each respondent is public and may therefore be used to screen out unmotivated individuals (Highhouse et al., 2017). More importantly, previous studies have demonstrated that MTurk respondents provide reliable and generalizable data (Highhouse et al., 2017). For the current study, MTurk rejection rate was 15% and SONA rejection rate was 30%.

Demographic Scale.

Participants were asked to provide their age, gender, ethnicity, employment status (i.e. employed, unemployed) and the highest formal education completed.

Measures

Seven measures were administered to all the participants for a total of 142 items. All instruments used in this study have been used in previous research and all participant completion scores for these scales have resulted in acceptable alpha coefficients which are indicative of reliability and validity in past research (Bartone, 2007; Connor & Davidson, 2003; Cohen et al., 1983; Banks, et al., 1980; Duckworth and Quinn, 2007; Gosling, Goldberg, 1999; Sheard et al., 2009). The four main constructs of interest were measured with the Connor-Davidson Resilience Scale (resilience), the Grit-S (grit), The Dispositional Resilience Scale 15 (hardiness), and the Sport Mental Toughness Scale (mental toughness). The two outcome variables were measured using the Perceived Stress Scale (stress) and the General Health Questionnaire (psychological health). The 50-Item International Personality Item Pool as used to measure the Big Five model of personality.

Connor-Davidson Resiliency Scale (CD-RISC) (Connor & Davidson, 2003). The CD-RISC is a 25-item measure that assess overall resilience and stress coping ability ($\alpha=.94$) (Connor &

Davidson, 2003; Windle et al., 2011). Each item is rated on a 5-point scale ranging from 0 = not true at all to 4 = true nearly all of the time. Higher scores reflect greater resilience. It is comprised of five factors: personal competence, trust/tolerance/strengthening effects of stress/acceptance of change and secure relationships, control, and spiritual influences (Windle, Bennett, & Noyes, 2011) (As shown in Appendix A).

Grit-O (Duckworth & Quinn, 2009). The Grit-O is an 12-item self-report questionnaire. It has a two-factor structure ($\alpha=.89$) (Duckworth, Peterson, Matthews, & Kelly, 2007) which are Consistency of Interest ($\alpha=.87$) and Perseverance of Effort ($\alpha=.88$) (Duckworth & Quinn, 2009). Although conceptualized as a compound trait, with both domains loading on grit as a second-order latent factor, Duckworth and Quinn (2009) found the total Grit score was a better predictor of success in at least two independent studies than either factor alone based on what they report, "...is a consequence of its superior reliability (p. 172). It is scored on a five-point Likert-like scale from 1 = not at all like me to 5 = very much like me. (As shown in Appendix B).

Dispositional Resiliency Scale (DRS-15) (Bartone, 2008). The DRS 15 is a 15-item scale which was designed to measure psychological hardiness ($\alpha=.87$) and is based on hardiness literature derived from the original scales created by Kobasa (1979a) and Maddi and Kobasa (1984) consisting of Commitment ($\alpha=.87$), Control ($\alpha=.84$) and Challenge ($\alpha=.79$) (Windle et al., 2011; Bartone, 1999). The scale includes 15 positively and negatively keyed items. It is scored on a four-point Likert scale ranging from 0 = Not at all to 3 = Completely True. The total hardiness score is obtained by adding all the factor scores then summing all the summed factor scores (Multi-Health Systems Inc, 2017) (As shown in Appendix C).

Sports Mental Toughness Questionnaire (SMTQ) (Sheard et al., 2009). The SMTQ is a 14-item measure which yields a total mental toughness score consisting of three factors ($\alpha=.90$):

Confidence ($\alpha=.86$), Constancy ($\alpha=.74$), and Control ($\alpha=.80$) (Sheard et al., 2009). Responses to the SMTQ is made on a four-point Likert-type scale with anchors ranging from 1 = Not At All True to 4 = Very True (Cowden, Fuller & Anshel, 2014). The three subscale scores are added together to give a measurement of global mental toughness (Cowden, Fuller & Anshel, 2014). Although originally developed for use in a sports environment, the items represent the general mental toughness construct and are worded such that they are applicable to a broader population (As shown in Appendix D).

Perceived Stress Scale (PSS) (Cohen et al., 1983). The PSS is a 14-item scale used, “to measure a person’s evaluation of stressful situations in the previous one month of his or her life” ($\alpha=.92$) (Warttig, Forshaw, South & White, 2013). It provides a global measure of stress. According to Cohen et al. (2003), the PSS questions are very general in nature and is, therefore, free of items that may be specific to a particular population. Respondents are asked to rate how often they experience stressful situation based on a five-point Likert scale ranging from 0=Never, to 4=Very Often (Warttig et al., 2013). The higher the score (after reverse coding negatively worded items), the greater one perceives their stress demands exceed their ability to cope (Warttig et al., 2013) (As shown in Appendix E).

General Health Questionnaire (GHQ) (Banks, et al., 1980). It is a 12-item measure of mental health and was developed as a self-administered test for minor psychiatric disorders. It is often employed to identify minor levels of psychological disorder in the general public ($\alpha=.94$) (Schat, Kelloway, & Desmarais, 2005). It consists of items related to depression, problem-solving, and self-confidence (Schat, Kelloway, & Desmarais, 2005). Higher scores represent higher levels of mental distress (Romppel, Braehler, Roth & Glaesmer, 2013). There are several

ways to score the scale. For the purpose of this study, a 5-point Likert scale ranging from 1=never to 5 = always was used (As shown in Appendix F).

50-Item International Personality Item Pool representation of the marker for the Big-Five factor structure (IPIP-50) (Goldberg (1992). This is personality measure of which the primary purpose is to provide a comparable scale to the NEO-PI (Costa & McCrae, 1985) using the Big-Five marker variables (Goldberg, 1992). The measure consists of the Big-Five personality traits of Neuroticism ($\alpha=.93$) Extroversion ($\alpha=.91$), Openness to Experience ($\alpha=.79$), Agreeableness ($\alpha=.83$), and Conscientiousness ($\alpha=.88$), with each trait having 10 items each (five positively oriented and five negatively oriented) for a total of 50 items (Goldberg, 1999). It is scored on a five-point Likert scale ranging from 1 = Very Inaccurate to 5 = Very accurate. Each trait is scored separately (As shown in Appendix G).

Procedure

The study took place completely online, through Qualtrics and the survey took approximately 30 minutes to complete. All seven measures were administered to the participants including the measures for the four main constructs of interest, namely, resilience, grit, hardiness and mental toughness. Items within each measure were presented in a random order to each respondent. The survey also included questions regarding the participants' employment conditions, request for demographic information, three attention checks, and other screening questions. (Survey items, and attention checks are as shown in Appendices A-H).

Construct Validity. MPlus version 8.2 and MPlus Diagrammer version 1.6 and SPSS version 24 were used to conduct this portion of the analysis. Eleven nested models were analyzed for best fit using Confirmatory Factor Analysis (as shown in Table 3). The one-factor model assumes that all four constructs (i.e. resilience, grit, hardiness, and mental toughness) are

completely redundant. The four and three factors, along with the nine dimension³ models assume that all factors are empirically distinguishable from each other (Highhouse et al., 2017). The second order models with the four and three group factors, along with the nine dimension models assumes that the higher order constructs load onto the underlying factors with the underlying constructs becoming the first order construct. The first order constructs are also assumed to be correlated. As mentioned previously, the bifactor models partitioned the variance between the proposed General Resiliency Factor and the group factors that correspond to the four individual measures of interest (i.e. resilience, grit, hardiness, and mental toughness). In these models, the residual group factors were constrained to be orthogonal to the General Resiliency Factor; however, given the high correlation observed in the data, the residual group factors were allowed to correlate even after accounting for the shared variance attributed to the General Resiliency Factor (Highhouse et al., 2017).

Table 3 *Nested Models Tested for Best Fit*

Model	Constructs/Subfactors
1. 1 Factor	Resilience, Grit, Hardiness and MT items combined
2. 4 Factors	Resilience, Grit, Hardiness, and MT entered as separate constructs
3. 3 Factors	Resilience, Grit, and Hardiness and MT Combined
4. 9 Subfactors	Resilience, Grit interest, Grit perseverance, Hardiness Commitment, Hardiness Control, Hardiness Challenge, MT Confidence, MT Constancy, MT Control
5. 2nd Order with 4 Factors	Resilience, Grit, Hardiness, and MT entered as separate constructs

³ The term “dimensions” encompasses the unidimensional resilience factor as well as the multidimensional subfactors of grit, hardiness, and mental toughness. The term also refers to the unique variances of each dimension which are above and beyond the GRF.

6. 2nd Order with 3 Factors	Resilience, Grit, and Hardiness and MT Combined
7. 2nd Order with 9 Subfactors	Resilience, Grit interest, Grit perseverance, Hardiness Commitment, Hardiness Control, Hardiness Challenge, MT Confidence, MT Constancy, MT Control
8. Bifactor Model with 4 Factors	Resilience, Grit, Hardiness, and MT entered as separate constructs
9. Bifactor Model with 3 Factors	Resilience, Grit, and Hardiness and MT Combined
10. Bifactor Model with 7 Factors	Resilience, Grit interest, Grit perseverance, Hardiness Commitment, Hardiness Challenge, MT Confidence, MT Constancy, Hardiness Control and MT Control combined)
11. Bifactor Model with 9 Factors	Resilience, Grit interest, Grit perseverance, Hardiness Commitment, Hardiness Control, Hardiness Challenge, MT Confidence, MT Constancy, MT Control

According to Tabachnick and Fidell (2013), “Good fitting models produce consistent results on many different indices” (p. 725). The RMSEA and CFI are the most often reported fit indices (Tabachnick and Fidell, 2013) while Hu and Bentler (1999) recommends reporting the SRMR and a comparative fit index. All four fit indices were used in this study to assess model fit. By convention the chi-square (χ^2) and the chi-square over degrees of freedom (χ^2/df), along with the TLI as another comparative fit index were also used to assessed best model fit. It should be noted, however, that while a non-significant χ^2 is the goal, χ^2 is sensitive to sample size such that a large sample (such as the one used in this study) would tend to result in a significant χ^2 (Kelloway, 2014; Tabachnick & Fidell, 2013). The acceptable threshold for these values are listed in Appendix I.

Criterion Validity. The PSS, GHQ and the IPIP-50 were administered to participants as part of the online survey described above. They were measures of stress, psychological health and personality. The presentation of these measures is as per the construct validity procedure.

SPSS version 24 was used to conduct the correlation and regression analysis. An R-based web application was used to conduct relative weight analysis

(<http://relativeimportance.davidson.edu>). Confidence intervals for the individual relative weights and all associated significant tests were based on bootstrapping 10,000 replicants, which was recommended by Tonidandel et al., (2009). Ninety-five percent confidence interval (CI) were used for all cases, which corresponds to a $p = .05$. Relative weight analysis (also known as “relative importance analysis”) provides information on the contribution that each variable contributes by itself and in combination with other predictor variables to the criterion variable (Johnson, 2000). It is defined as, “The proportionate contribution each predictor makes to R^2 , considering both its direct effect (i.e., its correlation with each criterion) and its effect when combined with other variables in the regression equation” (Johnson & LeBreton, 2004, p. 240). Relative weight sums to R^2 and ... “represents the percentage variance explained in the criterion that can be attributed to each predictor” (Tonidandel & LeBreton, 2011, p. 8). It is a helpful supplement to multiple regression analysis as, “...standardized regression weights do not appropriately partition variance when predictors are correlated [therefore] these indices are not suitable for addressing questions of relative importance” (Tonidandel & LeBreton, 2011, p. 2). Furthermore, any shared explanatory variance is apportioned based on the order the variables were entered in the sequence in the regression equation (Tonidandel & LeBreton, 2011). Relative weights are better suited than regression weights when the main purpose is to try to understand what is driving the significant multiple regression results, and how each variable contributes to the variance of a criterion (Tonidandel & LeBreton, 2011). Despite the benefits of the added clarity provided by relative weights, they do not, however, take precedence over standardized regression weights or changes in R^2 . They instead provide a different type of information, which

when used along with multiple regression indices, provide more clarity as to a variable's contribution in explaining variance in a criterion (Tonidandel & LeBreton, 2011). In short regression weights provide information about the incremental validity or the importance of individual predictors, while relative weights give information about a predictor's relative importance (Tonidandel & LeBreton, 2011).

Results

Invariance test

An invariance test was conducted to ascertain if the constructs examined in this study were psychometrically equivalent across the MTurk and SONA groups. Measurement invariance assesses whether or not constructs across groups are psychometrically equivalent. It is essential in demonstrating that the construct has the same meaning across different groups (Putnick and Bornstein, 2016). For nested models, Putnick and Bornstein (2016) recommend using the difference between fit statistics of two models, the χ^2 difference ($\Delta\chi^2$) and the change in Comparative Fit Index (ΔCFI) to test for invariance. The criteria for invariance are a non-significant p -value for $\Delta\chi^2$ and a $-.01$ ΔCFI . For the purpose of this study, using MPlus v8.2, two models of the constructs were compared: one model where the variances and correlations were freely estimated within each of the two subsamples and a second where the variances and correlations were constrained to equality across the subsamples. The result of the $\Delta\chi^2$ was significant ($\chi^2(114 N=512) = 199.54, p = .05$) and $\Delta CFI = -.001$ (see Table 4). As mentioned above, the chi-square test is overly sensitive to sample size and will, therefore, most likely be significant for any reasonable sample size (Kelloway, 2014; Tabachnick & Fidell, 2013). The $\Delta\chi^2$ also suffers from the same problem, which is the reason why the ΔCFI is also recommended by other researchers to test for invariance (Putnick and Bornstein, 2016). The result of the ΔCFI

does meet the threshold for invariance indicating that the survey results of the MTurk and the SONA samples were psychometrically equivalent. The two were therefore combined and used for the construct and criterion validity analysis.

Table 4 *Measure of invariance between MTurk and SONA*

	χ^2	<i>df</i>	CFI
Constrained Model	43313.99	19864	.612
Free Estimate Model	43114.45	19750	.613
Difference	199.54	114	-.001

Note. N= 512. $\Delta\chi^2$ significant at $p=.05$

Correlations

Descriptive statistics and correlations are presented in Tables 5. Table 5 shows that the constructs of resilience, grit, hardiness and mental toughness are significantly and substantially correlated ($r = .62$ to $r = .78$) with the exception of grit and hardiness having only a moderate correlation at $r = .48$. Further analysis shows that the unidimensional resilience construct and the subfactors of grit, hardiness, and mental toughness were also correlated. The highest significant correlation was between resilience and mental toughness confidence ($r = .81$) and grit perseverance and mental toughness constancy ($r = .81$). The lowest significant correlation was between hardiness control and grit interest ($r = .12$). Surprisingly, hardiness control and mental toughness control do not seem to be highly correlated despite having very similar definitions ($r = .23$). With the exception of grit interest, hardiness challenge, and mental toughness control, all other subfactors of grit, hardiness and mental toughness were also highly correlated with the resilience construct ($r = .63$ to $.71$).

The grit interest subfactor does not seem to be highly correlated with any of the three other constructs but was moderately correlated with the mental toughness constancy subconstruct

($r = .57$). The grit perseverance subfactor is highly correlated to the hardiness commitment, and the mental toughness confidence and constancy subfactors ($r = .65$ to $r = .80$). Finally, the mental toughness confidence subfactor is highly correlated with the mental toughness constancy subfactor ($r = .71$). The high to moderate correlations between the four main constructs of interest and between resilience and many of the eight subfactors would indicate that there may be some commonalities within these four constructs that is worthwhile investigating. These correlations partially support Hypothesis 2.

Table 5 Mean, Standard Deviations, and Correlations Between all the Variables

	Scale	Mean	SD	1	2	3	4	5	6
1. Age	18-72	32.89	11.50	-					
2. Sex	0-1	.53	.50	-.18**	-				
3. Ethnicity	0-1	.24	.43	-.19**	.01	-			
4. Education	0-1	.44	.50	-.29**	.16**	-.03	-		
5. Employment	0-1	.13	.34	-.25**	.21**	.04	.15**	-	
6. GRF	1-5	3.49	.62	.09*	-.11*	.07	-.12**	-.07	(.97)
7. Resilience	1-5	3.56	.67	-.00	-.05	.07	-.05	-.01	.94**
8. Grit	1-5	3.59	.74	.22**	-.14**	.06	-.18**	-.14**	.78**
9. Hardiness	1-5	3.38	.66	-.04	-.07	.07	-.06	-.01	.85**
10. MT	1-5	3.48	.78	.21**	-.22**	.05	-.17**	-.15**	.90**
11. Grit Interest	1-5	3.62	.88	.26**	-.11*	.04	-.12**	-.14**	.48**
12. Grit Perseverance	1-5	3.57	.87	.19**	-.14**	.06	-.19**	-.10*	.85**
13. Hardiness Commitment	1-5	3.34	.95	.04	-.02	.05	-.08	-.05	.81**
14. Hardiness Control	1-5	3.89	.75	-.11*	.09	.05	.01	.06	.65**
15. Hardiness Challenge	1-5	2.92	.86	-.04	-.03	.06	-.06	-.02	.48**
16. MT Confidence	1-5	3.19	.87	.06	-.19**	.05	-.13**	-.12**	.86**

17. MT Constancy	1-5	3.88	.76	.17**	-.18**	.05	-.14**	-.09*	.85**
18. MT Control	1-5	3.18	1.01	.29**	-.22**	.03	-.16**	-.16**	.68**
19. Neuroticism	1-5	2.58	1.01	-.20**	.21**	-.06	.17**	.13**	-.79**
20. Extroversion	1-5	2.97	.95	-.03	.03	-.04	-.05	-.05	.60**
21. Openness	1-5	3.79	.70	.03	.02	.06	-.05	-.03	.27**
22. Agreeableness	1-5	3.90	.63	.07	.11*	-.004	.01	.03	.47**
23. Conscientiousness	1-5	3.82	.74	.26**	-.12**	.02	-.16**	-.17**	.72**
24. Stress	1-5	3.07	.68	-.23**	.21**	.03	.18**	.06	-.73**
25. Psychological Well-Being	1-5	3.62	.87	.19**	-.14**	-.005	-.16**	-.07	.76**

Note. Listwise N=499. Reliabilities on the diagonal. Age reported in years; Sex (0=male, 1= female); Ethnicity (0=White/Caucasian, 1=Other); Education (0=Bachelor's Degree or higher; 1= Other); Employment (0=Employed; 1= Unemployed); GRF=General Resiliency Factor; MT=Mental Toughness.
** $p \leq 0.01$ level (2-tailed).

Table 5 Mean, Standard Deviations, and Correlations Between all the Variables (Continued)

	7	8	9	10	11	12	13	14	15	16
1. Age										
2. Sex										
3. Ethnicity										
4. School										
5. Employ										
6. GRF										
7. Res	(.94)									
8. Grit	.62**	(.89)								
9. Hardiness	.78**	.48**	(.87)							
10. MT	.78**	.73**	.69**	(.90)						
11. Grit Interest	.30**	.85**	.20**	.48**	(.87)					
12. Grit Perseverance	.76**	.85**	.63**	.77**	.45**	(.88)				
13. Hardiness Commitment	.76**	.55**	.85**	.65**	.29**	.65**	(.87)			
14. Hardiness Control	.63**	.35**	.77**	.46**	.12**	.49**	.60**	(.84)		
15. Hardiness Challenge	.39**	.18**	.68**	.45**	.03	.29**	.31**	.23**	(.79)	
16. MT Confidence	.81**	.58**	.71**	.86**	.26**	.74**	.65**	.53**	.43**	(.86)

17. MT Constancy	.73**	.81**	.61**	.87**	.57**	.80**	.60**	.49**	.34**	.71**
18. MT Control	.54**	.56**	.51**	.86**	.44**	.51**	.47**	.23**	.44**	.57**
19. Neuroticism	-.73**	-.58**	-.66**	-.79**	-.36**	-.63**	-.70**	-.43**	-.35**	-.68**
20. Extroversion	.57**	.35**	.64**	.52**	.16**	.44**	.57**	.41**	.47**	.57**
21. Openness	.23**	.19**	.29**	.25**	.07	.26**	.20**	.16**	.30**	.24**
22. Agreeableness	.43**	.35**	.45**	.40**	.22**	.38**	.44**	.34**	.24**	.32**
23. Conscientiousness	.58**	.80**	.49**	.72**	.60**	.76**	.59**	.36**	.15**	.59**
24. Stress	-.65**	-.57**	-.59**	-.77**	-.39**	-.59**	-.61**	-.44**	-.30**	-.62**
25. Psychological Well-Being	.71**	.55**	.66**	.74**	.34**	.60**	.71**	.50**	.28**	.64**

Note. Listwise N=499. Reliabilities on the diagonal. Age reported in years; Sex (0=male, 1= female); Ethnicity (0=White/Caucasian, 1=Other); Education (0=Bachelor's Degree or higher; 1= Other); Employment (0=Employed; 1= Unemployed); GRF=General Resiliency Factor; MT=Mental Toughness.
** $p \leq 0.01$ level (2-tailed).

17. MT Constancy	(.74)								
18. MT Control	.61**	(.80)							
19. Neuroticism	-.65**	-.73**	(.93)						
20. Extroversion	.42**	.39**	-.50**	(.91)					
21. Openness	.28**	.15**	-.18**	.29**	(.79)				
22. Agreeableness	.38**	.35**	-.47**	.33**	.23**	(.83)			
23. Conscientiousness	.78**	.54**	-.62**	.36**	.21**	.415**	(.88)		
24. Stress	-.66**	-.72**	.81**	-.41**	-.16**	-.40**	-.62**	(.92)	
25. Psychological Well-Being	.64**	.66**	-.86**	.46**	.17**	.43**	.62**	-.87**	(.94)

Note. Listwise N=499. Reliabilities on the diagonal. Age reported in years; Sex (0=male, 1= female); Ethnicity (0=White/Caucasian, 1=Other); Education (0=Bachelor's Degree or higher; 1= Other); Employment (0=Employed; 1= Unemployed); GRF=General Resiliency Factor; MT=Mental Toughness.
 ** $p \leq 0.01$ level (2-tailed).

Construct Validity

Table 6 shows the fit indices for all 11 models (as described in Table 3). Given the high correlations between the four main construct of interest described in Table 5 and the common underlying theory among all four constructs, it was hypothesized that a bifactor model would provide the best fit for the data. Upon initial inspection, this hypothesis seems to hold true as the separate factor models (models 1-4) --- in particular, the one factor model (model 1) ($\chi^2 = 9784.82$, CFI = .64, TLI = .63, RMSEA = .09, SRMR = .09) and the four factor model (model 2) ($\chi^2 = 8594.12$, CFI = .70, TLI = .69, RMSEA = .08, SRMR = .08) --- and the second order models (models 5-7) did not provide a better fit to the bifactor model with four group factors (model 8) ($\chi^2 = 6608.31$, CFI = .79, TLI = .77, RMSEA = .07, SRMR = .06). However, upon closer inspection, and in comparison to all the other bifactor models (models 8-11), the bifactor model with the nine dimensions (Model 11) provided the best fit to the data ($\chi^2 = 5522.51$, CFI = .84, TLI = .82, RMSEA = .06, SRMR = .05) among all the models tested. These results indicate that while a common General Resiliency Factor exists, the four group constructs of resilience, grit, hardiness and mental toughness are not enough to explain the data. In short, while Model 8 (Table 6) demonstrated better fit in comparison to all the non-bifactor models; however, Model 11--- with the nine domains --- actually provide an even better fit when the other bifactor models were also taken into consideration. Hypothesis 3a is, therefore, only partially supported. Figure 2 below represents the bifactor Model 11.

Table 6 *Fit Indices for the Models Tested with Merged Data*

Model	χ^2	<i>df</i>	χ^2 / df	CFI	TLI	RMSEA	90% CI RMSEA		SRMR
							Lower Bound	Upper Bound	
1. 1 Factor	9784.82**	2079	4.71	.64	.63	.09	.08	.09	.09
2. 4 Factors	8594.12**	2073	4.15	.70	.69	.08	.08	.08	.08
3. 3 Factors	9125.96**	2076	4.34	.68	.66	.08	.08	.08	.09
4. 9 Subfactors	7189.00**	2043	3.52	.76	.75	.07	.07	.07	.08
5. 2nd Order with 4 Factors	8650.98**	2075	4.17	.70	.69	.08	.08	.08	.09
6. 2nd Order with 3 Factors	9125.96**	2076	4.40	.68	.66	.08	.08	.08	.09
7. 2nd Order with 9 Subfactors	7759.99**	2070	3.75	.74	.73	.07	.07	.08	.08
8. Bifactor Model with 4 Factors	6608.31**	2007	3.30	.79	.77	.07	.07	.07	.06
9. Bifactor Model with 3 Factors	6881.38**	2010	3.42	.78	.76	.07	.07	.07	.06
10. Bifactor Model with 7 Factors	5655.53**	1985	2.85	.83	.82	.06	.06	.06	.05
11. Bifactor Model with 9 Factors	5522.51**	1977	2.79	.84	.82	.06	.06	.06	.05

Note: χ^2 =Chi square test; *df*=degrees of freedom; CFI=Comparative Fit Index; TLI=Tucker Lewis Index; RMSEA=Root Mean Square Error of Approximation; CI=Confidence Interval; SRMR=Standardized Root Mean Residual.

** $p < .001$

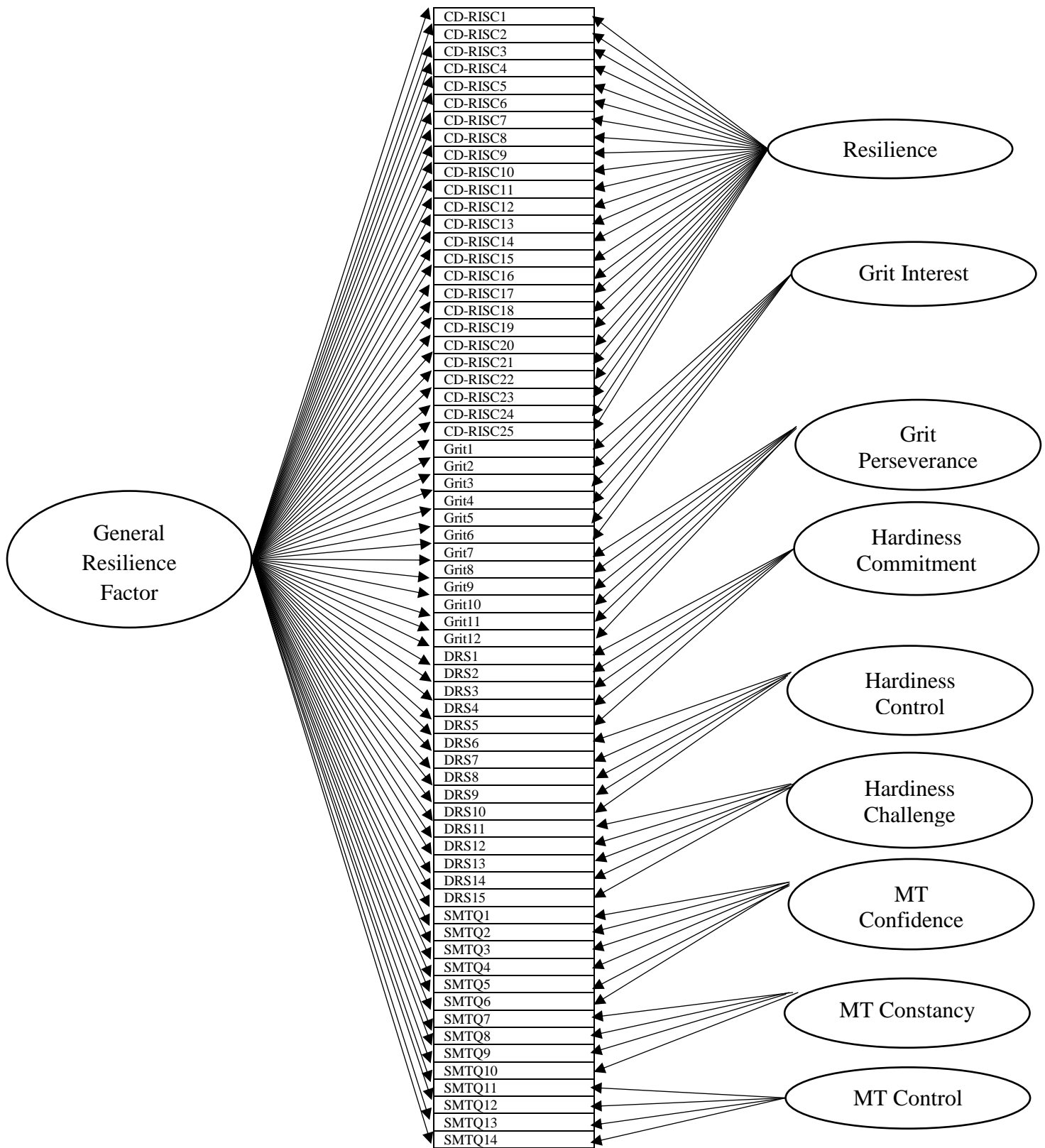


Figure 2 Resulting best fit bifactor model for assessing the structure of Overall Resilience.

Although the group factors were allowed to correlate, all other factor correlations were constrained to zero (i.e. all the group factors were uncorrelated with the GRF). Lines indicating correlations among the variables is not represented in the above model for simplicity.

To test hypothesis 3b, separate hierarchical regression analyses were conducted to test incremental validity of the four group factors above and beyond the General Resiliency Factor on stress and psychological well-being. For each of the regression analyses, sex and age were entered in the first step, followed by the General Resiliency Factor in the second step. Resilience, grit, hardiness, and mental toughness were added in separate regressions in turn for step three (3a-h). Regression analysis (Table 7) seems to partially support Hypothesis 3b with the factors providing incremental validity above and beyond the General Resiliency Factor; however, only mental toughness ($\Delta R^2 = .03$) provided incremental validity greater 1% for stress. Incremental validity for all other factors for both stress and psychological well-being were less than 1% after controlling for sex, age, and the General Resiliency Factor. Hardiness and resilience provided no incremental validity for predicting stress and for psychological well-being respectively.

Table 7 *Variances of the four main constructs while controlling for sex, age, and General Resiliency Factor*

Dependent Variable	Step	Variables	R^2	ΔR^2
Stress	1	Sex and age	.079	
	2	GRF	.574	.496
	3a	Resilience	.579	.005
	3b	Grit	.585	.002
	3c	Hardiness	.574	.000
	3d	Mental Toughness	.606	.032
Psychological Well-being	1	Sex and age	.046	
	2	GRF	.596	.544
	3e	Resilience	.596	.000
	3f	Grit	.606	.011
	3g	Hardiness	.592	.001
	3h	Mental Toughness	.602	.006

Note. Steps 1 and 2 and the resulting variances are the same for all the regression analysis, therefore, only steps 3(a-h) for each of the different regression analysis were reported. ΔR^2 is the R^2 difference between step 2 (GRF) and the different step 3 (group factors) for each respective regression analysis (i.e. incremental validity of construct after sex, age, and GRF were controlled). GRF=General Resiliency Factor; MT=Mental Toughness;

As the result of the CFA suggests the existence of nine correlated but distinct dimensions, a post hoc regression analysis was conducted to look at the incremental validity of nine domains on stress and psychological well-being when sex, age, and the General Resiliency Factor are controlled for. Hierarchical regression analyses were conducted similarly as above. Sex and age were entered in the first step, followed by the General Resiliency Factor in the second step. Each of the nine dimensions were added individually in separate regressions for step three (3a-3i).

The results of the exploratory regression analysis (Tables 8 and 9) show that the nine domains do provide some incremental validity. However, with the exception of mental toughness control ($\Delta R^2 = .06$), all other domains provide less than 1% in incremental validity for stress (Table 8) once sex, age, and the General Resiliency Factor are taken into consideration. Grit interest and hardiness control provided no incremental validity for the prediction of stress when sex, age, and the General Resilience Factor were controlled for.

Table 8 *Variances of the Nine Constructs with General Resiliency Factor on Stress*

Dependent Variable	Step	Variables	R^2	ΔR^2
Stress	1	Sex and age	.079	
	2	GRF	.574	.496
	3a	Resilience	.579	.005
	3b	Grit Interest	.574	.000
	3c	Grit Perseverance	.582	.007
	3d	Hardiness Commitment	.576	.002
	3e	Hardiness Control	.574	.000
	3f	Hardiness Challenge	.576	.002
	3g	Mental Toughness Confidence	.575	.001
3h	Mental Toughness Constancy	.575	.001	

3i	Mental Toughness Control	.634	.060
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Note. Steps 1 and 2 and the resulting variances are the same for all the regression analysis, therefore only step 3 (a-i) for each of the different regression analysis were reported. ΔR^2 is the R^2 difference between Step 2 (GRF) and the different Step 3 (domain) for each respective regression analysis (i.e. incremental validity of construct after sex, age, and GRF were controlled). GRF=General Resiliency Factor; MT=Mental T Toughness;

For psychological well-being (Table 9), only grit perseverance ($\Delta R^2=.01$), hardiness commitment ($\Delta R^2=.03$), and mental toughness control ($\Delta R^2 =.03$) provided greater than 1% incremental validity when sex, age, and the General Resiliency Factor were controlled. Resilience provided no incremental validity when sex, age, and the General Resiliency Factor were controlled for. Hypothesis 3b is only partially support based on the post hoc analysis.

Table 9 *Variances of the Nine Constructs with General Resilience Factor on Psychological Well-Being*

Dependent Variable	Step	Variables	R^2	ΔR^2
Psychological Well-being	1	Sex and age	.046	
	2	GRF	.596	.549
	3a	Resilience	.596	.000
	3b	Grit Interest	.598	.003
	3c	Grit Perseverance	.610	.014
	3d	Hardiness Commitment	.624	.028
	3e	Hardiness Control	.596	.001
	3f	Hardiness Challenge	.604	.009
	3g	Mental Toughness Confidence	.574	.001
	3h	Mental Toughness Constancy	.597	.002
	3i	Mental Toughness Control	.620	.025

Note. Steps 1 and 2 and the resulting variances are the same for all the regression analysis, therefore only the separate Step 3 (a-i) for each of the different regression analysis were reported. ΔR^2 is the R^2 difference between Step 2 (GRF) and Step 3 (domain) for each respective regression analysis. (i.e. incremental validity of construct after sex, age, and GRF were controlled). GRF=General Resiliency Factor; MT=Mental T Toughness;

Criterion Validity

The final test for construct redundancy is to show that the four constructs of interest make a unique contribution on a related outcome variable based on Highhouse et al.'s (2017) argument, and do not just provide incremental validity. In this case, the variables tested were stress, psychological well-being, and personality.

Stress. In order to ascertain if the four main constructs of interest make a unique contribution to stress, correlation, regression and relative weight analysis were conducted. First, correlation analysis (Table 5) showed that stress is negatively correlated with all four main constructs of resilience ($r=-.65$), grit ($r=-.57$), hardiness ($r=-.59$) and mental toughness ($r=-.77$). In a regression analysis (Table 10) where resilience, grit, hardiness, and mental toughness were entered in one step in this order, the four main constructs contributed 60% of the variance of stress. The unstandardized regression coefficients seem to indicate that the four main constructs of interest contributed differently to stress. Interestingly, resilience and grit were not significant; however, as stated previously, this result is deceptive as the regression results do not provide the unique variance contributed by each of the constructs to stress. Using relative weight analysis (Johnson, 2000), all four constructs of interest were significant with mental toughness having the highest negative association with stress ($b=-.55$, $p \leq .001$, $RW=.25$, $CI=.21-.27$) providing approximately 41% of the predicted variance (RS-RW). Resilience has the second highest relative weight ($b=-.08$, $p=.15$, $RW=.13$, $CI=.10-.16$) providing approximately 22% of the predicted variance. This was followed by grit ($b=-.03$, $p \leq .48$, $RW=.11$, $CI=.08-.14$) and hardiness ($b=-.10$, $p \leq .04$, $RW=.11$, $CI=.08-.14$) having the lowest negative association with stress, and providing approximately 19% of the predicted variance. These results support Hypothesis 4 (both regression and relative weight are as shown in Table 10).

Post hoc regression and relative analyses were conducted on the nine dimensions (Table 11). All nine dimensions demonstrated different regression and relative weights. Mental toughness control was shown to have the highest relative importance value ($b=-.33, p \leq .001, RW=.20, CI=.17-.25$) among all the nine dimensions, providing approximately 31% of the predicted variance in the criterion. Hardiness challenge had the lowest relative importance value ($b=.07, p \leq .01, RW=.02, CI=.01-.03$) providing only approximately 3% of the predicted variance in the criterion. This provides further support to Hypothesis 4.

Psychological Well-Being. In order to ascertain whether the four constructs of interest make a unique contribution to psychological well-being, a similar analysis conducted with the stress construct above was performed. Tables 5 shows that psychological health is positively correlated to the four main constructs of resilience ($r=.71$), grit ($r=.55$), hardiness ($r=.66$), and mental toughness ($r=.74$). In a regression analysis (Table 10) where resilience, grit, hardiness, and mental toughness were entered in one step in this order, the four main constructs of interest contributed 60% of the variance for psychological health. All but grit was significant. Relative weight analysis (Johnson, 2000) as shown in Table 10 indicate that mental toughness has the highest association with psychological health ($b=.50, p \leq .001, RW=.20, CI=.17-.23$) providing approximately 33% of the predicted variance. Grit had the lowest association with psychological health ($b=.01, p = .90, RW=.09, CI=.07-.12$) providing approximately 15% of the predicted variance. These results support Hypothesis 5.

Table 10 Regression and Relative Weight Analysis of Stress and Psychological well-being on Main Constructs

Criterion	Predictor	$b(SE)$	β	R ²	RW	CI-L	CI-U	RS-RW
Stress				.60				
	Constant	5.675***(.12)						

	Resilience	-.08(.06)	-.08	.13	.10	.16	21.73
	Grit	-.03(.04)	-.03	.11	.08	.14	18.50
	Hardiness	-.10*(.05)	-.09	.11	.08	.14	18.60
	Mental Toughness	-.55***(.05)	-.62	.25	.21	.27	41.16
Psychological well-being			.60				
	Constant	.02(.15)					
	Resilience	.32***(.07)	.24	.17	.14	.20	27.76
	Grit	.01(.05)	.01	.09	.07	.12	15.29
	Hardiness	.21**(.06)	.16	.14	.11	.17	23.69
	Mental Toughness	.50***(.06)	.44	.20	.17	.23	33.25

Note. *b* = unstandardized regression weight; β = standardized regression weight; RW= raw relative weight (within rounding errors raw weights will sum to R^2); CI-L = lower bound of confidence interval used to test the statistical significance of raw weight; CI-U = upper bound of confidence interval used to test the statistical significance of raw weight; RS-RW = relative weight rescaled as a percentage of predicted variance in the criterion variable attributed to each predictor (within rounding error rescaled weights sum to 100%). * $p \leq .05$; ** $p \leq .01$; $p \leq .001$

A post hoc regression and relative analyses were conducted on the nine dimensions (Table 11). All nine dimensions demonstrated different regression and relative weights. Mental toughness control was shown to have the highest relative importance value ($b=.34, p \leq .001, RW=.15, CI-.12-.19$) among all the nine dimensions, providing approximately 23% of the predicted variance in the criterion. Hardiness challenge had the lowest relative importance value ($b=-.12, p \leq .001, RW=.01, CI=.01-.02$) providing only approximately 2% of the predicted variance in the criterion. This provides further support to Hypothesis 5.

Table 11 Regression and Relative Weight Analysis of Stress and Psychological well-being on the Nine Dimensions

Criterion	Predictor	<i>b</i>	β	R^2	RW	CI-L	CI-U	RS-RW
Stress				.65				
	Constant	5.64***(.13)						

Resilience	-.14*(.06)	-.14	.08	.06	.09	11.52
Grit -Interest	-.001(.03)	-.001	.04	.02	.06	5.61
Grit-Perseverance	.02(.04)	.02	.05	.04	.07	8.40
Hardiness-Commitment	-.11***(.03)	-.15	.08	.06	.10	11.95
Hardiness-Control	-.08*(.03)	-.09	.04	.02	.06	6.18
Hardiness-Challenge	.07**(.02)	.08	.02	.01	.03	2.68
MT-Confidence	-.02(.04)	-.03	.07	.05	.08	10.20
MT-Constancy	-.14**(.05)	-.16	.08	.06	.10	12.59
MT-Control	-.33***(.03)	-.49	.20	.17	.25	30.88
Psychological Well-Being			.68			
Constant	.29*(.16)					
Resilience	.33***(.07)	.25	.10	.09	.12	15.17
Grit -Interest	-.02(.03)	-.02	.03	.02	.04	3.71
Grit-Perseverance	-.07(.05)	-.07	.05	.04	.07	7.94
Hardiness-Commitment	.29***(.04)	.31	.14	.11	.17	20.03
Hardiness-Control	.09*(.04)	.08	.06	.04	.08	8.25
Hardiness-Challenge	-.12***(.03)	-.12	.01	.01	.02	1.96
MT-Confidence	.00(.05)	.00	.07	.06	.08	10.23
MT-Constancy	.11(.06)	.09	.07	.05	.09	10.25
MT-Control	.34***(.03)	.40	.15	.12	.19	22.46

Note. *b* = unstandardized regression weight; β = standardized regression weight; RW= raw relative weight (within rounding errors raw weights will sum to R^2); CI-L = lower bound of confidence interval used to test the statistical significance of raw weight; CI-U = upper bound of confidence interval used to test the statistical significance of raw weight; RS-RW = relative weight rescaled as a percentage of predicted variance in the criterion variable attributed to each predictor (within rounding error rescaled weights sum to 100%); MT=Mental Toughness.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

Personality. All four main constructs of interest are all significantly correlated to all five personality factors (as shown in Table 5). Furthermore, Neuroticism and Conscientiousness had the highest correlation with the four main constructs of interest. Resilience, grit, hardiness, and

mental toughness are all negatively correlated to neuroticism (r ranging from $-.79$ for mental toughness and $-.58$ for grit). Conscientiousness (r ranging from $.80$ for grit and $.49$ for hardiness) were moderate to highly correlated. Both Extroversion (r ranging from $.64$ for hardiness and $.35$ for grit) and Agreeableness (r ranging from $.45$ for hardiness and $.35$ for grit) were weak to moderately correlated to the four constructs of interests. Openness had the weakest correlation for all main constructs of interest (r ranging from $.19$ for grit to $.29$ for hardiness). Regression and relative weight analysis (Table 12) indicate that the relationship of the four constructs of interest differ for all five personality traits --- with neuroticism, extroversion, and conscientiousness being the most dominant relationships among them.

For the resilience construct, the results indicate that the linear combination of the five personality traits explained over half of the variance ($R^2 = .62$). The relative weight analysis show that all five factors explained statistically significant amount of variance in resilience as none of the 95% CI for the test of significance contained zero, with the most important variables being Neuroticism (RW=.27) followed by Extroversion (RW=.15) and Conscientiousness (RW=.14). Together, these three personality traits explain approximately 89% of the predicted variance for the criterion. Regression weights, however, indicate non-significant beta weights for both Openness ($b = .02, p = .54$) and Agreeableness ($b = .05, p = .15$). This may be because the variance they contribute overlaps with those of the other three traits as well as the fact they contribute such a small amount of variance on their own, as evidence by their relative weights (Openness RW =.01 and Agreeableness RW=.06).

For grit construct, the results of the linear combination of the five personality traits explain over half of the variance ($R^2 = .65$). The relative weight analysis show that all five factors explained statistically significant amount of variance in grit as none of the 95% CI for the test of

significance contained zero, with the most important variables being Conscientiousness (RW=.43) followed distantly by Neuroticism (RW=.14). This is opposite for the resilience construct, and these two personality traits alone explain approximately 87% of the predicted variance in the grit construct. Regression weights, however, indicate non-significant beta weights for Extroversion ($b = .03, p = .16$), Openness ($b = .01, p = .65$) and Agreeableness ($b = -.03, p = .47$).

For the hardiness construct, the results of the weighted linear combination of the five personality traits explains just over half of the variance ($R^2 = .58$). The relative weight analysis show that all five factors explained statistically significant amount of variance in hardiness as none of the 95% CI for the test of significance contained zero, with the most important variables being Extroversion (RW=.22) followed by Neuroticism (RW=.19). Together, these two personality traits explain approximately 70% or the predicted variance for the criterion. This result is again different from those already found in both the resilience and grit constructs. Furthermore, hardiness is the only construct in which Conscientiousness is not significant ($b = .06, p = .07$).

For the mental toughness construct, the results of the weighted linear combination of the five personality traits explain almost three quarters of the variance ($R^2 = .73$). The relative weight analysis show that all five factors are explained statistically significant amount of variance in mental toughness as none of the 95% CI for the test of significance contained zero, with the most important variables being Neuroticism (RW=.32) followed by Conscientiousness (RW=.25). Together, these two personality alone traits explain approximately 77% of the predicted variance for the criterion. Regression weights, indicate a non-significant beta weight for Agreeableness ($b = .03, p = .08$). Again, this result differ from those obtained from the other three constructs.

The variance explained by personality in General Resiliency Factor was also examined in a post hoc analysis. The result shows that the results of the weighted linear combination of the five personality traits explain over three quarters of the variance in the General Resiliency Factor ($R^2 = .76$). The relative weight analysis show that all five factors explained statistically significant amount of variance in the General Resiliency Factor as none of the 95% CI for the test of significance contained zero, with the most important variables being Neuroticism (RW=.29) followed by Conscientiousness (RW=.24) and Extroversion (RS=.16). Together, these three personality traits explain approximately 89% of the predicted variance for the criterion. These combination of results are similar to the ones obtained for the mental toughness construct. Regression weights, however, indicate non-significant beta weights for Openness and for Agreeableness. The above results support Hypothesis 6.

Table 12 *Summary of Relative Weight Analysis of Personality on Various Criteria*

Criterion	Predictor	<i>b</i>	β	R^2	RW	CI-L	CI-U	RS-RW
Resilience				.62				
	Constant	2.97***(.23)						
	Neuroticism	-0.31***(.03)	-.47		.27	.23	.31	42.81
	Extroversion	0.18***(.02)	.25		.15	.11	.19	23.84
	Openness	0.02(.03)	.02		.01	.00	.03	2.13
	Agreeableness	0.05(.03)	.05		.06	.03	.08	9.18
Grit				.65				
	Constant	1.07***(.24)						
	Neuroticism	-0.10**(.03)	-.13		.14	.11	.17	21.27
	Extroversion	0.03(.02)	.04		.04	.02	.06	5.97
	Openness	0.01(.03)	.01		.01	.00	.03	1.60
	Agreeableness	-0.03(.04)	-.02		.04	.02	.06	5.47
Hardiness				.58				
	Constant	2.29***(.23)						

	Neuroticism	-0.24***(.03)	-.36	.19	.15	.23	32.73
	Extroversion	0.27***(.02)	.39	.22	.18	.26	37.66
	Openness	0.06*(.03)	.07	.03	.01	.05	4.77
	Agreeableness	0.11**(.04)	.11	.07	.04	.10	11.58
	Conscientiousness	0.06(.03)	.07	.08	.05	.11	13.26
Mental Toughness				.73			
	Constant	2.69***(.22)					
	Neuroticism	-0.39***(.03)	-.51	.32	.28	.35	42.92
	Extroversion	0.12***(.02)	.15	.11	.08	.14	14.44
	Openness	-0.06*(.03)	.05	.02	.01	.04	2.56
	Agreeableness	-0.03(.03)	-.05	.04	.03	.06	5.89
	Conscientiousness	0.38***(.03)	.36	.25	.21	.30	34.19
GRF				.76			
	Constant	2.40***(.17)	-.44				
	Neuroticism	-0.27***(.02)	.25	.29	.26	.32	37.72
	Extroversion	0.16***(.02)	.04	.16	.12	.19	20.56
	Openness	0.04(.02)	.03	.02	.01	.04	2.69
	Agreeableness	0.03(.03)	.34	.06	.04	.09	8.31
	Conscientiousness	0.28***(.02)		.24	.20	.27	30.73

Note. b = unstandardized regression weight; β = standardized regression weight; RW= raw relative weight (within rounding errors raw weights will sum to R^2); CI-L = lower bound of confidence interval used to test the statistical significance of raw weight; CI-U = upper bound of confidence interval used to test the statistical significance of raw weight; RS-RW = relative weight rescaled as a percentage of predicted variance in the criterion variable attributed to each predictor (within rounding error rescaled weights sum to 100%); MT=Mental Toughness; GRF=General Resiliency Factor (i.e. all items from resilience, grit, hardiness, and mental toughness measures).

Summary of Hypothesis

Content Validity

Hypothesis 1 proposed that the items from all four measures would be sorted on to multiple constructs by SMEs. This hypothesis was tested using Hinkin's (1985 and 1909) model for assessing content validation with non-expert respondents, and applying a lower index of agreement as set by Lawshe (1975). This hypothesis was supported as the results indicated that the SMEs were unable to correctly identify and sort the majority of the items into the correct construct and domain.

Construct Validity

Hypothesis 2 proposed that the all four main constructs of interest would be strongly correlated to each other. On the broad construct level, this hypothesis is partially supported. When investigating the correlation between the nine domains, not all met the $r > .60$ threshold. Therefore, at the domain level, this hypothesis is also only partially supported.

Hypothesis 3a proposed a bifactor model with a higher General Resiliency Factor construct along with four group factors. This hypothesis was partially supported as the results of the CFA indicate that a bifactor model with a higher General Resiliency Factor along with nine dimensions representing the multidimensional factors of the four constructs of interest provided the best fit based on the data.

Hypothesis 3b proposed that the four group factors of resilience, grit, hardiness and mental toughness would provide incremental validity in predicting stress and psychological well-being over and above that explained by the General Resiliency Factor. This hypothesis is partially supported, as regression analysis showed that only three of the four constructs demonstrated that they provided variance not accounted for by sex, age, and the General Resiliency Factor for both criterion. However, these variances were, in general, less than 1% in most cases, with hardiness and resilience providing no incremental validity for stress and psychological well-being respectively.

Criterion Validity

Hypothesis 4 proposed that the broader constructs of resilience, grit, hardiness, and mental toughness would make a unique contribution to stress. This hypothesis is supported using correlation, regression and relative weight analysis.

Similar to Hypothesis 4 above, Hypothesis 5 proposed that the broader constructs of resilience, grit, hardiness, and mental toughness would make a unique contribution to psychological well-being. This hypothesis is also supported using correlation, regression and relative weight analysis.

Hypothesis 6 proposed that the broader constructs of resilience, grit, hardiness, and mental toughness would be related differently with personality. This hypothesis is supported. Correlation, regression and relative weight analysis all show that all four main constructs of interests were related to personality differently.

Discussion

The primary purpose of this study was to examine whether the constructs of resilience, grit, hardiness and mental toughness are redundant. This was achieved by looking at three types of validity: content, construct, and criterion validity.

In Study 1, I looked at the content validity of the four constructs relating to resilience, grit, hardiness, and mental toughness. The analysis of their content validity through a SME item sorting demonstrated that despite the original authors' contention that the four main constructs of interest were conceptually unique, the results show that users of the measurements were unable to distinguish the differences between them, even when given the exact definition provided by the authors. This confusion is not aided by the researchers' propensity to use these terms interchangeably as Stoffel and Cain (2018) found with grit and resilience, or by the use of one construct term in the title of a popular measure for hardiness (i.e. DRS) (Bartone, 2008). This is troubling as it speaks directly to the difficulty regarding these four constructs that Singh (1991) and Le et al. (2010) note in both their studies. That is, that the lack of a good understanding of the differences between the constructs of resilience, grit, hardiness, and mental toughness has led

to confusion as to what exactly they are really measuring, what the results mean, and how to apply them. It should, therefore, be argued that Le et al.'s (2010) assertion that "Because of the conceptual/theoretical fluency of researchers, [content validity] requirement is essentially a weak one and is usually easily met" (p. 113) is ill-conceived. Instead, content validity should be the first test of construct redundancy given that most researchers and human resources specialists do not tend to delve into the empirical nature of the measures, nor normally take the time to truly understand what the constructs actually mean.

In Study 2, I looked at the data collected through MTurk and SONA to ascertain if the four main constructs of interests were empirically redundant. First, the correlation found in this data set are higher than those found in Martin et al.'s, (2015) work. The correlations of three of the four constructs of interest (i.e. resilience, hardiness, and mental toughness) for this study range mostly in .70 range, which would indicate that they are not only highly correlated, but may also be redundant based on Morrow's (1983) definition. This may, therefore, be the first indication that at least three of the four main constructs of interests could be redundant, or at minimum, that they may have a common factor underlying all four constructs of interest.

The empirical data also showed that previous studies comparing the four main constructs (Stoffel and Cain, 2018; Martin et al., 2015; Perkins-Gough, 2013; Guiccardi, 2010) were partially correct in that they are, in general terms, not redundant. However, the contrary arguments proposed by other authors who state that constructs of grit, hardiness and mental toughness were in part based on or somehow related to resilience (Lin et al., 2017; Guiccardi, 2010; Duckworth et al., 2007) were also partially correct in this assumption. These seemingly contrasting findings are supported by their high correlations and the CFA which suggest the existence of a General Resiliency Factor and nine residual dimensions corresponding to the

unidimensional construct of resilience, and the individual subfactors of grit, hardiness, and mental toughness. The existence of the General Resiliency Factor may be due to the fact that each of the four main constructs seem to borrow basic concepts from each other. For example, and as noted above, the grit construct is partially based on the resilience construct (Credé et al., 2017; Perkins-Gough, 2013), while Stoffer & Cain (2018) note that resilience is an inherent attribute of grit. Furthermore, Lin et al. (2017) argue that mental toughness share similarities with the resilience construct, and Maddi and Khoshaba offer the fact that the three hardiness subfactors together represent the idea of, "...resilience in facing life's tasks" (p. 267). The literature, therefore, provides some support to the potential existence of a General Resiliency Factor. Based on the data, the General Resiliency Factor accounted for much of the variance explained in both the stress and psychological health criterion, and remained significant, even after controlling for age, sex and the five personality factors, with the group factors only providing less than 1% incremental validity in most cases, as evidenced by ΔR^2 . Interpreting the impact of the magnitude of the effect of the group factors is difficult to ascertain in a theoretical paper such as this one, as it is not really meaningful without context --- a 1% increase in predictive ability may provide little meaning in one situation but may be of extreme importance in another (Tonidandel & Lebreton, 2011). It is, therefore, up to the user to decide if the addition of the group factors or dimensions would provide such meaning.

In assessing criterion validity, regression analysis suggests that the four main constructs made a unique contribution to stress and psychological health, further adding to the idea that they are not redundant. Relative weight analysis supports this finding. Interestingly, the relative weight analysis also showed that the four main constructs do not explain the residual variances to stress and psychological health equally. Mental toughness seems to be the best predictor of both

stress (i.e. more mentally tough individuals experience less stress) and psychological health (i.e. more mentally tough individuals experience better psychological health). This may be due to the fact that the mental toughness construct is aimed at athletes and those who are expected to perform at a high standard in the face of adversity (Zeiger & Zieger, 2018; Guicardie et al., 2015; Bull et al., 2005). This may indicate that the mentally tough individuals already have a higher level of resistance to stress, have better coping mechanisms and therefore, are in better mental health than the general population. The resilience construct does provide an added predictive ability for stress in the presence of mental toughness, as together they provide almost 63% of the predicted variance in the criterion. Resilience also seem to offer more predictive ability for psychological health. Together the resilience and mental toughness constructs provide almost 61% of the predicted variance in the criterion. It is not surprising that grit provided the weakest relationships for both stress and psychological health as the construct seems to be more focused on accomplishing the goal in the long-term (Duckworth et al., 2007), and is collinear with stable personality traits. This poor relationship between grit and the two criteria are supported by the studies conducted by Wong et al. (2017) and Salles et al. (2014).

Post hoc analysis on the relative importance of the resilience construct and the grit, hardiness, and mental toughness subfactors provided further proof that they differed from each other as all nine were significant even though not all their regression weights were. The mental toughness control subfactor seems to provide the highest relative importance as well as the largest negative regression weight among them. This seems to indicate that the ability to perceive some measure of control over how one feels about their ability to control future outcomes seem to have the best effects on stress and psychological health, providing further proof that the factors and subfactors have different utility. Again, the difference in significance between the

two indices may be due to the fact that relative weight indices look at how each variable contributes to the criterion, while regression weight indices looks at the incremental validity of individual predictors (Tonidandel & LeBreton, 2011). Therefore, as stated previously, while the importance of regression weights should not be discounted in light of the significance of relative weights, the interest lies in the fact that even though some subfactors do not provide incremental validity when combined with other subfactors, they are still important in understanding how they affect the criterion. This may suggest that when looking at stress, that the mental toughness construct, more specifically, its control subfactor, would be the best predictor of this criterion. On the other hand, when looking at psychological health, the hardiness commitment subfactor as well as the mental toughness control subfactors would seem to have the greatest influences on this criterion given the results of both their relative and regression weights. Interestingly enough, the hardiness subfactor of control did not have the same effect on either criterion than the mental toughness control subfactor. This may be due to the fact that the hardiness control items are mainly focused on outcomes (i.e. “by working hard you can nearly always achieve your goals) as opposed to feelings of helplessness that also accompany the loss of control, which the mental toughness control dimension also captures (i.e. “I get anxious by events I did not expect or cannot control”). This may mean that control is not just about being able to do something about the situation, but more importantly, it is also about feeling like you can do something about it, which hardiness control does not accurately tap into, but mental toughness control does. This would provide support in the uniqueness of these two dimensions, and perhaps explain their low correlation, in that they are capturing different aspects of control.

Looking at personality traits, it would seem that Neuroticism, Conscientiousness, and Extroversion are the main driving force to overcome adversity as proposed by several different

authors (Credé et al., 2017; Duckworth et al., 2007; Ramanaiah et al., 1999). It is possible that these three traits may be the underlying components of the General Resiliency Factor as they contribute 89% of the predicted variance of this factor. The mental toughness construct seem to have the most similar relative weight distribution as the General Resiliency Factor among the four construct of interest, and may, therefore be the best among the four. Despite this commonality, the relative weight analysis also shows differences among the four main constructs of interest. The differences stem mainly from the different importance each personality type is represented on each of the four different constructs. While studies on the effects of personality on the main constructs have been conducted, most allude to Neuroticism and Conscientiousness as being the main personality traits that define these constructs (Oshio et al., 2018; Stoffel & Cain, 2017; Duckworth et al., 2007; Ramanaiah et al., 1999). These studies, however, have looked at these personality traits as influencing the constructs equally, which does not seem to be the case. For example, Neuroticism seems to have twice the relative importance than Conscientiousness, with Extroversion having the second highest relative weight if one is looking at the resilience construct as it applies to individuals. The opposite is true for someone who has grit with Conscientiousness having a higher relative weight than Neuroticism. For hardiness, Extroversion seems to exude more relative importance than Neuroticism, and Conscientiousness being a distance third. For mental toughness, Neuroticism followed by Conscientiousness seem to be the two personality traits that have the greatest relative importance for this construct. It is also interesting to note that Extroversion had one of the higher relative weight index for resilience, hardiness, and mental toughness. This would seem to indicate that self-confidence, as well as the ability to express one's concerns with/to others may be an important component of recovering from adversity. With regards to Openness and Agreeableness, while regression

weights were, for the most part, not significant for these two personality traits, relative weights indicate that the effect of these two are significant, albeit small. It is possible that their non-significant regression weight results may be due to the fact that the other personality traits share variance with them and their contributions are, therefore, subsumed under the other more significant variables. It would, therefore, be erroneous to ignore their effects.

Considering the results of both studies as a whole, there seems to be a strong argument which suggests that the four constructs are largely redundant (even though there is some evidence of their unique contributions). First, from a theoretical point of view, there is the existence of a common theory underpinning of all four constructs. Second, the SMEs inability to correctly sort measurement items into the correct construct and subconstruct demonstrates a conceptual redundancy, which undermines the practical distinctiveness of the four main constructs. Third, from an empirical perspective, correlational analysis provides support that at least resilience, hardiness, and mental toughness are redundant given their high correlations. In addition, CFA showed evidence of a strong single factor that cuts across all nine dimensions, with the test of incremental validity demonstrating that a considerable amount of variance may be explained by the General Resiliency Factor. As mentioned above, the four constructs do seem to provide some small unique contribution; however this does not detract from the original finding that the constructs are largely redundant. Rather, the contributions provided from the incremental validity and criterion validity analyses may be a case of each construct capturing a different aspect of the larger construct of “Resilience⁴.” This distinctiveness/uniqueness of each of the construct may very well be akin to the parable of a group of blind men who are trying to

⁴ The term “Resilience” in quotation and with a capital R refers to a more global idea of overall resilience, which captures all related construct including resilience, grit, hardiness, and mental toughness. It is meant to differentiate from the resilience construct, which is only one aspect of “Resilience.”

describe an elephant (Wikipedia contributor, *n.d.*). In the parable, a group of blind men each touch a different part of the elephant ---but only one part (e.g. a trunk, a leg, the tusk, etc.) with no two individuals touching the same part. When they compare their observations, they discover that even though their respective observations were correct, they disagree on what an elephant looks like. This parable exemplifies what is also known as the Rashomon effect (Heider, 1988; Reider, 1988), based on a 1969 Japanese movie where the characters provide a different version of the same event. In the context of this study, the unique contribution of each of the four construct may be as a result of each construct author describing the larger construct of “Resilience” from different points of view (e.g. coping mechanism, academic, professional, personal, sports, long-term, short-term, etc.). This leads back to the parable that, in the end, each author is still describing the same construct just from a different angle. The moral of the story, therefore, is that true “Resilience” is one large construct with many parts, and that in order to be truly “Resilient” one needs not only what is redundant among all the four constructs of interest, but what are also unique components within each one of the dimensions. This is not a new concept in the social sciences. Ethnographic studies, for example, have had to contend with these differences and to somehow reconcile them in order to paint a more accurate account of the same event (Heider, 1988). A similar issue also seems to occur with studies regarding transformational leadership, which have also contended that it is a construct that is comprised of four separate but related behaviours (Roberston, 2018).

Potential Practical Application

This study was undertaken to fill a gap in the literature with regards to construct redundancy using content, construct, and criterion validity. More specifically, this study investigated whether or not the seemingly related constructs of resilience, grit, hardiness, and

mental toughness are redundant, which has never been attempted previously. In addition, the use of the bifactor model to do so is a relatively new concept in the field of Industrial-Organizational Psychology.

While the resilience, grit, hardiness, and mental toughness seem to offer some unique contribution, the overall findings of this study seem to provide enough evidence that demonstrate their redundancy based on the existence of a General Resiliency Factor. These results, therefore, warrant a further exploration of a General Resiliency Factor, which may be better employed in studies where the main purpose is to look at an individual's ability to overcome adversity in general or when the author is unsure as to which of the four constructs are most suitable for their study. The General Resiliency Factor may also be potentially used in combination with one or more of the group factors or dimensions if the intent is to delve into a particular aspect of overcoming a specific type of adversity. This would be of great import if one is to look at the larger construct of "Resilience" as being environment and situation specific. The use of the General Resiliency Factor would be able to provide a broad overview of the construct while the group factors/dimensions would provide additional, and perhaps different information about the criterion, much like the added information provided by relative weight indices to regression weight indices used in this study.

During the literature review conducted for the purpose of this study, it was evident that the constructs of resilience, grit, hardiness and mental toughness created confusion among its users, and most likely their readers. Users of these measures should, therefore, take the time to understand these constructs and the meaning of their results prior to their administration, given that they do not seem to predict related criteria to varying degrees. More importantly, authors of new measurements and constructs should take the time to more robustly test their content

validity in order to ensure that they are not creating new constructs or developing new measures that are confusing to users and readers alike. Care should also be taken to ensure that the naming of factors, subfactors and the actual measures themselves are clear and do not cause further confusion such as the DRS, which purports to measure hardiness but uses the term “resilience” in its name. However, given the current state of the four constructs of interest and the users’ often lack of understanding of them, it would seem that mental toughness measures would be the best scale to use to evaluate stress and/or psychological health.

Training for overcoming adversity has typically often been focused on the study of only one of the main constructs of interest. The results of this study seem to indicate that each of the four constructs have different impacts and effects on different criterion. Training developers and trainers should, therefore, endeavour to be well-versed on each of the constructs and their subfactors in order to ensure that they are training the right competencies. The alternative is to provide training that would cover all the competencies based on all four constructs and subfactors, if the user is uncertain or if they wish to have a more holistic view of “Resilience.”

This study also highlights the need for multidimensional constructs to be scored as such. In particular, caution should be taken when representing the measures of grit, hardiness, and mental toughness as the sum of the total scores of the construct. Rather, they should be presented as independent subfactor scores similar to how the traits in the Five Factor Model of personality are reported. This would more accurately reflect the way that these constructs were originally conceptualized by their respective authors.

Limitations and Future Research

Although the results provided evidence that seem to indicate that a General Resiliency Factor exists among the four measures of interest, the findings are based on cross-sectional data

which was collected in one administration for both MTurk and SONA using self-report measures. One of the prevailing limitations of this study, therefore, is common method variance (CMV) which has the potential to introduce systemic error among the variables measured as a function of the data collection. Although the data was collected from two different sources, error could have been introduced as a result of collecting the data using the same method and/or source (Richardson, Simmering, & Sturman, 2009), the scale type and response formats (Johnson, Rosen, & Djurdjevic, 2011) as well as a result of response bias such as social desirability (Baogzzi & Yi, 1990). It is, therefore, possible that the General Resiliency Factor is as a result of the CMV. CMV may also explain the very high correlations and variances explained by the four main constructs of interest for stress, personal well-being, and personality. However, the use of a similar underlying theory between the four constructs of interest, and finding common personality traits among them, seem to point to the possibility of the existence of such a common factor. Future research should endeavour to replicate this study using methodology which minimizes the potential for CMV, such as the methodology proposed by Le et al. (2012).

Another limitation for this study is the choice for the measures used. There were numerous measures available for each of the four constructs of interest, each accompanied by their own theoretical underpinnings. Although the theories for each of the constructs were similar, each original author were apt to provide their own interpretations, as well as provide their own understanding of them. Care was taken to ensure that all the measures, including the criterion and personality measures, that were chosen represented the broadest spectrum of the specific construct, that each had good reliability, and was touted by other researchers as the “best” or the “gold standard” for each the specific construct. However, even with this in mind, this could only

be done with the best of what was available opensource online. The only exception was for the DRS-15 which was purchased for the purpose of this study as no other hardiness measure was available on any opensource website. Should cost not be an issue, it is recommended that both free and “paid for” measures of resilience, grit, hardiness, and mental toughness be considered for future research in order to ensure that the measures truly represented the constructs in question.

This study focused primarily on whether or not the constructs of resilience, grit, hardiness, and mental toughness were redundant, and discovered the potential existence of a General Resiliency Factor with nine dimensions. This study, however, did not attempt to define these factors. It is therefore recommended that future research look into what these factors are, and in perhaps creating a new measure which represents this model more accurately.

Only three criteria were analyzed in this study - stress, health and personality. Given that the constructs of resilience, grit, hardiness, and mental toughness are associated with a plethora of other criterion, it may be of benefit for future research to look at other criterion like physical health, gender differences, education level, as well as different life scenarios (e.g. work, home, school, etc.) in order to have a better understand of how these four constructs further differ in their practical applications.

Future research on the possible redundant relationship of the four constructs with personality may also be worthwhile given some of the high correlations with some of the traits, particularly between grit and Conscientiousness. In addition, given the high correlation between several of the five personality traits explored in this study, as well as the literature supporting these findings, future research should also look at their relationship with resilience, grit,

hardiness, and mental toughness to ascertain if the four main construct of interests are redundant with any of the personality traits.

Generalizability across different languages and different English-speaking cultures cannot be assumed based on the findings of this study. This study was conducted using participants from North America who presumably had a good grasp of the English language. Cultural differences among other English-speaking cultures may present nuanced interpretation of the construct definitions that may be different from those of the current participants. Furthermore, the constructs of resilience, grit, hardiness, and mental toughness may be represented differently in other languages. Future studies on the construct redundancy of the four main constructs of interest should investigate if the findings in this study still hold true in other English speaking cultures and in other languages.

Finally, generalizability of the results of this study across different situations also cannot be assumed as the general ability to be resilient may be context specific and even age specific. MTurk and SONA participants cannot be expected to represent all types of context nor provide a large enough sample size to make any interpretation of the results by context meaningful or significant. In other words, the findings of this study is most likely influence by the survey participants, and that combat soldiers, for example, may not necessarily respond in the same manner than MTurk workers or SONA participants. Future research should, therefore, investigate if the four main constructs of interest are redundant across multiple situations such as in academic, professional, and personal life. It would also be interesting to replicate this study to investigate whether the four constructs are redundant in an individual versus a team setting.

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Appendix A - Connor-Davidson Resiliency Scale (CD-RISC)

(0 = not true at all, 1 = rarely true, 2 = sometimes true, 3 = often true, 4 = true nearly all of the time)

1. Able to adapt to change*
2. Close and secure relationships
3. Sometimes fate or God can help
4. Can deal with whatever comes*
5. Past success gives confidence for new challenge
6. See the humorous side of things*
7. Coping with stress strengthens*
8. Tend to bounce back after illness or hardship *
9. Things happen for a reason
10. Best effort no matter what
11. You can achieve your goals*
12. When things look hopeless, I don't give up
13. Know where to turn for help
14. Under pressure, focus and think clearly*
15. Prefer to take the lead in problem solving
16. Not easily discouraged by failure*
17. Think of self as strong person*
18. Make unpopular or difficult decisions

19. Can handle unpleasant feelings*
20. Have to act on a hunch
21. Strong sense of purpose
22. In control of your life
23. I like challenges
24. You work to attain your goals
25. Pride in your achievements

*Reverse-scored

Appendix B - Grit Scale

(1= not at all like me; 5 = very much like me)

Consistency of Interest

1. I often set a goal but later choose to pursue a different one.
2. New ideas and new projects sometimes distract me from previous ones.
3. I become interested in new pursuits every few months.
4. My interests change from year to year.
5. I have been obsessed with a certain idea or project for a short time but later lost interest.
6. I have difficulty maintaining my focus on projects that take more than a few months to complete.

Perseverance of Effort

7. I have achieved a goal that took years of work.
8. I have overcome setbacks to conquer an important challenge. I finish whatever I begin.
9. I finish whatever I begin.
10. Setbacks don't discourage me.
11. I am a hard worker.
12. I am diligent.

Appendix C - DRS-15 (Dispositional Resiliency Scale⁵)

Below are statements about life that people often feel differently about. Please check a box to show how much you think each one is true for you. Give your own honest opinions... There are no right or wrong answers!

(0 = Not at all, 1= A little true, 2=Quite true, 3=Completely true)

1. Most of my life gets spent doing things that are meaningful (Commitment)
2. By working hard you can nearly always achieve your goals (Control)
3. I don't like to make changes in my regular activities * (Challenge)

*Reverse-scored

⁵ Due to proprietary rights, only a sample of the DRS-15 is listed here.

Appendix D - Sports Mental Toughness Questionnaire (SMTQ)

Responses to the SMTQ items were made on a four-point Likert scale anchored by not at all true and very true.

Confidence

- 13 I interpret potential threats as positive opportunities
- 5 I have an unshakeable confidence in my ability
- 11 I have qualities that set me apart from other competitors
- 6 I have what it takes to perform well while under pressure
- 14 Under pressure, I am able to make decisions with confidence and commitment
- 1 I can regain my composure if I have momentarily lost it

Constancy

- 3 I am committed to completing the tasks I have to do
- 12 I take responsibility for setting myself challenging targets
- 8 I give up in difficult situations
- 10 I get distracted easily and lose my concentration

Control

- 2 I worry about performing poorly
- 4 I am overcome by self-doubt
- 9 I get anxious by events I did not expect or cannot control
- 7 I get angry and frustrated when things do not go my way

Appendix E - Perceived Stress Scale (PSS)

(0 = never, 1 = almost never, 2 = sometimes, 3 = fairly often, 4 = very often)

1. In the last month how often have you been upset because of something that happened unexpectedly?
2. In the last month how often have you felt you were unable to control the important things in your life?
3. In the last month how often have you felt nervous and 'stressed'?
4. In the last month how often have you dealt successfully with day to day problems and annoyances? *
5. In the last month how often did you feel that you were effectively coping with the important changes that were occurring in your life? *
6. In the last month how often have you felt confident about your ability to handle your personal problems? *
7. In the last month how often have you felt that things were going your way? *
8. In the last month how often have you found that you could not cope with all the things you had to do?
9. In the last month how often have you been able to control irritations in your life? *
10. In the last month how often have you felt that you were on top of things? *
11. In the last month how often have you been angered because of things that were outside of your control?

12. In the last month how often have you found yourself thinking about things that you have to accomplish?
13. In the last month how often have you been able to control the way you spend your time? *
14. In the last month how often have you felt difficulties were piling up so high that you could not overcome them?

*Reverse-scored

Appendix F - General Health Questionnaire (GHQ - measure of mental health)

“Have you recently (over the past few weeks) ...”

(1 = Never to 5 = Always)

1. been able to concentrate on whatever you are doing?
2. lost much sleep over worry?
3. felt that you are playing a useful part in things?
4. felt capable of making decisions about things?
5. felt constantly under strain?
6. felt you couldn't overcome your difficulties?
7. been able to enjoy your normal day-to-day activities?
8. been able to face up to your problems?
9. been feeling unhappy and depressed?
10. been losing confidence in yourself?
11. been thinking of yourself as a worthless person?
12. been feeling reasonably happy all things considered?

Appendix G - International Personality Item Pool 50 (IPIP-50)

Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence. Indicate for each statement whether it is 1. Very Inaccurate, 2. Moderately Inaccurate, 3. Neither Accurate Nor Inaccurate, 4. Moderately Accurate, or 5. Very Accurate as a description of you.

Neuroticism

1. Often feel blue.
2. Dislike myself.
3. Am often down in the dumps.
4. Have frequent mood swings.
5. Panic easily.
6. Rarely get irritated. *
7. Seldom feel blue. *
8. Feel comfortable with myself. *
9. Am not easily bothered by things. *
10. Am very pleased with myself. *

Extroversion

1. Feel comfortable around people.

2. Make friends easily.
3. Am skilled in handling social situations.
4. Am the life of the party.
5. Know how to captivate people.
6. Have little to say. *
7. Keep in the background. *
8. Would describe my experiences as somewhat dull. *
9. Don't like to draw attention to myself. *
10. Don't talk a lot. *

Openness to Experience

1. Believe in the importance of art.
2. Have a vivid imagination.
3. Tend to vote for liberal political candidates.
4. Carry the conversation to a higher level.
5. Enjoy hearing new ideas.
6. Am not interested in abstract ideas. *
7. Do not like art.*
8. Avoid philosophical discussions. *
9. Do not enjoy going to art museums. *
10. Tend to vote for conservative political candidates. *

Agreeableness

1. Have a good word for everyone.

2. Believe that others have good intentions.
3. Respect others.
4. Accept people as they are.
5. Make people feel at ease.
6. Have a sharp tongue. *
7. Cut others to pieces. *
8. Suspect hidden motives in others. *
9. Get back at others. *
10. Insult people. *

Conscientiousness

1. Am always prepared.
2. Pay attention to details.
3. Get chores done right away.
4. Carry out my plans.
5. Make plans and stick to them.
6. Waste my time. *
7. Find it difficult to get down to work. *
8. Do just enough work to get by. *
9. Don't see things through. *
10. Shirk my duties. *

*Reverse-scored

Appendix H - Attention Checks (Kung, Kwok, & Brown, 2018)

1. I eat cement.
2. I have never used a computer.
3. I can teleport through time and space.

Appendix I – Fit Indices and Target Values for Good Fit

Test	Target
Chi-Square (χ^2)	$p > .05$
Chi-square divided by degrees of freedom test (χ^2/df)	$\leq 2.00^{**}$
Comparative Fit Index (CFI)	$\geq .95^*$
Tucker Lewis Index (TLI)	$\geq .95^*$
Root Mean Square Error of Approximation (RMSEA)	$\leq .06^{***}$
Standard Root Mean Square Residual (SRMSR)	$\leq .10$

Note. Individual “target values” should be considered as “close to” when used in combination with other fit indices (Meyer et al., 2017).

*Values between .90 and .95 indicate an acceptable level of fit;

**Values up to about 5.00 may be acceptable

***Values between .07 - .08 indicate a moderate fit; values between .08 - .10 indicate a marginal fit; values greater than .10 indicate a poor fit

(Meyer et al., 2017)